Abstract

The LaTeX package \texttt{nicematrix} provides new environments similar to the classical environments \texttt{\{tabular\}}, \texttt{\{array\}} and \texttt{\{matrix\}} of \texttt{array} and \texttt{amsmath} but with extended features.

\[ \begin{array}{cccc}
C_1 & C_2 & \cdots & C_n \\
L_1 & a_{11} & a_{12} & \cdots & a_{1n} \\
L_2 & a_{21} & a_{22} & \cdots & a_{2n} \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
L_n & a_{n1} & a_{n2} & \cdots & a_{nn} \\
\end{array} \]

The package \texttt{nicematrix} is entirely contained in the file \texttt{nicematrix.sty}. This file may be put in the current directory or in a \texttt{texmf} tree. However, the best is to install \texttt{nicematrix} with a TeX distribution such as MiKTeX, TeX Live or MacTeX.

Remark: If you use LaTeX via Internet with, for example, Overleaf, you can upload the file \texttt{nicematrix.sty} in the repertory of your project in order to take full advantage of the latest version de \texttt{nicematrix}.

This package can be used with \texttt{xelatex}, \texttt{lualatex}, \texttt{pdflatex} but also by the classical workflow \texttt{latex-dvips-ps2pdf} (or Adobe Distiller). However, the file \texttt{nicematrix.dtp} of the present documentation should be compiled with \texttt{XeLaTeX}.

This package requires and loads the packages \texttt{l3keys2e}, \texttt{array}, \texttt{amsmath}, \texttt{pgfcore} and the module \texttt{shapes} of PGF (\texttt{tikz}, which is a layer over PGF is not loaded). The final user only has to load the package with \texttt{\usepackage\{nicematrix\}}.

If you use TeX Live as TeX distribution, you should note that TeX Live 2020 at least is required by \texttt{nicematrix}.

The idea of \texttt{nicematrix} is to create PGF nodes under the cells and the positions of the rules of the tabular created by \texttt{array} and to use these nodes to develop new features. As usual with PGF, the coordinates of these nodes are written in the \texttt{aux} to be used on the next compilation and that’s why \texttt{nicematrix} may need several compilations.

Most features of \texttt{nicematrix} may be used without explicit use of PGF or Tikz (which, in fact, is not loaded by default).

A command \texttt{\NiceMatrixOptions} is provided to fix the options (the scope of the options fixed by this command is the current TeX group: they are semi-global).

\*\*This document corresponds to the version 6.7 of \texttt{nicematrix}, at the date of 2022/03/02.

The latest version of the file \texttt{nicematrix.sty} may be downloaded from the \texttt{svn} server of TeXLive: \url{https://www.tug.org/svn/texlive/trunk/Master/texmf-dist/tex/latex/nicematrix/nicematrix.sty}

If you use Overleaf, Overleaf will do automatically the right number of compilations.

\begin{tabular}{|c|c|c|c|}
\hline
Product & dimensions (cm) & Price \\
\hline
small & 3 & 5.5 & 1 & 30 \\
standard & 5.5 & 8 & 1.5 & 50.5 \\
premium & 8.5 & 10.5 & 2 & 80 \\
extra & 8.5 & 10 & 1.5 & 85.5 \\
special & 12 & 12 & 0.5 & 70 \\
\hline
\end{tabular}
1 The environments of this package

The package `nicematrix` defines the following new environments.

- `{NiceTabular}`
- `{NiceArray}`
- `{NiceMatrix}`
- `{pNiceArray}`
- `{BNiceArray}`
- `{vNiceArray}`
- `{vNiceMatrix}`
- `{vNiceMatrix}`
- `{vNiceMatrix}`
- `{BNiceMatrix}`
- `{BNiceMatrix}`
- `{BNiceMatrix}`

The environments `{NiceArray}`, `{NiceTabular}` and `{NiceTabular*}` are similar to the environments `{array}`, `{tabular}` and `{tabular*}` of the package `array` (which is loaded by `nicematrix`).

The environments `{pNiceArray}`, `{bNiceArray}`, etc. have no equivalent in `array`.

The environments `{NiceMatrix}`, `{pNiceMatrix}`, etc. are similar to the corresponding environments of `amsmath` (which is loaded by `nicematrix`): `{matrix}`, `{pmatrix}`, etc.

The environment `{NiceTabularX}` is similar to the environment `{tabularx}` from the eponymous package.

It’s recommended to use primarily the classical environments and to use the environments of `nicematrix` only when some feature provided by these environments is used (this will save memory).

All the environments of the package `nicematrix` accept, between square brackets, an optional list of `key=value` pairs. There must be no space before the opening bracket (`{`) of this list of options.

2 The vertical space between the rows

It’s well known that some rows of the arrays created by default with LaTeX are, by default, too close to each other. Here is a classical example.

$$\begin{pmatrix}
\frac{1}{2} & -\frac{1}{2} \\
\frac{1}{3} & \frac{1}{4}
\end{pmatrix}$$

Inspired by the package `cellspace` which deals with that problem, the package `nicematrix` provides two keys `cell-space-top-limit` and `cell-space-bottom-limit` similar to the parameters `\cellspacetoplimit` and `\cellspacebottomlimit` of `cellspace`.

There is also a key `cell-space-limits` to set both parameters at once.

The initial value of these parameters is 0 pt in order to have for the environments of `nicematrix` the same behaviour as those of `array` and `amsmath`. However, a value of 1 pt would probably be a good choice and we suggest to set them with `{\NiceMatrixOptions{cell-space-limits = 1pt}}`.

```
\NiceMatrixOptions{cell-space-limits = 1pt}
$\begin{pmatrix}
\frac{1}{2} & -\frac{1}{2} \\
\frac{1}{3} & \frac{1}{4}
\end{pmatrix}$$
```

\footnote{In fact, it’s possible to use directly the X columns in the environment `{NiceTabular}` (and the required width for the tabular is fixed by the key `width`); cf. p. 21}

\footnote{One should remark that these parameters apply also to the columns of type S of `siunitx` whereas the package `cellspace` is not able to act on such columns of type S.}
The vertical position of the arrays

The package \texttt{nicematrix} provides an option \texttt{baseline} for the vertical position of the arrays. This option takes in as value an integer which is the number of the row on which the array will be aligned.

\begin{pNiceMatrix}[baseline=2]
\frac{1}{\sqrt{1+p^2}} & p & 1-p \\
1 & 1 & 1 \\
1 & p & 1+p
\end{pNiceMatrix}

It’s also possible to use the option \texttt{baseline} with one of the special values \texttt{t}, \texttt{c} or \texttt{b}. These letters may also be used absolutely like the option of the environments \{tabular\} and \{array\} of \texttt{array}. The initial value of \texttt{baseline} is \texttt{c}.

In the following example, we use the option \texttt{t} (equivalent to \texttt{baseline=t}) immediately after an \texttt{item} of list. One should remark that the presence of a \texttt{\hline} at the beginning of the array doesn’t prevent the alignment of the baseline with the baseline of the first row (with \{tabular\} or \{array\} of \texttt{array}, one must use \texttt{\firsthline}).

\begin{enumerate}
\item an item
\item \renewcommand{\arraystretch}{1.2}
\begin{NiceArray}[t]{lcccccc}
\hline
n & 0 & 1 & 2 & 3 & 4 & 5 \\
u_n & 1 & 2 & 4 & 8 & 16 & 32 \\
\hline
\end{NiceArray}
\end{enumerate}

However, it’s also possible to use the tools of \texttt{booktabs}\footnote{The extension \texttt{booktabs} is \textit{not} loaded by \texttt{nicematrix}.}: \texttt{\toprule}, \texttt{\bottomrule}, \texttt{\midrule}, etc.

\begin{enumerate}
\item an item
\item \begin{NiceArray}[t]{lcccccc}
\toprule
n & 0 & 1 & 2 & 3 & 4 & 5 \\
u_n & 1 & 2 & 4 & 8 & 16 & 32 \\
\midrule
\bottomrule
\end{NiceArray}
\end{enumerate}

It’s also possible to use the key \texttt{baseline} to align a matrix on an horizontal rule (drawn by \texttt{\hline}). In this aim, one should give the value \texttt{line-i} where \texttt{i} is the number of the row following the horizontal rule.

\NiceMatrixOptions{cell-space-limits=1pt}

\begin{pNiceMatrix}[baseline=line-3]
dfrac{A}{A} & dfrac{B}{B} & 0 & 0 \\
dfrac{C}{C} & dfrac{D}{D} & 0 & 0 \\
\hline
0 & 0 & A & B \\
0 & 0 & D & D \\
\end{pNiceMatrix}
4 The blocks

4.1 General case

In the environments of \texttt{nicematrix}, it’s possible to use the command \texttt{\Block} in order to place an element in the center of a rectangle of merged cells of the array.\footnote{The spaces after a command \texttt{\Block} are deleted.}

The command \texttt{\Block} must be used in the upper leftmost cell of the array with two arguments.

- The first argument is the size of the block with the syntax $i\text{--}j$ where $i$ is the number of rows of the block and $j$ its number of columns.
  
  If this argument is empty, its default value is 1-1. If the number of rows is not specified, or equal to $\ast$, the block extends until the last row (idem for the columns).

- The second argument is the content of the block. It’s possible to use $\backslash\backslash$ in that content to have a content on several lines. In \texttt{\{NiceTabular\}}, \texttt{\{NiceTabular\}*} and \texttt{\{NiceTabular\}X}, the content of the block is composed in text mode whereas, in the other environments, it is composed in math mode.

Here is an example of utilisation of the command \texttt{\Block} in mathematical matrices.

\begin{footnotesize}
\begin{verbatim}
\begin{bNiceArray}{cw{c}{1cm}c|c}
\Block{3-3}{A} & & & 0 \\
& & & \Vdots \\
& & & 0 \\
\hline
0 & \Cdots& 0 & 0
\end{bNiceArray}
\end{verbatim}
\end{footnotesize}

One may wish to raise the size of the “$A$” placed in the block of the previous example. Since this element is composed in math mode, it’s not possible to use directly a command like \texttt{\Large}, \texttt{\LARGE} and \texttt{\LARGE}. That’s why the command \texttt{\Block} provides an option between angle brackets to specify some \LaTeX{} code which will be inserted before the beginning of the math mode.\footnote{This argument between angular brackets may also be used to insert a command of font such as \texttt{\bfseries} when the command $\backslash\backslash$ is used in the content of the block.}

\begin{footnotesize}
\begin{verbatim}
\begin{bNiceArray}{cw{c}{1cm}c|c}
\Block{3-3}<\Large>{A} & & & 0 \\
& & & \Vdots \\
& & & 0 \\
\hline
0 & \Cdots& 0 & 0
\end{bNiceArray}
\end{verbatim}
\end{footnotesize}

It’s possible to set the horizontal position of the block with one of the keys \texttt{l}, \texttt{c} and \texttt{r}.

\begin{footnotesize}
\begin{verbatim}
\begin{bNiceArray}{cw{c}{1cm}c|c}
\Block[r]{3-3}<\LARGE>{A} & & & 0 \\
& & & \Vdots \\
& & & 0 \\
\hline
0 & \Cdots& 0 & 0
\end{bNiceArray}
\end{verbatim}
\end{footnotesize}

In fact, the command \texttt{\Block} accepts as first optional argument (between square brackets) a list of couples key=value. The available keys are as follows:
the keys l, c and r are used to fix the horizontal position of the content of the block, as explained previously;

the key fill takes in as value a color and fills the block with that color;

the key draw takes in as value a color and strokes the frame of the block with that color (the default value of that key is the current color of the rules of the array);

the key color takes in as value a color and apply that color the content of the block but draws also the frame of the block with that color;

the key line-width is the width (thickness) of the frame (this key should be used only when the key draw or the key hvlines is in force);

the key rounded-corners requires rounded corners (for the frame drawn by draw and the shape drawn by fill) with a radius equal to the value of that key (the default value is 4 pt);

the keys t and b fix the base line that will be given to the block when it has a multi-line content (the lines are separated by \);

the keys hlines, vlines and hvlines draw all the corresponding rules in the block;

when the key tikz is used, the Tikz path corresponding of the rectangle which delimits the block is executed with Tikz\(^9\) by using as options the value of that key tikz (which must be a list of keys allowed for a Tikz path). For examples, cf. p. 46;

the key name provides a name to the rectangular Tikz node corresponding to the block; it’s possible to use that name with Tikz in the \CodeAfter of the environment (cf. p. 28);

New 6.5 the key respect-arraystretch prevents the setting of \arraystretch to 1 at the beginning of the block (which is the behaviour by default);

the key borders provides the ability to draw only some borders of the blocks; the value of that key is a (comma-separated) list of elements covered by left, right, top and bottom;

Nouveau 6.7 it’s possible, in fact, in the list which is the value of the key borders, to add an entry of the form tikz={list} where list is a list of couples key=value of Tikz specifying the graphical characteristics of the lines that will be drawn (for an example, see p. 50).

One must remark that, by default, the commands \Blocks don’t create space. There is exception only for the blocks mono-row and the blocks mono-column as explained just below.

In the following example, we have had to enlarge by hand the columns 2 and 3 (with the construction wc{...} of array).

\begin{NiceTabular}{cwc{2cm}wc{3cm}c}
 rose & tulip & daisy & dahlia \ 
 violet & \Block[draw=red,fill=\{RGB\}\{204,204,255\},rounded-corners\{2-2\}]{\LARGE Some beautiful flowers}
   & & marigold \ 
 iris & & & lis \ 
 arum & periwinkle & forget-me-not & hyacinth
\end{NiceTabular}

\begin{tabular}{cccc}
 rose & tulip & daisy & dahlia \\
 violet & Some beautiful flowers & marigold \\
 iris & & & lis \\
 arum & periwinkle & forget-me-not & hyacinth
\end{tabular}

\footnotesize
\(^8\)This value is the initial value of the rounded corners of Tikz.
\(^9\)Tikz should be loaded (by default, nicematrix only loads PGF) and, if it’s not, an error will be raised.
4.2 The mono-column blocks

The mono-column blocks have a special behaviour.

- The natural width of the contents of these blocks is taken into account for the width of the current column.

  In the columns with a fixed width (columns \texttt{w\{\ldots\}\{\ldots\}}, \texttt{p\{\ldots\}}, \texttt{b\{\ldots\}}, \texttt{m\{\ldots\}} and \texttt{X}), the content of the block is formatted as a paragraph of that width.

- The specification of the horizontal position provided by the type of column (\texttt{c}, \texttt{r} or \texttt{l}) is taken into account for the blocks.

- The specifications of font specified for the column by a construction >\{\ldots\} in the preamble of the array are taken into account for the mono-column blocks of that column (this behaviour is probably expected).

\begin{NiceTabular}{@{}>{\bfseries}lr@{}} \hline
\text{Block}{2-1}\{John\} & 12 \ \backslash \\
& 13 \ \backslash \\
\hline
Steph & 8 \ \backslash \\
\hline
\text{Block}{3-1}\{Sarah\} & 18 \ \backslash \\
& 17 \ \backslash \\
& 15 \ \backslash \\
\hline
Ashley & 20 \ \backslash \\
\hline
Henry & 14 \ \backslash \\
\hline
\text{Block}{2-1}\{Madison\} & 15 \ \backslash \\
& 19 \ \backslash \\
\hline
\end{NiceTabular}

4.3 The mono-row blocks

For the mono-row blocks, the natural height and depth are taken into account for the height and depth of the current row (as does a standard \texttt{\multicolumn} of \LaTeX).

4.4 The mono-cell blocks

A mono-cell block inherits all the properties of the mono-row blocks and mono-column blocks.

At first sight, one may think that there is no point using a mono-cell block. However, there are some good reasons to use such a block.

- It's possible to use the command \texttt{\\} in a (mono-cell) block.
- It's possible to use the option of horizontal alignment of the block in derogation of the type of column given in the preamble of the array.
- It's possible do draw a frame around the cell with the key \texttt{draw} of the command \texttt{\Block} and to fill the background with rounded corners with the keys \texttt{fill} and \texttt{rounded-corners}.\footnote{If one simply wishes to color the background of a unique cell, there is no point using the command \texttt{\Block}: it's possible to use the command \texttt{\cellcolor} (when the key \texttt{colortbl-like} is used).}
- It's possible to draw one or several borders of the cell with the key \texttt{borders}.
We recall that if the first mandatory argument of \texttt{Block} is left blank, the block is mono-cell.\footnote{One may consider that the default value of the first mandatory argument of \texttt{Block} is 1-1.}

### 4.5 Horizontal position of the content of the block

By default, the horizontal position of the content of a block is computed by using the positions of the contents of the columns implied in that block. That’s why, in the following example, the header “First group” is correctly centered despite the instruction \texttt{!\{\quad\}} in the preamble which has been used to increase the space between the columns (this is not the behaviour of \texttt{multicolumn}).

```
\begin{NiceTabular}{@{}c!{\quad}ccc!{\quad}ccc@{}}
\toprule
Rank & \texttt{Block}[1-3]\{First group\} & \texttt{&} & \texttt{Block}[1-3]\{Second group\} & \texttt{&} & 1A & 1B & 1C & 2A & 2B & 2C \\
\midrule
1 & 0.657 & 0.913 & 0.733 & 0.830 & 0.387 & 0.893\\
2 & 0.343 & 0.537 & 0.655 & 0.690 & 0.471 & 0.333\\
3 & 0.783 & 0.885 & 0.015 & 0.306 & 0.643 & 0.263\\
4 & 0.161 & 0.708 & 0.386 & 0.257 & 0.074 & 0.336\\
\bottomrule
\end{NiceTabular}
```

In order to have an horizontal positioning of the content of the block computed with the limits of the columns of the LaTeX array (and not with the contents of those columns), one may use the key \texttt{L}, \texttt{R} and \texttt{C} of the command \texttt{Block}.

### 5 The rules

The usual techniques for the rules may be used in the environments of \texttt{nicematrix} (excepted \texttt{\vline}). However, there is some small differences with the classical environments.
5.1 Some differences with the classical environments

5.1.1 The vertical rules

In the environments of \nicematrix, the vertical rules specified by | in the preambles of the environments are never broken, even by an incomplete row or by a double horizontal rule specified by \hline\hline (there is no need to use \hhline).

\begin{NiceTabular}{|c|c|} \hline First & Second \ \hline Peter \ \hline Mary & George\ \hline \end{NiceTabular}

First Second
\hline
Peter
\hline
Mary George

However, the vertical rules are not drawn in the blocks (created by \Block: cf. p. 4) nor in the corners (created by the key \texttt{corner}: cf. p. 10).

If you use \texttt{booktabs} (which provides \texttt{\toprule}, \texttt{\midrule}, \texttt{\bottomrule}, etc.) and if you really want to add vertical rules (which is not in the spirit of \texttt{booktabs}), you should notice that the vertical rules drawn by \nicematrix are compatible with \texttt{booktabs}.

\$\begin{NiceArray}{|cccc|} \toprule a & b & c & d \ \midrule 1 & 2 & 3 & 4 \ \bottomrule \end{NiceArray}\$

However, it’s still possible to define a specifier (named, for instance, I) to draw vertical rules with the standard behaviour of \texttt{array}.

\newcolumntype{I}{!\{\vrule}}

5.1.2 The command \texttt{\cline}

The horizontal and vertical rules drawn by \texttt{\hline} and the specifier “|” make the array larger or wider by a quantity equal to the width of the rule (with \texttt{array} and also with \nicematrix).

For historical reasons, this is not the case with the command \texttt{\cline}, as shown by the following example.

\setlength{\arrayrulewidth}{2pt}
\begin{tabular}{cccc} \hline A&B&C&D \\ \cline{2-2} A&B&C&D \ \hline \end{tabular}

In the environments of \nicematrix, this situation is corrected (it’s still possible to go to the standard behaviour of \texttt{\cline} with the key \texttt{standard-cline}).

\setlength{\arrayrulewidth}{2pt}
\begin{NiceTabular}{cccc} \hline A&B&C&D \ \cline(2) A&B&C&D \ \hline \end{NiceTabular}

In the environments of \nicematrix, an instruction \texttt{\cline}\texttt{i} is equivalent to \texttt{\cline}\texttt{i-i}.
5.2 The thickness and the color of the rules

The environments of \texttt{nicematrix} provide a key \texttt{rules/width} to set the width (in fact the thickness) of the rules in the current environment. In fact, this key merely sets the value of the length \texttt{\arrayrulewidth}.

It’s well known that \texttt{colortbl} provides the command \texttt{\arrayrulecolor} in order to specify the color of the rules.

With \texttt{nicematrix}, it’s possible to specify the color of the rules even when \texttt{colortbl} is not loaded. For sake of compatibility, the command is also named \texttt{\arrayrulecolor}. The environments of \texttt{nicematrix} also provide a key \texttt{rules/color} to fix the color of the rules in the current environment. This key sets the value locally (whereas \texttt{\arrayrulecolor} acts globally).

\begin{NiceTabular}{|ccc|}
\hline
rose & tulipe & lys \\ arum & iris & violette \\ muguet & dahlia & souci \\ \hline
\end{NiceTabular}

5.3 The tools of \texttt{nicematrix} for the rules

Here are the tools provided by \texttt{nicematrix} for the rules.

- the keys \texttt{hlines}, \texttt{vlines}, \texttt{hlines} and \texttt{hlines-except-borders};
- the specifier “\texttt{|}” in the preamble (for the environments with preamble);
- the command \texttt{\Hline}.

All these tools don’t draw the rules in the blocks nor in the empty corners (when the key \texttt{corners} is used).

- These blocks are:
  - the blocks created by the command \texttt{\Block} \footnote{And also the command \texttt{\multicolumn} but it’s recommended to use instead \texttt{\Block} in the environments of \texttt{nicematrix}.} presented p. 4;
  - the blocks implicitly delimited by the continuous dotted lines created by \texttt{\Cdots}, \texttt{\Vdots}, etc. (cf. p. 23).

- The corners are created by the key \texttt{corners} explained below (see p. 10).

In particular, this remark explains the difference between the standard command \texttt{\hline} and the command \texttt{\Hline} provided by \texttt{nicematrix}.

5.3.1 The keys \texttt{hlines} and \texttt{vlines}

The keys \texttt{hlines} and \texttt{vlines} (which draw, of course, horizontal and vertical rules) take in as value a list of numbers which are the numbers of the rules to draw.\footnote{It’s possible to put in that list some intervals of integers with the syntax \texttt{i-j}.}

In fact, for the environments with delimiters (such as \texttt{\pNiceMatrix} or \texttt{\bNiceArray}), the key \texttt{vlines} don’t draw the exterior rules (this is certainly the expected behaviour).

\$\begin{pNiceMatrix}[vlines, rules/width=0.2pt]
1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 2 & 3 & 4 & 5 & 6 \\
\end{pNiceMatrix}\$

\begin{NiceTabular}{|c|c|c|c|c|c|}
\hline
rose & tulipe & lys & arum & iris & violette \\
muguet & dahlia & souci & \\
\hline
\end{NiceTabular}
5.3.2 The keys \texttt{hvlines} and \texttt{hvlines-except-borders}

The key \texttt{hvlines} (no value) is the conjunction of the keys \texttt{hlines} and \texttt{vlines}.

\begin{NiceTabular}{cccc}[hvlines, rules/color=blue]  
rose & tulipe & marguerite & dahlia \ 
violette & \ Block[draw=red]{2-2}\{\LARGE fleurs\} & & souci \ 
pervenche & & & lys \ 
arum & iris & jacinthe & muguet
\end{NiceTabular}

The key \texttt{hvlines-except-borders} is similar to the key \texttt{hvlines} but does not draw the rules on the horizontal and vertical borders of the array.

5.3.3 The (empty) corners

The four corners of an array will be designed by NW, SW, NE and SE (north west, south west, north east and south east).

For each of these corners, we will call empty corner (or simply corner) the reunion of all the empty rectangles starting from the cell actually in the corner of the array.\footnote{For sake of completeness, we should also say that a cell contained in a block (even an empty cell) is not taken into account for the determination of the corners. That behaviour is natural. The precise definition of a “non-empty cell” is given below (cf. p. 45).}

However, it’s possible, for a cell without content, to require nicematrix to consider that cell as not empty with the key \texttt{NotEmpty}.

In the example on the right (where B is in the center of a block of size $2 \times 2$), we have colored in blue the four (empty) corners of the array.

When the key \texttt{corners} is used, nicematrix computes the (empty) corners and these corners will be taken into account by the tools for drawing the rules (the rules won’t be drawn in the corners).

\begin{NiceTabular}{*{6}{c}}[corners, hvlines]  
& & & & A \ 
& & A & A & A \ 
& & A & A & A & A \ 
& & & & \ 
& \Block{2-2}\{B\} & & & \ 
& & & & \ 
\end{NiceTabular}
It’s also possible to provide to the key `corners` a (comma-separated) list of corners (designed by NW, SW, NE and SE).

\NiceMatrixOptions{cell-space-top-limit=3pt}
\begin{NiceTabular}{*{6}{c}}[corners=NE,hvlines]
  1 & 1 & 1 & 1 & 1 & 1 \\
  1 & 2 & 1 & 1 & 1 & 1 \\
  1 & 3 & 3 & 1 & 1 & 1 \\
  1 & 4 & 6 & 4 & 1 & 1 \\
\end{NiceTabular}

▷ The corners are also taken into account by the tools provided by nicematrix to color cells, rows and columns. These tools don’t color the cells which are in the corners (cf. p. 14).

5.4 The command \texttt{\textbackslash diagbox}

The command \texttt{\textbackslash diagbox} (inspired by the package diagbox), allows, when it is used in a cell, to slash that cell diagonally downwards.\textsuperscript{15}

\begin{NiceArray}{*{5}{c}}[hvlines]
\diagbox{x}{y} & e & a & b & c \\
e & e & a & b & c \\
a & a & e & c & b \\
b & b & c & e & a \\
c & c & b & a & e \\
\end{NiceArray}

It’s possible to use the command \texttt{\textbackslash diagbox} in a \texttt{\textbackslash Block}.

5.5 Dotted rules

In the environments of the package nicematrix, it’s possible to use the command \texttt{\textbackslash hdottedline} (provided by nicematrix) which is a counterpart of the classical command \texttt{\textbackslash hline}.

\begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 \\
\hdottedline
6 & 7 & 8 & 9 & 10 \\
11 & 12 & 13 & 14 & 15
\end{pNiceMatrix}

\begin{pmatrix}
1 & 2 & 3 & 4 & 5 \\
6 & 7 & 8 & 9 & 10 \\
11 & 12 & 13 & 14 & 15
\end{pmatrix}

In the environments with an explicit preamble (like \texttt{\textbackslash NiceTabular}, \texttt{\textbackslash NiceArray}, etc.), it’s possible to draw a vertical dotted line with the specifier “:”.

\begin{NiceArray}{cccccc:}
1 & 2 & 3 & 4 & 5 \\
6 & 7 & 8 & 9 & 10 \\
11 & 12 & 13 & 14 & 15
\end{NiceArray}

\begin{pmatrix}
1 & 2 & 3 & 4 & 5 \\
6 & 7 & 8 & 9 & 10 \\
11 & 12 & 13 & 14 & 15
\end{pmatrix}

It’s possible to change in nicematrix the letter used to specify a vertical dotted line with the option letter-for-dotted-lines available in \texttt{\NiceMatrixOptions}.

Remark: In the package array (on which the package nicematrix relies), horizontal and vertical rules make the array larger or wider by a quantity equal to the width of the rule\textsuperscript{16}. In nicematrix, the dotted lines drawn by \texttt{\textbackslash hdottedline} and “:” do likewise.

\textsuperscript{15}The author of this document considers that type of construction as graphically poor.

\textsuperscript{16}In fact, with array, this is true only for \texttt{\textbackslash hline} and “|” but not for \texttt{\textbackslash cline}: cf p. 8
5.6 Commands for customized rules

New 6.5 It’s possible to define commands and letters for customized rules with the key custom-line available in \NiceMatrixOptions and in the options of individual environments. That key takes in as argument a list of key=value pairs. First, there is two keys to define the tools which will be used to use that new type of rule.

- the key command is the name (without the backslashes) of a command that will be created by nicematrix and that will be available for the final user in order to draw horizontal rules (similarly to \hline);
- the key letter takes in as argument a letter\(^\text{17}\) that the user will use in the preamble of an environment with preamble (such as \{NiceTabular\}) in order to specify a vertical rule.

For the description of the rule itself, there is three possibilities.

- First possibility
  It’s possible to specify composite rules, with a color and a color for the inter-rule space (as possible with colorbl for instance).
  - the key multiplicity is the number to consecutive rules that will be drawn: for instance, a value of 2 will create double rules such those created by \hline\hline or || in the preamble of an environment;
  - the key color sets the color of the rule ;
  - the key sep-color sets the color between two successive rules (should be used only in conjunction with multiplicity).

- Second possibility
  The key dotted forces a style with dotted rules such as those created by \hdottedline or the letter “:” in the preamble (cf. p. 11). The key color may be used also in that case.

- New 6.6 Third possibility
  It’s possible to use the key tikz (if Tikz is loaded). In that case, the rule is drawn directly with Tikz by using as parameters the value of the key tikz which must be a list of key=value pairs which may be applied to a Tikz path.

  By default, no space is reserved for the rule that will be drawn with Tikz. It possible to specify a reservation (horizontal for a vertical rule and vertical for an horizontal one) with the key width. That value of that key, is, in some ways, the width of the rule that will be drawn (nicematrix does not compute that width from the characteristics of the rule specified in tikz).

That system may be used, in particular, for the definition of commands and letters to draw rules with a specific color (and those rules will respect the blocks as do all rules of nicematrix).

\begin{NiceTabular}{lcIcIc}[custom-line = {letter=I, color=blue}]
\hline
 & \Block{1-3}{dimensions} \ \\
 & L & l & h \ \\
\hline
Product A & 3 & 1 & 2 \ \\
Product B & 1 & 3 & 4 \ \\
Product C & 5 & 4 & 1 \ \\
\hline
\end{NiceTabular}

\(^{17}\)The following letters are forbidden: lcrmbVX:\{()!<>
Here is an example of the key \texttt{tikz}.

\begin{verbatim}
\documentclass{article}
\usepackage{nicematrix,tikz}
\usetikzlibrary{decorations.pathmorphing}
\NiceMatrixOptions
  {
    custom-line =
    {
      letter = I ,
      tikz = { decorate, decoration = { coil, aspect = 0 } } ,
      width = 2 mm
    }
  }
\begin{document}
\begin{NiceTabular}{cIcIc}
  one & two & three \\
  four & five & six \\
  seven & eight & nine
\end{NiceTabular}
\end{document}
\end{verbatim}

6 The color of the rows and columns

6.1 Use of colortbl

We recall that the package \texttt{colortbl} can be loaded directly with \texttt{\usepackage[colortbl]} or by loading \texttt{xcolor} with the key \texttt{table}: \texttt{\usepackage[table]{xcolor}}.

Since the package \texttt{necmatrix} is based on \texttt{array}, it’s possible to use \texttt{colortbl} with \texttt{necmatrix}.

However, there is two drawbacks:

- The package \texttt{colortbl} patches \texttt{array}, leading to some incompatibilities (for instance with the command \texttt{\hdotsfor}).

- The package \texttt{colortbl} constructs the array row by row, alternating colored rectangles, rules and contents of the cells. The resulting PDF is difficult to interpret by some PDF viewers and may lead to artefacts on the screen.

  - Some rules seem to disappear. This is because many PDF viewers give priority to graphical element drawn posteriorly (which is in the spirit of the “painting model” of PostScript and PDF). Concerning this problem, MuPDF (which is used, for instance, by SumatraPDF) gives better results than Adobe Reader.)
– A thin white line may appear between two cells of the same color. This phenomenon occurs when each cell is colored with its own instruction `fill` (the PostScript operator `fill` noted `f` in PDF). This is the case with `colortbl`: each cell is colored on its own, even when \texttt{\texttt{\textbackslash columncolor}} or \texttt{\texttt{\textbackslash rowcolor}} is used. As for this phenomenon, Adobe Reader gives better results than MuPDF.

The package \texttt{nicematrix} provides tools to avoid those problems.

### 6.2 The tools of \texttt{nicematrix} in the \texttt{\CodeBefore}

The package \texttt{nicematrix} provides some tools (independent of \texttt{colortbl}) to draw the colored panels first, and, then, the content of the cells and the rules. This strategy is more conform to the “painting model” of the formats PostScript and PDF and is more suitable for the PDF viewers. However, it requires several compilations.\footnote{If you use Overleaf, Overleaf will do automatically the right number of compilations.}

The extension \texttt{nicematrix} provides a key \texttt{code-before} for some code that will be executed before the drawing of the tabular.

An alternative syntax is provided: it’s possible to put the content of that \texttt{code-before} between the keywords \texttt{\CodeBefore} and \texttt{\Body} at the beginning of the environment.

\begin{verbatim}
\begin{pNiceArray}{preamble}
\CodeBefore
  instructions of the code-before
\Body
  contents of the environment
\end{pNiceArray}
\end{verbatim}

New commands are available in that \texttt{\CodeBefore}: \texttt{\cellcolor}, \texttt{\rectanglecolor}, \texttt{\rowcolor}, \texttt{\columncolor}, \texttt{\rowcolors}, \texttt{\rowlistcolors}, \texttt{\chessboardcolors} and \texttt{arraycolor}.\footnote{Remark that, in the \texttt{\CodeBefore}, PGF/Tikz nodes of the form “(i-|j)” are also available to indicate the position to the potential rules: cf. p. 42.}

All these commands accept an optional argument (between square brackets and in first position) which is the color model for the specification of the colors.

These commands don’t color the cells which are in the “corners” if the key \texttt{corners} is used. This key has been described p. 10.

- The command \texttt{\cellcolor} takes its name from the command \texttt{\cellcolor} of \texttt{colortbl}.
  
  This command takes in as mandatory arguments a color and a list of cells, each of which with the format \texttt{i-j} where \texttt{i} is the number of the row and \texttt{j} the number of the column of the cell.

  \begin{verbatim}
  \begin{NiceTabular}{|c|c|c|}
  \CodeBefore
    \cellcolor[HTML]{FFFF88}\{3-1,2-2,1-3\}
  \Body
  a & b & c \hline
  e & f & g \hline
  h & i & j \hline
  \end{NiceTabular}
  \end{verbatim}

- The command \texttt{\rectanglecolor} takes three mandatory arguments. The first is the color. The second is the upper-left cell of the rectangle and the third is the lower-right cell of the rectangle.
\begin{NiceTabular}{|c|c|c|} 
\CodeBefore 
\rectanglecolor{blue!15}{2-2}{3-3} 
\Body 
\hline 
a & b & c \\
\hline 
e & f & g \\
\hline 
h & i & j \\
\hline 
\end{NiceTabular}

- The command `\arraycolor` takes as mandatory argument a color and color the whole tabular with that color (excepted the potential exterior rows and columns: cf. p. 21). It’s only a particular case of `\rectanglecolor`.

- The command `\chessboardcolors` takes in as mandatory arguments two colors and it colors the cells of the tabular in quincunx with these colors.

\[
\begin{pNiceMatrix}[r,margin] 
\CodeBefore 
\chessboardcolors{red!15}{blue!15} 
\Body 
1 & -1 & 1 \\
-1 & 1 & -1 \\
1 & -1 & 1 \\
\end{pNiceMatrix}
\]

We have used the key `r` which aligns all the columns rightwards (cf. p. 36).

- The command `\rowcolor` takes its name from the command `\rowcolor` of `colortbl`. Its first mandatory argument is the color and the second is a comma-separated list of rows or interval of rows with the form `a-b` (an interval of the form `a-` represent all the rows from the row `a` until the end).

\[
\begin{NiceArray}{lll}[hvlines] 
\CodeBefore 
\rowcolor{red!15}{1,3-5,8-} 
\Body 
a_1 & b_1 & c_1 \\
a_2 & b_2 & c_2 \\
a_3 & b_3 & c_3 \\
a_4 & b_4 & c_4 \\
a_5 & b_5 & c_5 \\
a_6 & b_6 & c_6 \\
a_7 & b_7 & c_7 \\
a_8 & b_8 & c_8 \\
a_9 & b_9 & c_9 \\
a_{10} & b_{10} & c_{10} \\
\end{NiceArray}
\]

- The command `\columncolor` takes its name from the command `\columncolor` of `colortbl`. Its syntax is similar to the syntax of `\rowcolor`.

- The command `\rowcolors` (with a `s`) takes its name from the command `\rowcolors` of `xcolor`. The `s` emphasizes the fact that there is two colors. This command colors alternately the rows

---

\textsuperscript{20}The command `\rowcolors` of `xcolor` is available when `xcolor` is loaded with the option `table`. That option also loads the package `colortbl`. 

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of the \texttt{tabular} with the two colors (provided in second and third argument), beginning with the row whose number is given in first (mandatory) argument.

In fact, the first (mandatory) argument is, more generally, a comma separated list of intervals describing the rows involved in the action of \texttt{\rowcolors} (an interval of the form $i$-- describes in fact the interval of all the rows of the \texttt{tabular}, beginning with the row $i$).

The last argument of \texttt{\rowcolors} is an optional list of pairs \texttt{key=value} (the optional argument in the first position corresponds to the colorimetric space). The available keys are \texttt{cols}, \texttt{restart} and \texttt{respect-blocks}.

- The key \texttt{cols} describes a set of columns. The command \texttt{\rowcolors} will color only the cells of these columns. The value is a comma-separated list of intervals of the form $i$-- $j$ (where $i$ or $j$ may be replaced by $\ast$).
- With the key \texttt{restart}, each interval of rows (specified by the first mandatory argument) begins with the same color.\footnote{Otherwise, the color of a given row relies only upon the parity of its absolute number.}
- With the key \texttt{respect-blocks} the “rows” alternately colored may extend over several rows if they have to incorporate blocks (created with the command \texttt{\Block}: cf. p. 4).

\begin{NiceTabular}{clr}[hvlines]
\CodeBefore
\rowcolors[gray]{2}{0.8}{}[cols=2-3,restart]
\Body
\Block{1-\ast}{Results} \& John \& 12 \\
\& Stephen \& 8 \\
\& Sarah \& 18 \\
\& Ashley \& 20 \\
\& Henry \& 14 \\
\& Madison \& 15
\end{NiceTabular}

\begin{NiceTabular}{lr}[hvlines]
\CodeBefore
\rowcolors{1}{blue!10}{}[respect-blocks]
\Body
\Block{2-1}{John} \& 12 \\
\& 13 \\
\& Steph \& 8 \\
\Block{3-1}{Sarah} \& 18 \\
\& 17 \\
\& 15 \\
\& Ashley \& 20 \\
\& Henry \& 14 \\
\Block{2-1}{Madison} \& 15 \\
\& 19
\end{NiceTabular}

- The extension \texttt{nicematrix} provides also a command \texttt{\rowlistcolors}. This command generalises the command \texttt{\rowcolors}: instead of two successive arguments for the colors, this command takes in an argument which is a (comma-separated) list of colors. In that list, the symbol $=$ represent a color identical to the previous one.
We recall that all the color commands we have described don’t color the cells which are in the “corners”. In the following example, we use the key \texttt{corners} to require the determination of the corner \texttt{north east} (NE).

\begin{NiceTabular}{cc}
\CodeBefore
\rowlistcolors{1}\{red!15,blue!15,green!15\}
\Body
Peter \\
Peter \\
James \\
James \\
Abigail \\
Abigail \\
Elisabeth \\
Elisabeth \\
Claudius \\
Claudius \\
Jane \\
Jane \\
Alexandra \\
Alexandra
\end{NiceTabular}

One should remark that all the previous commands are compatible with the commands of \texttt{booktabs} (\texttt{\toprule}, \texttt{\midrule}, \texttt{\bottomrule}, etc). However, \texttt{booktabs} is not loaded by \texttt{nicematrix}.

\begin{NiceTabular}{cccccc}
\CodeBefore
\rowlistcolors{1}\{blue!15, }\end{NiceTabular}

\begin{NiceTabular}{lSSSS}
\CodeBefore
\rowcolor{red!15}{1-2} \rowcolors{3}{blue!15}{}
\Body
\toprule
\Block{2-1}\{Product\} & & & & \\
\Block{1-3}\{dimensions (cm)\} & & & & \\
\Block{2-1}\{\texttt{rotate} Price\} & & & & \\
\cmidrule(rl){2-4} \\
\Block{2-1}\{Product\} & \texttt{L} & \texttt{l} & \texttt{h} \\
\midrule
\texttt{small} & 3 & 5.5 & 1 & 30 \\
\texttt{standard} & 5.5 & 8 & 1.5 & 50.5 \\
\texttt{premium} & 8.5 & 10.5 & 2 & 80 \\
\texttt{extra} & 8.5 & 10 & 1.5 & 85.5 \\
\texttt{special} & 12 & 12 & 0.5 & 70 \\
\bottomrule
\end{NiceTabular}

We have used the type of column \texttt{S} of \texttt{siunitx}. 
6.3 Color tools with the syntax of colortbl

It’s possible to access the preceding tools with a syntax close to the syntax of colortbl. For that, one must use the key `colortbl-like` in the current environment.\footnote{Up to now, this key is not available in \texttt{NiceMatrixOptions}.}

There are three commands available (they are inspired by colortbl but are independent of colortbl):

- \texttt{\cellcolor} which colorizes a cell;\footnote{However, this command \texttt{\cellcolor} will delete the following spaces, which does not the command \texttt{\cellcolor} of colortbl.}
- \texttt{\rowcolor} which must be used in a cell and which colorizes the end of the row;
- \texttt{\columncolor} which must be used in the preamble of the environment with the same syntax as the corresponding command of colortbl (however, unlike the command \texttt{\columncolor} of colortbl, this command \texttt{\columncolor} can appear within another command, itself used in the preamble of the array).

\begin{NiceTabular}[colortbl-like]{>{\Blue}c>{\Blue}cc}
\toprule
\rowcolor{red!15}
Last name & First name & Birth day \\
\midrule
Achard & Jacques & 5 juin 1962 \\
Lefebvre & Mathilde & 23 mai 1988 \\
Vanesse & Stephany & 30 octobre 1994 \\
Dupont & Chantal & 15 janvier 1998 \\
\bottomrule
\end{NiceTabular}

7 The command \RowStyle

The command \texttt{\RowStyle} takes in as argument some formatting instructions that will be applied to each cell on the rest of the current row.

That command also takes in as optional argument (between square brackets) a list of key=value pairs.

- The key \texttt{nb-rows} sets the number of rows to which the specifications of the current command will apply.
- The keys \texttt{cell-space-top-limit}, \texttt{cell-space-bottom-limit} and \texttt{cell-space-limits} are available with the same meaning that the corresponding global keys (cf. p. 2).
- The key \texttt{rowcolor} sets the color of the background and the key \texttt{color} sets the color of the text.\footnote{The key \texttt{color} uses the command \texttt{\color} but inserts also an instruction \texttt{\leavevmode} before. This instruction prevents a extra vertical space in the cells which belong to columns of type \texttt{p}, \texttt{b}, \texttt{n} and \texttt{X} (which start in vertical mode).
The key **bold** enforces bold characters for the cells of the row, both in math mode and text mode.

\begin{NiceTabular}{cccc}
\hline
\RowStyle[cell-space-limits=3pt]{\rotate}
first & second & third & fourth \\
\RowStyle[nb-rows=2,rowcolor=blue!50,color=white]{\sffamily}
1 & 2 & 3 & 4 \\
I & II & III & IV \\
\end{NiceTabular}

The command \rotate is described p. 36.

8 The width of the columns

8.1 Basic tools

In the environments with an explicit preamble (like \{NiceTabular\}, \{NiceArray\}, etc.), it’s possible to fix the width of a given column with the standard letters \texttt{w}, \texttt{W}, \texttt{p}, \texttt{b} and \texttt{m} of the package \texttt{array}.

\begin{NiceTabular}{Wc{2cm}cc}[hvlines]
Paris & New York & Madrid \\
Berlin & London & Roma \\
Rio & Tokyo & Oslo \\
\end{NiceTabular}

In the environments of \texttt{nicematrix}, it’s also possible to fix the minimal width of all the columns (excepted the potential exterior columns: cf. p. 21) directly with the key \texttt{columns-width}.

\$\begin{pNiceMatrix}[columns-width = 1cm]
1 & 12 & -123 \\
12 & 0 & 0 \\
4 & 1 & 2 \\
\end{pNiceMatrix}\$

Note that the space inserted between two columns (equal to 2 \texttt{\tabcolsep} in \{NiceTabular\} and to 2 \texttt{\arraycolsep} in the other environments) is not suppressed (of course, it’s possible to suppress this space by setting \texttt{\tabcolsep} or \texttt{\arraycolsep} equal to 0 pt before the environment).

It’s possible to give the special value \texttt{auto} to the option \texttt{columns-width}: all the columns of the array will have a width equal to the widest cell of the array.\footnote{The result is achieved with only one compilation (but PGF/Tikz will have written informations in the aux file and a message requiring a second compilation will appear).}

\$\begin{pNiceMatrix}[columns-width = auto]
1 & 12 & -123 \\
12 & 0 & 0 \\
4 & 1 & 2 \\
\end{pNiceMatrix}\$

Without surprise, it’s possible to fix the minimal width of the columns of all the arrays of a current scope with the command \texttt{\NiceMatrixOptions}.

\texttt{\NiceMatrixOptions{columns-width=10mm}}

\$\begin{pNiceMatrix}
a & b \\
c & d \\
\end{pNiceMatrix} = \begin{pNiceMatrix}
a & b \\
c & d \\
\end{pNiceMatrix}\$

\begin{pNiceMatrix}
1 & 1245 \\
345 & 2 \\
\end{pNiceMatrix}
But it's also possible to fix a zone where all the matrices will have their columns of the same width, equal to the widest cell of all the matrices. This construction uses the environment \NiceMatrixBlock with the option \texttt{auto-columns-width}.\footnote{At this time, this is the only usage of the environment \texttt{NiceMatrixBlock} but it may have other usages in the future.} The environment \texttt{NiceMatrixBlock} has no direct link with the command \texttt{\Block} presented previously in this document (cf. p. 4).

\begin{NiceMatrixBlock}[auto-columns-width]
\begin{array}{c}
\begin{bNiceMatrix}
9 & 17 \\
-2 & 5
\end{bNiceMatrix} \\
\begin{bNiceMatrix}
1 & 1245345 \\
345 & 2
\end{bNiceMatrix}
\end{array}
\end{NiceMatrixBlock}

\section{8.2 The columns V of \texttt{varwidth}}

\begin{itemize}
\item first item
\item second item
\end{itemize}

\begin{itemize}
\item first item
\item second item
\end{itemize}

The package \texttt{varwidth} provides also the column type \texttt{V}. A column of type \texttt{V\{(dim)\}} encapsulates all its cells in a \texttt{varwidth} with the argument \texttt{(dim)} (and does also some tuning).

When the package \texttt{varwidth} is loaded, the columns \texttt{V} of \texttt{varwidth} are supported by \texttt{nicematrix}. Concerning \texttt{nicematrix}, one of the interests of this type of columns is that, for a cell of a column of type \texttt{V}, the PGF/Tikz node created by \texttt{nicematrix} for the content of that cell has a width adjusted to the content of the cell: cf. p. 40. If the content of the cell is empty, the cell will be considered as empty by \texttt{nicematrix} in the construction of the dotted lines and the «empty corners» (that's not the case with a cell of a column \texttt{p}, \texttt{m} or \texttt{b}).

\begin{NiceTabular}[corners=NW,hvlines]{V{3cm}V{3cm}V{3cm}}
\text{some very very very long text} & \text{some very very very long text} \\
\text{some very very very long text} & \text{some very very very long text} & \text{some very very very long text}
\end{NiceTabular}
8.3 The columns \texttt{X}

The environment \texttt{\{NiceTabular\}} provides \texttt{X} columns similar to those provided by the environment \texttt{\{tabularx\}} of the eponymous package.

The required width of the tabular may be specified with the key \texttt{width} (in \texttt{\{NiceTabular\}} or in \texttt{\{NiceMatrixOptions\}}). The initial value of this parameter is \texttt{\linewidth} (and not \texttt{\textwidth}).

For sake of similarity with the environment \texttt{\{tabularx\}}, \texttt{nicematrix} also provides an environment \texttt{\{NiceTabularX\}} with a first mandatory argument which is the width of the tabular.\footnote{If \texttt{tabularray} is loaded, one must use \texttt{\{NiceTabularX\}} (and not \texttt{\{NiceTabular\}}) in order to use the columns \texttt{X} (this point comes from a conflict in the definitions of the specifier \texttt{X}).}

As with the packages \texttt{tabu} and \texttt{tabularray}, the specifier \texttt{X} takes in an optional argument (between square brackets) which is a list of keys.

- It’s possible to give a weight for the column by providing a positive integer directly as argument of the specifier \texttt{X}. For example, a column \texttt{X[2]} will have a width double of the width of a column \texttt{X} (which has a weight equal to 1).\footnote{The negative values of the weight, as provided by \texttt{tabu} (which is now obsolete), are \textit{not} supported by \texttt{nicematrix}. If such a value is used, an error will be raised.}

- It’s possible to specify an horizontal alignment with one of the letters \texttt{l}, \texttt{c} and \texttt{r} (which insert respectively \texttt{\raggedright}, \texttt{\centering} and \texttt{\raggedleft} followed by \texttt{\arraybackslash}).

- It’s possible to specify a vertical alignment with one of the keys \texttt{t} (alias \texttt{p}), \texttt{m} and \texttt{b} (which construct respectively columns of type \texttt{p}, \texttt{m} and \texttt{b}). The default value is \texttt{t}.

\begin{NiceTabular} \[width=9\text{cm}\]\{X[2,1]\{1\}\}[hvlines]
a rather long text which fits on several lines \\
& a rather long text which fits on several lines \\
a shorter text & a shorter text 
\end{NiceTabular}

9 The exterior rows and columns

The options \texttt{first-row}, \texttt{last-row}, \texttt{first-col} and \texttt{last-col} allow the composition of exterior rows and columns in the environments of \texttt{nicematrix}. It’s particularly interesting for the (mathematical) matrices.

A potential “first row” (exterior) has the number 0 (and not 1). Idem for the potential “first column”.

\[
\begin{array}{|c|c|}
\hline
\text{some very very very long text} & \text{some very very very long text} \\
\text{some very very very long text} \\
\text{some very very very long text} \\
\hline
\end{array}
\]
The dotted lines have been drawn with the tools presented p. 23.

We have several remarks to do.

- For the environments with an explicit preamble (i.e. \{NiceTabular\}, \{NiceArray\} and its variants), no letter must be given in that preamble for the potential first column and the potential last column: they will automatically (and necessarily) be of type r for the first column and l for the last one.

- One may wonder how nicematrix determines the number of rows and columns which are needed for the composition of the “last row” and “last column”.
  - For the environments with explicit preamble, like \{NiceTabular\} and \{pNiceArray\}, the number of columns can obviously be computed from the preamble.
  - When the option light-syntax (cf. p. 38) is used, nicematrix has, in any case, to load the whole body of the environment (and that’s why it’s not possible to put verbatim material in the array with the option light-syntax). The analysis of this whole body gives the number of rows (but not the number of columns).
  - In the other cases, nicematrix compute the number of rows and columns during the first compilation and write the result in the aux file for the next run.

However, it’s possible to provide the number of the last row and the number of the last column as values of the options last-row and last-col, tending to an acceleration of the whole compilation of the document. That’s what we will do throughout the rest of the document.

It’s possible to control the appearance of these rows and columns with options code-for-first-row, code-for-last-row, code-for-first-col and code-for-last-col. These options specify tokens that will be inserted before each cell of the corresponding row or column.

\begin{pNiceMatrix}[first-row,last-row,first-col,last-col,nullify-dots]
& C_1 & \Cdots & & C_4 & \\
L_1 & a_{11} & a_{12} & a_{13} & a_{14} & L_1 \\
\Vdots & a_{21} & a_{22} & a_{23} & a_{24} & \Vdots \\
& a_{31} & a_{32} & a_{33} & a_{34} & \\
L_4 & a_{41} & a_{42} & a_{43} & a_{44} & L_4 \\
& C_1 & \Cdots & & C_4 &
\end{pNiceMatrix}

The users wishing exterior columns with another type of alignment should consider the command \SubMatrix available in the \CodeAfter (cf. p. 29).
&& a_{31} & a_{32} & a_{33} & a_{34} & \\ & L_4 & a_{41} & a_{42} & a_{43} & a_{44} & L_4 & \\ & C_1 & \cdots & & C_4 & \\
\end{pNiceArray}

\begin{bNiceMatrix}
C_1 & \cdots & \ldots & \cdots & C_4 \\
| a_{11} & a_{12} & a_{13} & a_{14} | & L_1 \\
| a_{21} & a_{22} & a_{23} & a_{24} | \\
| a_{31} & a_{32} & a_{33} & a_{34} | & L_4 \\
| a_{41} & a_{42} & a_{43} & a_{44} | \\
C_1 & \cdots & \ldots & \cdots & C_4 \\
\end{bNiceMatrix}

Remarks

- As shown in the previous example, the horizontal and vertical rules don’t extend in the exterior rows and columns. This remark also applies to the customized rules created by the key custom-line (cf. p. 12).
- A specification of color present in code-for-first-row also applies to a dotted line drawn in that exterior “first row” (excepted if a value has been given to xdots/color). Idem for the other exterior rows and columns.
- Logically, the potential option columns-width (described p. 19) doesn’t apply to the “first column” and “last column”.
- For technical reasons, it’s not possible to use the option of the command \ after the “first row” or before the “last row”. The placement of the delimiters would be wrong. If you are looking for a workaround, consider the command SubMatrix in the CodeAfter described p. 29.

10 The continuous dotted lines

Inside the environments of the package nicematrix, new commands are defined: \Ldots, \Cdots, \Vdots, \ddots, and \iddots. These commands are intended to be used in place of \dots, \cdots, \vdots, \ddots and \iddots.\footnote{\text{The command } \iddots, \text{ defined in nicematrix, is a variant of } \ddots \text{ with dots going forward. If mathdots is loaded, the version of mathdots is used. It corresponds to the command } \adots \text{ of unicode-math.}}

Each of them must be used alone in the cell of the array and it draws a dotted line between the first non-empty cells\footnote{The precise definition of a “non-empty cell” is given below (cf. p. 45).} on both sides of the current cell. Of course, for \Ldots and \Cdots, it’s an horizontal line; for \Vdots, it’s a vertical line and for \ddots and \iddots diagonal ones. It’s possible to change the color of these lines with the option color.\footnote{It’s also possible to change the color of all these dotted lines with the option xdots/color (xdots to remind that it works for \Cdots, \Ldots, \Vdots, etc.): cf. p. 27.}

\begin{verbatim}
\begin{bNiceMatrix}
a_1 & \Cdots & & & a_1 \\
\Vdots & a_2 & \Cdots & & a_2 \\
& \Vdots & \Ddots[color=red] \\
\vdots & a_n & & & a_n \\
\end{bNiceMatrix}
\end{verbatim}

In order to represent the null matrix, one can use the following codage:

\begin{verbatim}
\begin{bNiceMatrix}
0 & \Cdots & 0 \\
\Vdots & & \Vdots \\
0 & \Cdots & 0 \\
\end{bNiceMatrix}
\end{verbatim}
However, one may want a larger matrix. Usually, in such a case, the users of LaTeX add a new row and a new column. It’s possible to use the same method with `nicematrix`:

\begin{bNiceMatrix}
0 & \Cdots & \Cdots & 0 \\
\Vdots & & & \Vdots \\
\Vdots & & & \Vdots \\
0 & \Cdots & \Cdots & 0
\end{bNiceMatrix}

\[
\begin{pmatrix}
0 & 0 & 0 & 0 \\
\ldots & \ldots & \ldots & \ldots \\
\ldots & \ldots & \ldots & \ldots \\
0 & 0 & 0 & 0
\end{pmatrix}
\]

In the first column of this example, there are two instructions \texttt{\Vdots} but, of course, only one dotted line is drawn.

In fact, in this example, it would be possible to draw the same matrix more easily with the following code:

\begin{bNiceMatrix}
0 & \Cdots & & 0 \\
\Vdots & & & \\
& & & \Vdots \\
0 & & \Cdots & 0
\end{bNiceMatrix}

\[
\begin{pmatrix}
0 & 0 & 0 & 0 \\
\ldots & \ldots & \ldots & \ldots \\
\ldots & \ldots & \ldots & \ldots \\
0 & 0 & 0 & 0
\end{pmatrix}
\]

There are also other means to change the size of the matrix. Someone might want to use the optional argument of the command \texttt{\\} for the vertical dimension and a command \texttt{\hspace*} in a cell for the horizontal dimension.\footnote{In \texttt{nicematrix}, one should use \texttt{\hspace*} and not \texttt{\hspace} for such an usage because \texttt{nicematrix} loads \texttt{array}. One may also remark that it’s possible to fix the width of a column by using the environment \texttt{\NiceArray} (or one of its variants) with a column of type \texttt{w} or \texttt{W}: see p. 19}

However, a command \texttt{\hspace*} might interfere with the construction of the dotted lines. That’s why the package \texttt{nicematrix} provides a command \texttt{\Hspace} which is a variant of \texttt{\hspace} transparent for the dotted lines of \texttt{nicematrix}.

\begin{bNiceMatrix}
0 & \Cdots & \Hspace*{1cm} & 0 \\
\Vdots & & & \\
& & & \Vdots \\
0 & & \Cdots & 0
\end{bNiceMatrix}

\[
\begin{pmatrix}
0 & 0 & 0 & 0 \\
\ldots & \ldots & \ldots & \ldots \\
\ldots & \ldots & \ldots & \ldots \\
0 & 0 & 0 & 0
\end{pmatrix}
\]

\subsection{The option nullify-dots}

Consider the following matrix composed classically with the environment \texttt{\pmatrix} of \texttt{amsmath}.

$A = \begin{pmatrix}
h & i & j & k & l & m \\
x & & & & & x
\end{pmatrix}$

If we add \texttt{\ldots} instructions in the second row, the geometry of the matrix is modified.

$B = \begin{pmatrix}
h & i & j & k & l & m \\
x & \ldots & \ldots & \ldots & \ldots & x
\end{pmatrix}$

By default, with \texttt{nicematrix}, if we replace \texttt{\pmatrix} by \texttt{\pNiceMatrix} and \texttt{\ldots} by \texttt{\Ldots}, the geometry of the matrix is not changed.

$C = \begin{pNiceMatrix}
h & i & j & k & l & m \\
x & \Ldots & \Ldots & \Ldots & \Ldots & x
\end{pNiceMatrix}$
However, one may prefer the geometry of the first matrix $A$ and would like to have such a geometry with a dotted line in the second row. It’s possible by using the option \texttt{nullify-dots} (and only one instruction \texttt{\Ldots} is necessary).

$$D = \begin{pNiceMatrix}[nullify-dots]
 h & i & j & k & l & m \\
 x & \Ldots & & & & x
\end{pNiceMatrix}$$

The option \texttt{nullify-dots} smashes the instructions \texttt{\Ldots} (and the variants) horizontally but also vertically.

10.2 The commands \texttt{\Hdots} and \texttt{\Vdots}

Some people commonly use the command \texttt{\Hdots} of \texttt{amsmath} in order to draw horizontal dotted lines in a matrix. In the environments of \texttt{nicematrix}, one should use instead \texttt{\Hdots} in order to draw dotted lines similar to the other dotted lines drawn by the package \texttt{nicematrix}.

As with the other commands of \texttt{nicematrix} (like \texttt{\Cdots}, \texttt{\Ldots}, \texttt{\Vdots}, etc.), the dotted line drawn with \texttt{\Hdots} extends until the contents of the cells on both sides.

$$\begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 \\
\hline
1 & \Hdotsfor{3} & 5 \\
1 & 2 & 3 & 4 & 5 \\
1 & 2 & 3 & 4 & 5
\end{pNiceMatrix}$$

However, if these cells are empty, the dotted line extends only in the cells specified by the argument of \texttt{\Hdots}.

$$\begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 \\
\hline
\Hdotsfor{3} \\
1 & 2 & 3 & 4 & 5 \\
1 & 2 & 3 & 4 & 5
\end{pNiceMatrix}$$

Remark: Unlike the command \texttt{\Hdots} of \texttt{amsmath}, the command \texttt{\Hdots} may be used even when the package \texttt{colortbl}\footnote{We recall that when \texttt{xcolor} is loaded with the option \texttt{table}, the package \texttt{colortbl} is loaded.} is loaded (but you might have problem if you use \texttt{\rowcolor} on the same row as \texttt{\Hdots}).

The package \texttt{nicematrix} also provides a command \texttt{\Vdots} similar to \texttt{\Hdots} but for the vertical dotted lines. The following example uses both \texttt{\Hdots} and \texttt{\Vdots}:

\begin{bNiceMatrix}
C[a_1,a_1] & C[a_1,a_1] & \Cdots & C[a_1,a_n] \\
& \hline
\rule{0pt}{15mm} & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots & \\
C[a_n,a_1] & C[a_n,a_1] & \Cdots & C[a_n,a_n] \\
& \hline
C[a_1,a_1] & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots & \\
\rule{0pt}{15mm} & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots & \\
C[a_n,a_1] & C[a_n,a_1] & \Cdots & C[a_n,a_n] \\
& \hline
C[a_1,a_1] & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots & & \Vdotsfor{1} & \Ddots &
\end{bNiceMatrix}
10.3 How to generate the continuous dotted lines transparently

Imagine you have a document with a great number of mathematical matrices with ellipsis. You may wish to use the dotted lines of nicematrix without having to modify the code of each matrix. It’s possible with the keys \texttt{renew-dots} and \texttt{renew-matrix}.

- The option \texttt{renew-dots}

  With this option, the commands \texttt{\ldots}, \texttt{\cdots}, \texttt{\vdots}, \texttt{\ddots}, \texttt{\iddots} and \texttt{\hdotsfor} are redefined within the environments provided by nicematrix and behave like \texttt{\Ldots}, \texttt{\Cdots}, \texttt{\Vdots}, \texttt{\Ddots}, \texttt{\Iddots} and \texttt{\Hdots}; the command \texttt{\dots} (“automatic dots” of amsmath) is also redefined to behave like \texttt{\Ldots}.

- The option \texttt{renew-matrix}

  With this option, the environment \texttt{\{matrix\}} is redefined and behave like \texttt{\{NiceMatrix\}}, and so on for the five variants.

Therefore, with the keys \texttt{renew-dots} and \texttt{renew-matrix}, a classical code gives directly the output of nicematrix.

\begin{verbatim}
\NiceMatrixOptions{renew-dots,renew-matrix}
\begin{pmatrix}
1 & \cdots & \cdots & 1 \\
0 & \ddots & & \vdots \\
\vdots & \ddots & \ddots & \vdots \\
0 & \cdots & 0 & 1
\end{pmatrix}
\end{verbatim}

10.4 The labels of the dotted lines

The commands \texttt{\ldots}, \texttt{\cdots}, \texttt{\vdots}, \texttt{\ddots}, \texttt{\iddots} and \texttt{\hdotsfor} (and the command \texttt{\line} in the \texttt{\CodeAfter} which is described p. 28) accept two optional arguments specified by the tokens _ and ^ for labels positioned below and above the line. The arguments are composed in math mode with \texttt{\scriptstyle}.

\begin{verbatim}
$\begin{bNiceMatrix}$
1 & \hspace*{1cm} & 0 \\
\& & \hdots^{n \text{ times}} & \& \\
0 & \& & 1
$\end{bNiceMatrix}$
\end{verbatim}

\footnote{The options \texttt{renew-dots}, \texttt{renew-matrix} can be fixed with the command \texttt{\NiceMatrixOptions} like the other options. However, they can also be fixed as options of the command \texttt{\usepackage}. There is also a key \texttt{transparent} which is an alias for the conjunction of \texttt{renew-dots} and \texttt{renew-matrix} but it must be considered as obsolete.}
10.5 Customisation of the dotted lines

The dotted lines drawn by \Ldots, \Cdots, \Vdots, \Ddots, \iddots and \Vdotsfor (and by the command \line in the \CodeAfter which is described p. 28) may be customized by three options (specified between square brackets after the command):

- color;
- shorten;
- line-style.

These options may also be fixed with \NiceMatrixOptions, as options of \CodeAfter or at the level of a given environment but, in those cases, they must be prefixed by xdots (xdots to remind that it works for \Cdots, \Ldots, \Vdots, etc.), and, thus have for names:

- xdots/color;
- xdots/shorten;
- xdots/line-style.

For the clarity of the explanations, we will use those names.

The option xdots/color

The option xdots/color fixes the color or the dotted line. However, one should remark that the dotted lines drawn in the exterior rows and columns have a special treatment: cf. p. 21.

The option xdots/shorten

The option xdots/shorten fixes the margin of both extremities of the line. The name is derived from the options “shorten >” and “shorten <” of Tikz but one should notice that nicematrix only provides xdots/shorten. The initial value of this parameter is 0.3 cm (it is recommended to use a unit of length dependent of the current font).

The option xdots/line-style

It should be pointed that, by default, the lines drawn by Tikz with the parameter dotted are composed of square dots (and not rounded ones).\footnote{The first reason of this behaviour is that the pdf format includes a description for dashed lines. The lines specified with this descriptor are displayed very efficiently by the pdf readers. It’s easy, starting from these dashed lines, to create a line composed by square dots whereas a line of rounded dots needs a specification of each dot in the pdf file.}

\begin{verbatim}
\tikz \draw [dotted] (0,0) -- (5,0) ;
\end{verbatim}

In order to provide lines with rounded dots in the style of those provided by \Ldots (at least with the Computer Modern fonts), the package nicematrix embeds its own system to draw a dotted line (and this system uses PGF and not Tikz). This style is called standard and that’s the initial value of the parameter xdots/line-style.

However (when Tikz is loaded) it’s possible to use for xdots/line-style any style provided by Tikz, that is to say any sequence of options provided by Tikz for the Tizk pathes (with the exception of “color”, “shorten >” and “shorten <”).

Here is for example a tridiagonal matrix with the style loosely dotted:

\begin{verbatim}
\begin{pNiceMatrix}[nullify-dots,xdots/line-style=loosely dotted]
a & b & 0 & & \Cdots & 0 \\
b & a & b & \Ddots & & \Vdots \\
0 & b & a & \Ddots & & \\
& \Ddots & \Ddots & \Ddots & & 0 \\
\Vdots & & & & & b \\
0 & \Cdots & & 0 & b & a
\end{pNiceMatrix}
\end{verbatim}
The dotted lines and the rules

The dotted lines determine virtual blocks which have the same behaviour regarding the rules (the rules specified by the specifier | in the preamble, by the command \Hline, by the keys hlines, vlines, hvlines and hvlines-except-borders and by the tools created by custom-line are not drawn within the blocks).\[\begin{bNiceMatrix}[margin,hvlines]
\Block{3-3}<\LARGE>{A} & & & 0 \\
& \hspace*{1cm} & & \Vdots \\
& & & 0 \\
0 & \Cdots& 0 & 0
\end{bNiceMatrix}\]

The option code-after may be used to give some code that will be executed after the construction of the matrix.

For the legibility of the code, an alternative syntax is provided: it’s possible to give the instructions of the code-after at the end of the environment, after the keyword CodeAfter. Although CodeAfter is a keyword, it takes in an optional argument (between square brackets). The keys accepted in that optional argument form a subset of the keys of the command WithArrowsOptions.

The experienced users may, for instance, use the PGF/Tikz nodes created by nicematrix in the CodeAfter. These nodes are described further beginning on p. 39.

Moreover, several special commands are available in the CodeAfter: line, \SubMatrix, \OverBrace and \UnderBrace. We will now present these commands.

11.1 The \textbackslash line in the \textbackslash CodeAfter

The command line draws directly dotted lines between nodes. It takes in two arguments for the two cells to link, both of the form i-j where is the number of the row and j is the number of the column. The options available for the customisation of the dotted lines created by \Cdots, \Vdots, etc. are also available for this command (cf. p. 27).

This command may be used, for example, to draw a dotted line between two adjacent cells.

\begin{NiceMatrixOptions}{xdots/shorten = 0.6 em}
\begin{pNiceMatrix}
I & 0 & \Cdots &0 \\
0 & I & \Ddots &\Vdots\\
\Vdots &\Ddots & I &0 \\
0 &\Cdots & 0 &I
\CodeAfter \line{2-2}{3-3}
\end{pNiceMatrix}
It can also be used to draw a diagonal line not parallel to the other diagonal lines (by default, the dotted lines drawn by \Ddots are “parallelized”: cf. p. 44).

\begin{bNiceMatrix}
1 & \Cdots & & 1 & 2 & \Cdots & 2 \\
0 & \Ddots & & \Vdots & \Vdots & \hspace*{2.5cm} & \Vdots \\
\Vdots & \Ddots & & & & & \\
0 & \Cdots & 0 & 1 & 2 & \Cdots & 2
\CodeAfter \line[shorten=6pt]{1-5}{4-7}
\end{bNiceMatrix}

$$
\begin{bNiceMatrix}
1 & 1 & 1 & x \\
\frac{1}{4} & \frac{1}{2} & \frac{1}{4} & y \\
1 & 2 & 3 & z
\CodeAfter \SubMatrix({1-1}{3-3})
\SubMatrix({1-4}{3-4})
\end{bNiceMatrix}$$

$${}$$

\begin{align*}
\begin{bNiceMatrix}
1 & 1 & 1 \\
1 & a & b \\
1 & c & d
\CodeAfter \SubMatrix[{2-2}{3-3}]^{T}
\end{bNiceMatrix}
\end{align*}

11.2 The command \SubMatrix in the \CodeAfter

The command \SubMatrix provides a way to put delimiters on a portion of the array considered as a submatrix. The command \SubMatrix takes in five arguments:

- the first argument is the left delimiter, which may be any extensible delimiter provided by LaTeX: (, [ , \{, \langle, \lgroup, \lfloor, etc. but also the null delimiter .;
- the second argument is the upper-left corner of the submatrix with the syntax $i-j$ where $i$ the number of row and $j$ the number of column;
- the third argument is the lower-right corner with the same syntax;
- the fourth argument is the right delimiter;
- the last argument, which is optional, is a list of key=value pairs.\footnote{There is no optional argument between square brackets in first position because a square bracket just after \SubMatrix must be interpreted as the first (mandatory) argument of the command \SubMatrix: that bracket is the left delimiter of the sub-matrix to construct (eg: \SubMatrix[{2-2}{4-7}]).}

One should remark that the command \SubMatrix draws the delimiters after the construction of the array: no space is inserted by the command \SubMatrix itself. That’s why, in the following example, we have used the key margin and you have added by hand some space between the third and fourth column with @\hspace{1.5em} in the preamble of the array.

\begin{NiceArray}{ccc}@{\hspace{1.5em}}c}
1 & 1 & 1 & x \\
\frac{1}{4} & \frac{1}{2} & \frac{1}{4} & y \\
1 & 2 & 3 & z
\CodeAfter \SubMatrix((1-1){3-3})
\SubMatrix((1-4){3-4})
\end{NiceArray}

In fact, the command \SubMatrix also takes in two optional arguments specified by the traditional symbols \^ and _ for material in superscript and subscript.

$\begin{bNiceMatrix}[right-margin=1em]
1 & 1 & 1 \\
1 \& a \& b \\
1 \& c \& d
\CodeAfter \SubMatrix[{2-2}{3-3}]^T
\end{bNiceMatrix}$

The options of the command \SubMatrix are as follows:
• **left-xshift** and **right-xshift** shift horizontally the delimiters (there exists also the key \texttt{xshift} which fixes both parameters);

• **extra-height** adds a quantity to the total height of the delimiters (height \texttt{ht} + depth \texttt{dp});

• **delimiters/color** fixes the color of the delimiters (also available in \texttt{\NiceMatrixOptions}, in the environments with delimiters and as option of the keyword \texttt{\CodeAfter});

• **slim** is a boolean key: when that key is in force, the horizontal position of the delimiters is computed by using only the contents of the cells of the submatrix whereas, in the general case, the position is computed by taking into account the cells of the whole columns implied in the submatrix (see example below). ;

• **vlines** contents a list of numbers of vertical rules that will be drawn in the sub-matrix (if this key is used without value, all the vertical rules of the sub-matrix are drawn);

• **hlines** is similar to **vlines** but for the horizontal rules;

• **hvlines**, which must be used without value, draws all the vertical and horizontal rules.

One should remark that these keys add their rules after the construction of the main matrix: no space is added between the rows and the columns of the array for these rules.

All these keys are also available in \texttt{\NiceMatrixOptions}, at the level of the environments of \texttt{nicematrix} or as option of the command \texttt{\CodeAfter} with the prefix \texttt{sub-matrix} which means that their names are therefore \texttt{sub-matrix/left-xshift}, \texttt{sub-matrix/right-xshift}, \texttt{sub-matrix/xshift}, etc.

\[
\begin{NiceArray}{cc@{\hspace{5mm}}l}[cell-space-limits=2pt]
& & \frac12 \\
& & \frac14 \\
a & b & \frac12a+\frac14b \\
c & d & \frac12c+\frac14d \end{NiceArray}
\]

Here is the same example with the key \texttt{slim} used for one of the submatrices.

\[
\begin{NiceArray}{cc@{\hspace{5mm}}l}[cell-space-limits=2pt]
& & \frac12 \\
& & \frac14 \\
a & b & \frac12a+\frac14b \\
c & d & \frac12c+\frac14d \end{NiceArray}[slim]
\]

There is also a key **name** which gives a name to the submatrix created by \texttt{\SubMatrix}. That name is used to create PGF/Tikz nodes: cf p. 43.

It’s also possible to specify some delimiters\footnote{Those delimiters are \texttt{()}, \texttt{[]} and the closing ones. Of course, it’s also possible to put \texttt{|} and \texttt{||} in the preamble of the environment.} by placing them in the preamble of the environment (for the environments with a preamble: \texttt{\NiceArray}, \texttt{\pNiceArray}, etc.). This syntax is inspired by the extension \texttt{blkarray}.

When there are two successive delimiters (necessarily a closing one following by an opening one for another submatrix), a space equal to \texttt{\enskip} is automatically inserted.

\[
\begin{NiceArray}{cc@{\hspace{5mm}}l}
\begin{NiceArray}{cc@{\hspace{5mm}}l}[cell-space-limits=2pt]
& & \frac12 \\
& & \frac14 \\
a & b & \frac12a+\frac14b \\
c & d & \frac12c+\frac14d \end{NiceArray}
\end{NiceArray}
\]

30
\[ \begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 & 6 \\
11 & 12 & 13 & 14 & 15 & 16 \\
\CodeAfter
\OverBrace[shorten,yshift=3pt]{1-1}{2-3}\{A\}
\OverBrace[shorten,yshift=3pt]{1-4}{2-6}\{B\}
\end{pNiceMatrix} \]

In fact, the commands \OverBrace and \UnderBrace take in an optional argument (in first position and between square brackets) for a list of key=value pairs. The available keys are:

- **left-shorten** and **right-shorten** which do not take in value; when the key left-shorten is used, the abscissa of the left extremity of the brace is computed with the contents of the cells of the involved sub-array, otherwise, the position of the potential vertical rule is used (idem for right-shorten).

- **shorten**, which is the conjunction of the keys left-shorten and right-shorten;

- **yshift**, which shifts vertically the brace (and its label);

- **New 6.7** color, which sets the color of the brace (and its label).

\begin{pNiceMatrix}
1 & 2 & 3 & 4 & 5 & 6 \\
11 & 12 & 13 & 14 & 15 & 16 \\
\CodeAfter
\OverBrace[shorten,yshift=3pt]{1-1}{2-3}\{A\}
\OverBrace[shorten,yshift=3pt]{1-4}{2-6}\{B\}
\end{pNiceMatrix}
12 The notes in the tabulars

12.1 The footnotes

The package \texttt{nicematrix} allows, by using \texttt{footnote} or \texttt{footnotehyper}, the extraction of the notes inserted by \texttt{footnote} in the environments of \texttt{nicematrix} and their composition in the footpage with the other notes of the document.

If \texttt{nicematrix} is loaded with the option \texttt{footnote} (with \texttt{\usepackage[footnote]{nicematrix}} or with \texttt{\PassOptionsToPackage}), the package \texttt{footnote} is loaded (if it is not yet loaded) and it is used to extract the footnotes.

If \texttt{nicematrix} is loaded with the option \texttt{footnotehyper}, the package \texttt{footnotehyper} is loaded (if it is not yet loaded) and it is used to extract footnotes.

Caution: The packages \texttt{footnote} and \texttt{footnotehyper} are incompatible. The package \texttt{footnotehyper} is the successor of the package \texttt{footnote} and should be used preferently. The package \texttt{footnote} has some drawbacks, in particular: it must be loaded after the package \texttt{xcolor} and it is not perfectly compatible with \texttt{hyperref}.

12.2 The notes of tabular

The package \texttt{nicematrix} also provides a command \texttt{\tabularnote} which gives the ability to specify notes that will be composed at the end of the array with a width of line equal to the width of the array (excepted the potential exterior columns). With no surprise, that command is available only in the environments without delimiters, that is to say \texttt{\{NiceTabular\}}, \texttt{\{NiceArray\}} and \texttt{\{NiceMatrix\}}.

In fact, this command is available only if the extension \texttt{enumitem} has been loaded (before or after \texttt{nicematrix}). Indeed, the notes are composed at the end of the array with a type of list provided by the package \texttt{enumitem}.

\begin{NiceTabular}{@{}llr@{}}
\toprule
\RowStyle{\bfseries}
Last name & First name & Birth day \\
midrule
Achard & Jacques & June 5, 2005 \\
Lefebvre & Mathilde & January 23, 1975 \\
Vanesse & Stephany & October 30, 1994 \\
Dupont & Chantal & January 15, 1998 \\
\bottomrule
\end{NiceTabular}

\begin{itemize}
  \item If you have several successive commands \texttt{\tabularnote{...}} with no space at all between them, the labels of the corresponding notes are composed together, separated by commas (this is similar to the option \texttt{multiple} of \texttt{footmisc} for the footnotes).
\end{itemize}
• If a command \texttt{\tabularnote{...}} is exactly at the end of a cell (with no space at all after), the label of the note is composed in an overlapping position (towards the right). This structure may provide a better alignment of the cells of a given column.

• If the key \texttt{\textbackslash notes/para} is used, the notes are composed at the end of the array in a single paragraph (as with the key \texttt{\textbackslash para} of \texttt{threeparttable}).

• There is a key \texttt{\textbackslash tabularnote} which provides a way to insert some text in the zone of the notes before the numbered tabular notes.

• If the package \texttt{booktabs} has been loaded (before or after \texttt{nicematrix}), the key \texttt{\textbackslash notes/bottomrule} draws a \texttt{\bottomrule} of \texttt{booktabs} after the notes.

• The command \texttt{\tabularnote} may be used before the environment of \texttt{nicematrix}. Thus, it’s possible to use it on the title inserted by \texttt{\textbackslash caption} in an environment \texttt{\textbackslash table} of \LaTeX.

• It’s possible to create a reference to a tabular note created by \texttt{\tabularnote} (with the usual command \texttt{\textbackslash label} used after the \texttt{\tabularnote}).

For an illustration of some of those remarks, see table 1, p. 33. This table has been composed with the following code.

\begin{table}
\setlength{\belowcaptionskip}{1ex}
\centering
\caption{Use of \texttt{\textbackslash tabularnote} \texttt{\tabularnote{It’s possible to put a note in the caption.}}}
\label{t:tabularnote}
\begin{NiceTabular}{@{}llc@{}}
\toprule
Last name & First name & Length of life \\
\midrule
Churchill & Wiston & 91 \\
Nightingale & Florence & 90 \\
Schoelcher & Victor & 89 \\
Touchet & Marie & 89 \\
Wallis & John & 87 \\
\bottomrule
\end{NiceTabular}
\end{table}

Table 1: Use of \texttt{\tabularnote}^{a}

<table>
<thead>
<tr>
<th>Last name</th>
<th>First name</th>
<th>Length of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Churchill</td>
<td>Wiston</td>
<td>91</td>
</tr>
<tr>
<td>Nightingale</td>
<td>\textsuperscript{b,c}</td>
<td>Florence</td>
</tr>
<tr>
<td>Schoelcher</td>
<td>Victor</td>
<td>89\textsuperscript{d}</td>
</tr>
<tr>
<td>Touchet</td>
<td>Marie</td>
<td>89</td>
</tr>
<tr>
<td>Wallis</td>
<td>John</td>
<td>87</td>
</tr>
</tbody>
</table>

Some text before the notes.

\textsuperscript{a} It’s possible to put a note in the caption.
\textsuperscript{b} Considered as the first nurse of history.
\textsuperscript{c} Nicknamed “the Lady with the Lamp”.
\textsuperscript{d} The label of the note is overlapping.
12.3 Customisation of the tabular notes

The tabular notes can be customized with a set of keys available in \texttt{NiceMatrixOptions}. The name of these keys is prefixed by \texttt{notes}.

- \texttt{notes/para}
- \texttt{notes/bottomrule}
- \texttt{notes/style}
- \texttt{notes/label-in-tabular}
- \texttt{notes/label-in-list}
- \texttt{notes/enumitem-keys}
- \texttt{notes/enumitem-keys-para}
- \texttt{notes/code-before}

For sake of commodity, it is also possible to set these keys in \texttt{NiceMatrixOptions} via a key \texttt{notes} which takes in as value a list of pairs \texttt{key=value} where the name of the keys need no longer be prefixed by \texttt{notes}:

\begin{verbatim}
\NiceMatrixOptions
{ notes =
  { bottomrule ,
    style = ... ,
    label-in-tabular = ... ,
    enumitem-keys =
    { labelsep = ... ,
      align = ... ,
      ...
    }
  }
}
\end{verbatim}

We detail these keys.

- The key \texttt{notes/para} requires the composition of the notes (at the end of the tabular) in a single paragraph.
  Initial value: \texttt{false}
  That key is also available within a given environment.

- The key \texttt{notes/bottomrule} adds a \texttt{\bottomrule} of booktabs after the notes. Of course, that rule is drawn only if there is really notes in the tabular. The package booktabs must have been loaded (before or after the package nicematrix). If it is not, an error is raised.
  Initial value: \texttt{false}
  That key is also available within a given environment.

- The key \texttt{notes/style} is a command whose argument is specified by \texttt{#1} and which gives the style of numerotation of the notes. That style will be used by \texttt{\ref} when referencing a tabular note marked with a command \texttt{\label}. The labels formatted by that style are used, separated by commas, when the user puts several consecutive commands \texttt{\tabularnote}. The marker \texttt{#1} is meant to be the name of a LaTeX counter.
  Initial value: \texttt{\textit{\alph{#1}}}
  Another possible value should be a mere \texttt{\arabic{#1}}
• The key `notes/label-in-tabular` is a command whose argument is specified by `#1` which is used when formatting the label of a note in the tabular. Internally, this number of note has already been formatted by `notes/style` before sent to that command.

  Initial value: `\textsuperscript{#1}`

  In French, it’s a tradition of putting a small space before the label of note. That tuning could be achieved by the following code:

  ```latex
  \NiceMatrixOptions{notes/label-in-tabular = \,\textsuperscript{#1}}
  ```

• The key `notes/label-in-list` is a command whose argument is specified by `#1` which is used when formatting the label in the list of notes at the end of the tabular. Internally, this number of note has already been formatted by `notes/style` before sent to that command.

  Initial value: `\textsuperscript{#1}`

  In French, the labels of notes are not composed in upper position when composing the notes. Such behaviour could be achieved by:

  ```latex
  \NiceMatrixOptions{notes/label-in-list = #1.\nobreak\hspace{0.25em}}
  ```

  The command `\nobreak` is for the event that the option `para` is used.

• The notes are composed at the end of the tabular by using internally a style of list of `enumitem`. This style of list is defined as follows (with, of course, keys of `enumitem`):

  ```latex
  noitemsep, lefthmargin = *, align = left, labelsep = Opt
  ```

  The specification `align = left` in that style requires a composition of the label leftwards in the box affected to that label. With that tuning, the notes are composed flush left, which is pleasant when composing tabulars in the spirit of `booktabs` (see for example the table 1, p. 33).

  The key `notes/enumitem-keys` specifies a list of pairs `key=value` (following the specifications of `enumitem`) to customize that style of list (it uses internally the command `\setlist*` of `enumitem`).

• The key `notes/enumitem-keys-para` is similar to the previous one but corresponds to the type of list used when the option `para` is in force. Of course, when the option `para` is used, a list of type `inline` (as called by `enumitem`) is used and the pairs `key=value` should correspond to such a list of type `inline`.

  Initially, the style of list is defined by: `afterlabel = \nobreak, itemjoin = \quad`

• The key `notes/code-before` is a token list inserted by `nicematrix` just before the composition of the notes at the end of the tabular.

  Initial value: `empty`

  For example, if one wishes to compose all the notes in gray and `\footnotesize`, he should use that key:

  ```latex
  \NiceMatrixOptions{notes/code-before = \footnotesize \color{gray}}
  ```

  It’s also possible to add `\raggedright` or `\RaggedRight` in that key (`\RaggedRight` is a command of `ragged2e`).

For an example of customisation of the tabular notes, see p. 47.

### 12.4 Use of `{NiceTabular}` with `threeparttable`

If you wish to use the environment `{NiceTabular}`, `{NiceTabular*}` `{NiceTabularX}` in an environment `{threeparttable}` of the eponymous package, you have to patch the environment `{threeparttable}` with the following code (with a version of LaTeX at least 2020/10/01).

```latex
\makeatletter
\AddToHook{env/threeparttable/begin}{\TPT@hookin{NiceTabular}\TPT@hookin{NiceTabular*}\TPT@hookin{NiceTabularX}}
\makeatother
```
13 Other features

13.1 Use of the column type S of siunitx

If the package siunitx is loaded (before or after nicematrix), it’s possible to use the S column type of siunitx in the environments of nicematrix. The implementation doesn’t use explicitly any private macro of siunitx.

\begin{pNiceArray}{ScWc{1cm}c}
\nullify-dots,first-row
\{C_1\} & \Cdots & \& C_n \\ 2.3 & 0 & \& 0 \\ 12.4 & \Vdots & \& \Vdots \\ 1.45 & \& \& \\ 7.2 & 0 & \& 0 \\
\end{pNiceArray}

On the other hand, the d columns of the package dcolumn are not supported by nicematrix.

13.2 Alignment option in \{NiceMatrix\}

The environments without preamble (\{NiceMatrix\}, \{pNiceMatrix\}, \{bNiceMatrix\}, etc.) provide two options \texttt{l} and \texttt{r} which generate all the columns aligned leftwards (or rightwards).

\begin{bNiceMatrix}[r]
\cos x & -\sin x \\
\sin x & \cos x
\end{bNiceMatrix}

13.3 The command \rotate

The package nicematrix provides a command \texttt{\rotate}. When used in the beginning of a cell, this command composes the contents of the cell after a rotation of 90° in the direct sens.

In the following command, we use that command in the code-for-first-row.\footnote{It can also be used in \texttt{\RowStyle} (cf. p. 18.)}

\NiceMatrixOptions%
{code-for-first-row = \scriptstyle \rotate \text{image of },}
{code-for-last-col = \scriptstyle }
\begin{pNiceMatrix}[first-row,last-col=4]
e_1 & e_2 & e_3 & \text{image of } e_1 \\
1 & 2 & 3 & e_1 \\
4 & 5 & 6 & e_2 \\
7 & 8 & 9 & e_3
\end{pNiceMatrix}

If the command \texttt{\rotate} is used in the “last row” (exterior to the matrix), the corresponding elements are aligned upwards as shown below.

\NiceMatrixOptions%
{code-for-last-row = \scriptstyle \rotate ,}
{code-for-last-col = \scriptstyle }
\begin{pNiceMatrix}[last-row=4,last-col=4]
e_1 & e_2 & e_3 & \text{image of } e_1 \\
1 & 2 & 3 & e_1 \\
4 & 5 & 6 & e_2 \\
7 & 8 & 9 & e_3
\end{pNiceMatrix}
13.4 The option small

With the option small, the environments of the package nicematrix are composed in a way similar to the environment \{smallmatrix\} of the package amsmath (and the environments \{psmallmatrix\}, \{bsmallmatrix\}, etc. of the package mathtools).

\[ \begin{bNiceArray}{cccc|c}
\small, last-col, 
code-for-last-col = \scriptscriptstyle, 
columns-width = 3mm \\
1 & -2 & 3 & 4 & 5 \\
0 & 3 & 2 & 1 & 2 & L_2 \gets 2 L_1 - L_2 \\
0 & 1 & 1 & 2 & 3 & L_3 \gets L_1 + L_3 \\
\end{bNiceArray} \]

One should note that the environment \{NiceMatrix\} with the option small is not composed exactly as the environment \{smallmatrix\}. Indeed, all the environments of nicematrix are constructed upon \{array\} (of the package array) whereas the environment \{smallmatrix\} is constructed directly with an \halign of TeX.

In fact, the option small corresponds to the following tuning:

- the cells of the array are composed with \scriptstyle;
- \arraystretch is set to 0.47;
- \arraycolsep is set to 1.45 pt;
- the characteristics of the dotted lines are also modified.

13.5 The counters iRow and jCol

In the cells of the array, it’s possible to use the LaTeX counters iRow and jCol which represent the number of the current row and the number of the current column\footnote{We recall that the exterior “first row” (if it exists) has the number 0 and that the exterior “first column” (if it exists) has also the number 0.}. Of course, the user must not change the value of these counters which are used internally by nicematrix.

In the \CodeBefore (cf. p. 14) and in the \CodeAfter (cf. p. 28), iRow represents the total number of rows (excepted the potential exterior rows) and jCol represents the total number of columns (excepted the potential exterior columns).

\[ \begin{pNiceMatrix}
\% don’t forget the %
\[ \begin{array}{cccc}
\alpha{jCol} & \beta & \gamma & \delta \\
\mathbf{\arabic{iRow}} & 1 & 2 & 3 \\
\mathbf{\arabic{iRow}} & 5 & 6 & 7 \\
\mathbf{\arabic{iRow}} & 9 & 10 & 11 \\
\end{array} \]
\end{pNiceMatrix} \]

If LaTeX counters called iRow and jCol are defined in the document by packages other than nicematrix (or by the final user), they are shadowed in the environments of nicematrix.
The package `nicematrix` also provides commands in order to compose automatically matrices from a general pattern. These commands are `\AutoNiceMatrix`, `\pAutoNiceMatrix`, `\bAutoNiceMatrix`, `\vAutoNiceMatrix`, `\VAutoNiceMatrix` and `\BAutoNiceMatrix`. These commands take in two mandatory arguments. The first is the format of the matrix, with the syntax \texttt{n-p} where \texttt{n} is the number of rows and \texttt{p} the number of columns. The second argument is the pattern (it’s a list of tokens which are inserted in each cell of the constructed matrix).

\[
C = \begin{pNiceMatrix}[3-3] C_{\arabic{iRow},\arabic{jCol}} \end{pNiceMatrix}
\]

\[
C = \begin{pmatrix}
C_{1,1} & C_{1,2} & C_{1,3} \\
C_{2,1} & C_{2,2} & C_{2,3} \\
C_{3,1} & C_{3,2} & C_{3,3}
\end{pmatrix}
\]

### 13.6 The option light-syntax

The option \texttt{light-syntax} (inspired by the package \texttt{spalign}) allows the user to compose the arrays with a lighter syntax, which gives a better legibility of the \TeX{} source. When this option is used, one should use the semicolon for the end of a row and spaces or tabulations to separate the columns. However, as usual in the \TeX{} world, the spaces after a control sequence are discarded and the elements between curly braces are considered as a whole.

\[
\begin{bNiceMatrix}[light-syntax,first-row,first-col]
{} & a & b \\
a & 2 \cos a & \{ \cos a + \cos b \} ; \\
b & \cos a + \cos b & \{ 2 \ \cos b \}
\end{bNiceMatrix}
\]

It’s possible to change the character used to mark the end of rows with the option \texttt{end-of-row}. As said before, the initial value is a semicolon.

When the option \texttt{light-syntax} is used, it is not possible to put verbatim material (for example with the command \texttt{\verb}) in the cells of the array.

### 13.7 Color of the delimiters

For the environments with delimiters (\texttt{pNiceArray}, \texttt{pNiceMatrix}, etc.), it’s possible to change the color of the delimiters with the key \texttt{delimiters/color}.

\[
\begin{bNiceMatrix}[delimiters/color=red]
\begin{array}{cc}
1 & 2 \\
3 & 4
\end{array}
\end{bNiceMatrix}
\]

This colour alos applies to the delimiters drawn by the command \texttt{\SubMatrix} (cf. p. 29).

### 13.8 The environment \texttt{NiceArrayWithDelims}

In fact, the environment \texttt{pNiceArray} and its variants are based upon a more general environment, called \texttt{NiceArrayWithDelims}. The first two mandatory arguments of this environment are the left and right delimiters used in the construction of the matrix. It’s possible to use \texttt{NiceArrayWithDelims} if we want to use atypical or asymetrical delimiters.

\[
\begin{NiceArrayWithDelims}[
\downarrow\uparrow
cccc][\text{margin}]
\begin{array}{ccc}
1 & 2 & 3 \\
4 & 5 & 6 \\
7 & 8 & 9
\end{array}
\end{NiceArrayWithDelims}
\]

---

43The reason is that, when the option \texttt{light-syntax} is used, the whole content of the environment is loaded as a \TeX{} argument to be analyzed. The environment doesn’t behave in that case as a standard environment of \LaTeX{} which only put \TeX{} commands before and after the content.
13.9 The command \OnlyMainNiceMatrix

The command \OnlyMainNiceMatrix executes its argument only when it is in the main part of the array, that is to say it is not in one of the exterior rows. If it is used outside an environment of nicematrix, that command is no-op.
For an example of utilisation, see tex.stackexchange.com/questions/488566

14 Use of Tikz with nicematrix

14.1 The nodes corresponding to the contents of the cells

The package nicematrix creates a PGF/Tikz node for each (non-empty) cell of the considered array. These nodes are used to draw the dotted lines between the cells of the matrix (inter alia).

Caution : By default, no node is created in a empty cell.
However, it’s possible to impose the creation of a node with the command \NotEmpty. 44

The nodes of a document must have distinct names. That’s why the names of the nodes created by nicematrix contains the number of the current environment. Indeed, the environments of nicematrix are numbered by a internal global counter.
In the environment with the number n, the node of the row i and column j has for name nm-n-i-j.
The command \NiceMatrixLastEnv provides the number of the last environment of nicematrix (for LaTeX, it’s a “fully expandable” command and not a counter).
However, it’s advisable to use instead the key name. This key gives a name to the current environment.
When the environment has a name, the nodes are accessible with the name “name-i-j” where name is the name given to the array and i and j the numbers of row and column. It’s possible to use these nodes with PGF but the final user will probably prefer to use Tikz (which is a convenient layer upon PGF). However, one should remind that nicematrix doesn’t load Tikz by default. In the following examples, we assume that Tikz has been loaded.

\begin{pNiceMatrix}[name=mymatrix]
\[1 & 2 & 3 \]
\[4 & 5 & 6 \]
\[7 & 8 & 9 \]
\end{pNiceMatrix}
\tikz[remember picture,overlay]
\draw (mymatrix-2-2) circle (2mm);
Don’t forget the options remember picture and overlay.

In the \CodeAfter, the things are easier : one must refer to the nodes with the form i-j (we don’t have to indicate the environment which is of course the current environment).

\begin{pNiceMatrix}
\[1 & 2 & 3 \]
\[4 & 5 & 6 \]
\[7 & 8 & 9 \]
\CodeAfter
\tikz \draw (2-2) circle (2mm);
\end{pNiceMatrix}

In the following example, we have underlined all the nodes of the matrix (we explain below the technic used : cf. p. 54).

---

44One should note that, with that command, the cell is considered as non-empty, which has consequences for the continuous dotted lines (cf. p. 23) and the computation of the “corners” (cf. p. 10).
The nodes of the last column (excepted the potential «last column» specified by last-col) may also be indicated by i-last. Similarly, the nodes of the last row may be indicated by last-j.

### 14.1.1 The columns V of varwidth

When the extension varwidth is loaded, the columns of the type V defined by varwidth are supported by nicematrix. It may be interessant to notice that, for a cell of a column of type V, the PGF/Tikz node created by nicematrix for the content of that cell has a width adjusted to the content of the cell. This is in contrast to the case of the columns of type p, m or b for which the nodes have always a width equal to the width of the column. In the following example, the command \lipsum is provided by the eponymous package.

\begin{NiceTabular}{V{10cm}}
\bfseries \large
Titre \\
\lipsum[1][1-4]
\CodeAfter
\tikz \draw [rounded corners] (1-1) -| (last-|2) -- (last-|1) |- (1-1) ;
\end{NiceTabular}

We have used the nodes corresponding to the position of the potential rules, which are described below (cf. p. 42).

### 14.2 The “medium nodes” and the “large nodes”

In fact, the package nicematrix can create “extra nodes”: the “medium nodes” and the “large nodes”. The first ones are created with the option create-medium-nodes and the second ones with the option create-large-nodes.45

These nodes are not used by nicematrix by default, and that’s why they are not created by default.

The names of the “medium nodes” are constructed by adding the suffix “-medium” to the names of the “normal nodes”. In the following example, we have underlined the “medium nodes”. We consider that this example is self-explanatory.

\[
\begin{pmatrix}
  a & a+b & a+b+c \\
  a & a & a+b \\
  a & a & a
\end{pmatrix}
\]

The names of the “large nodes” are constructed by adding the suffix “-large” to the names of the “normal nodes”. In the following example, we have underlined the “large nodes”. We consider that this example is self-explanatory.46

\[
\begin{pmatrix}
  a & a+b & a+b+c \\
  a & a & a+b \\
  a & a & a
\end{pmatrix}
\]

45There is also an option create-extra-nodes which is an alias for the conjunction of create-medium-nodes and create-large-nodes.
46There is no “large nodes” created in the exterior rows and columns (for these rows and columns, cf. p. 21).
The “large nodes” of the first column and last column may appear too small for some usage. That’s why it’s possible to use the options \texttt{left-margin} and \texttt{right-margin} to add space on both sides of the array and also space in the “large nodes” of the first column and last column. In the following example, we have used the options \texttt{left-margin} and \texttt{right-margin}.\footnote{The options \texttt{left-margin} and \texttt{right-margin} take dimensions as values but, if no value is given, the default value is used, which is \texttt{arraycolsep} (by default: 5 pt). There is also an option \texttt{margin} to fix both \texttt{left-margin} and \texttt{right-margin} to the same value.}

\[
\begin{array}{ccc}
\hline
a & a+b & a+b+c \\
a & a & a+b \\
a & a & a \\
\hline
\end{array}
\]

It’s also possible to add more space on both side of the array with the options \texttt{extra-left-margin} and \texttt{extra-right-margin}. These margins are not incorporated in the “large nodes”. It’s possible to fix both values with the option \texttt{extra-margin} and, in the following example, we use \texttt{extra-margin} with the value 3 pt.

\[
\begin{array}{ccc}
\hline
a & a+b & a+b+c \\
a & a & a+b \\
a & a & a \\
\hline
\end{array}
\]

\textbf{Be careful :} These nodes are reconstructed from the contents of the contents cells of the array. Usually, they do not correspond to the cells delimited by the rules (if we consider that these rules are drawn).

Here is an array composed with the following code:

\begin{verbatim}
\large
\begin{NiceTabular}{wl{2cm}ll}[hvlines]
\hline
fraise & amande & abricot \\
prune & pêche & poire \\
noix & noisette & brugnon \\
\hline
\end{NiceTabular}
\end{verbatim}

Here, we have colored all the cells of the array with \texttt{chessboardcolors}.

Here are the “large nodes” of this array (without use of \texttt{margin} nor \texttt{extra-margin}).

The nodes we have described are not available by default in the \texttt{CodeBefore} (described p. 14). It’s possible to have these nodes available in the \texttt{CodeBefore} by using the key \texttt{create-cell-nodes} of the keyword \texttt{CodeBefore} (in that case, the nodes are created first before the construction of the array by using informations written on the aux file and created a second time during the construction of the array itself).

Here is an example which uses these nodes in the \texttt{CodeAfter}.

\begin{verbatim}
\begin{NiceArray}{c@{}c@{}c@{}c@{}c}[create-medium-nodes]
\hline
u_1 & -& u_0 & =& r \\
u_2 & -& u_1 & =& r \\
\hline
\end{NiceArray}
\end{verbatim}
\[
\begin{align*}
u_3 - u_2 &= r \\
u_4 - u_3 &= r \\
\phantom{u_5} & \phantom{u_4} & \phantom{r} & \cdots \\
u_n - u_{n-1} &= r \\
\end{align*}
\]

\[u_n - u_0 = nr\]

14.3 The nodes which indicate the position of the rules

The package `nicematrix` creates a PGF/Tikz node merely called \textit{i} (with the classical prefix) at the intersection of the horizontal rule of number \textit{i} and the vertical rule of number \textit{i} (more specifically the potential position of those rules because maybe there are not actually drawn). The last node has also an alias called \textit{last}. There is also a node called \textit{i.5} midway between the node \textit{i} and the node \textit{i + 1}. These nodes are available in the `\CodeBefore` and the `\CodeAfter`.

```
\begin{NiceMatrix}
\CodeBefore
\tikz \draw [fill=red!15] (7-|4) |- (8-|5) |- (9-|6) |- cycle ;
\Body
1 \\
1 & 1 \\
1 & 2 & 1 \\
1 & 3 & 3 & 1 \\
1 & 4 & 6 & 4 & 1 \\
1 & 5 & 10 & 10 & 5 & 1 \\
1 & 6 & 15 & 20 & 15 & 6 & 1 \\
1 & 7 & 21 & 35 & 35 & 21 & 7 & 1 \\
1 & 8 & 28 & 56 & 70 & 56 & 28 & 8 & 1
\end{NiceMatrix}
```

If we use Tikz (we remind that `nicematrix` does not load Tikz by default, by only PGF, which is a sub-layer of Tikz), we can access, in the `\CodeAfter` but also in the `\CodeBefore`, to the intersection of the (potential) horizontal rule \textit{i} and the (potential) vertical rule \textit{j} with the syntax \textit{(i-|j)}.
The nodes of the form $i.5$ may be used, for example to cross a row of a matrix (if Tikz is loaded).

\begin{pNiceArray}{ccc|c}
  2 & 1 & 3 & 0 \\
\CodeAfter
  \tikz \draw [red] (3.5-|1) -- (3.5-|last) ;
\end{pNiceArray}

14.4 The nodes corresponding to the command \texttt{\SubMatrix}

The command \texttt{\SubMatrix} available in the \texttt{\CodeAfter} has been described p. 29.

If a command \texttt{\SubMatrix} has been used with the key \texttt{name} with an expression such as \texttt{name=MyName} three PGF/Tikz nodes are created with the names \texttt{MyName-left}, \texttt{MyName} and \texttt{MyName-right}.

The nodes \texttt{MyName-left} and \texttt{MyName-right} correspond to the delimiters left and right and the node \texttt{MyName} correspond to the submatrix itself.

In the following example, we have highlighted these nodes (the submatrix itself has been created with \texttt{\SubMatrix\{{2-2}{3-3}\}}).

\begin{verbatim}
121 23 345 345 \\
45 \{346 863 444 \}
3462 \{38458 \} 34 294
34 7 78 309
\end{verbatim}

15 API for the developpers

The package \texttt{nicematrix} provides two variables which are internal but public\textsuperscript{48}:

- \texttt{\g_nicematrix_code_before_tl}
- \texttt{\g_nicematrix_code_after_tl}

These variables contain the code of what we have called the “code-before” (usually specified at the beginning of the environment with the syntax using the keywords \texttt{\CodeBefore} and \texttt{\Body}) and the “code-after” (usually specified at the end of the environment after the keyword \texttt{\CodeAfter}). The developper can use them to add code from a cell of the array (the affectation must be global, allowing to exit the cell, which is a TeX group).

One should remark that the use of \texttt{\g_nicematrix_code_before_tl} needs one compilation more (because the instructions are written on the aux file to be used during the next run).

\textsuperscript{48}According to the LaTeX3 conventions, each variable with name beginning with \texttt{\g_nicematrix} or \texttt{\l_nicematrix} is public and each variable with name beginning with \texttt{\g__nicematrix} or \texttt{\l__nicematrix} is private.
Example: We want to write a command \crossbox to draw a cross in the current cell. This command will take in an optional argument between square brackets for a list of pairs key-value which will be given to Tikz before the drawing.
It’s possible to program such command \crossbox as follows, explicitly using the public variable \g_nicematrix_code_after_tl.

\ExplSyntaxOn
\cs_new_protected:Nn \__pantigny_crossbox:nnn
{\tikz \draw [ #3 ]
( #1 -| \int_eval:n { #2 + 1 } ) -- ( \int_eval:n { #1 + 1 } -| #2 )
( #1 -| #2 ) -- ( \int_eval:n { #1 + 1 } -| \int_eval:n { #2 + 1 } ) ;}
\NewDocumentCommand \crossbox { ! O { } }{\tl_gput_right:Nx \g_nicematrix_code_after_tl
{ \__pantigny_crossbox:nnn
{ \int_use:c { c@iRow } }
{ \int_use:c { c@jCol } }
{ \exp_not:n { #1 } }}}\ExplSyntaxOff

Here is an example of utilisation:
\begin{NiceTabular}{ccc}[hvlines]
merlan & requin & cabillaud \\
baleine & \crossbox[red] & morue \\
mante & raie & poule
\end{NiceTabular}

16 Technical remarks

16.1 Diagonal lines

By default, all the diagonal lines\textsuperscript{49} of a same array are “parallelized”. That means that the first diagonal line is drawn and, then, the other lines are drawn parallel to the first one (by rotation around the left-most extremity of the line). That’s why the position of the instructions \Ddots in the array can have a marked effect on the final result.

In the following examples, the first \Ddots instruction is written in color:

Example with parallelization (default):

\begin{pNiceMatrix}
\begin{pmatrix}
1 & \Cdots & \ & 1 \\
a+b & \Ddots & \ & \Vdots \\
\Vdots & \Ddots & \ & \\
a+b & \Cdots & a+b & 1
\end{pmatrix}
\end{pNiceMatrix}

\begin{pmatrix}
1 & & & 1 \\
a+b & \ & & \\
\ & a+b & \ldots & a+b & 1
\end{pmatrix}

\textsuperscript{49}We speak of the lines created by \Ddots and not the lines created by a command \line in the \CodeAfter.
\[ A = \begin{pNiceMatrix} 
1 & \Cdots & \multicolumn{2}{c}{1} \\ 
\rowcolor{lightgray} a+b & \multicolumn{2}{c}{\multicolumn{2}{c}{} \Vdots} \ 
\rowcolor{lightgray} \Vdots & \Ddots & \Ddots & \ 
\rowcolor{lightgray} a+b & \Cdots & a+b & 1 \end{pNiceMatrix} \]

It's possible to turn off the parallelization with the option `parallelize-diags` set to `false`:

\[
A = \begin{pmatrix}
1 & a+b \\
\vdots & \vdots \\
a+b & a+b \\
\end{pmatrix}
\]

The same example without parallelization:

\[
A = \begin{pmatrix}
1 & a+b \\
\vdots & \vdots \\
a+b & a+b & 1 \\
\end{pmatrix}
\]

It’s possible to specify the instruction \Ddots which will be drawn first (and which will be used to draw the other diagonal dotted lines when the parallelization is in force) with the key `draw-first`: \Ddots[draw-first].

### 16.2 The “empty” cells

An instruction like \Ldots, \Cdots, etc. tries to determine the first non-empty cell on both sides. When the key `corners` is used (cf. p. 10), `nicematrix` computes corners consisting of empty cells. However, an “empty cell” is not necessarily a cell with no TeX content (that is to say a cell with no token between the two ampersands \&). The precise rules are as follow.

- An implicit cell is empty. For example, in the following matrix:

  \[
  \begin{pmatrix}
  a & b \\
  c \\
  \end{pmatrix}
  \]

the last cell (second row and second column) is empty.

- Each cell whose TeX output has a width equal to zero is empty.

- A cell containing the command \NotEmpty is not empty (and a PGF/Tikz node) is created in that cell.

- A cell with a command \Hspace (or \Hspace*) is empty. This command \Hspace is a command defined by the package `nicematrix` with the same meaning as \hspace except that the cell where it is used is considered as empty. This command can be used to fix the width of some columns of the matrix without interfering with `nicematrix`.

- A cell of a column of type `p`, `m` or `t` is always considered as not empty. Caution: One should not rely upon that point because it may change in a future version of `nicematrix`. On the other side, a cell of a column of type `V` of `varwidth` (cf. p. 20) is empty when its TeX content has a width equal to zero.

### 16.3 The option `exterior-arraycolsep`

The environment `{array}` inserts an horizontal space equal to `{arraycolsep}` before and after each column. In particular, there is a space equal to `{arraycolsep}` before and after the array. This feature of the environment `{array}` was probably not a good idea\textsuperscript{50}. The environment `{matrix}`

\[50\] In the documentation of `{amsmath}`, we can read: The extra space of `{arraycolsep}` that `{array}` adds on each side is a waste so we remove it [in `{matrix}`] (perhaps we should instead remove it from `{array}` in general, but that’s a harder task).
of \texttt{amsmath} and its variants (\texttt{pmatrix}, \texttt{vmatrix}, etc.) of \texttt{amsmath} prefer to delete these spaces with explicit instructions \texttt{\hskip -arraycolsep}. The package \texttt{nicematrix} does the same in all its environments, \texttt{NiceArray} included. However, if the user wants the environment \texttt{NiceArray} behaving by default like the environment \texttt{array} of \texttt{array} (for example, when adapting an existing document) it’s possible to control this behaviour with the option \texttt{exterior-arraycolsep}, set by the command \texttt{\NiceMatrixOptions}. With this option, exterior spaces of length \texttt{arraycolsep} will be inserted in the environments \texttt{NiceArray} (the other environments of \texttt{nicematrix} are not affected).

### 16.4 Incompatibilities

The package \texttt{nicematrix} is not compatible with the class \texttt{ieeeaccess} (because that class is not compatible with PGF/Tikz).

In order to use \texttt{nicematrix} with the class \texttt{aastex631}, you have to add the following lines in the preamble of your document:

\begin{verbatim}
\BeforeBegin{NiceTabular}{\let\begin\BeginEnvironment\let\end\EndEnvironment}
\BeforeBegin{NiceArray}{\let\begin\BeginEnvironment}
\BeforeBegin{NiceMatrix}{\let\begin\BeginEnvironment}
\end{verbatim}

In order to use \texttt{nicematrix} with the class \texttt{sn-jnl}, \texttt{pgf} must be loaded before the \texttt{documentclass}:

\begin{verbatim}
\RequirePackage{pgf}
\documentclass{sn-jnl}
\end{verbatim}

The package \texttt{nicematrix} is not fully compatible with the package \texttt{arydshln} (because this package redefines many internal of \texttt{array}). By any means, in the context of \texttt{nicematrix}, it’s recommended to draw dashed rules with the tools provided by \texttt{nicematrix}, by creating a customized line style with \texttt{custom-line}: cf. p. 12.

### 17 Examples

#### 17.1 Utilisation of the key “tikz” of the command \texttt{Block}

The key \texttt{tikz} of the command \texttt{\Block} is available only when Tikz is loaded. For the following example, we need also the Tikz library \texttt{patterns}.

\begin{verbatim}
\usetikzlibrary{patterns}
\end{verbatim}

\begin{verbatim}
\begin{NiceTabular}{X[m]X[m]X[m]}[hvlines,cell-space-limits=3pt]
\Block[tikz={pattern=grid,pattern color=lightgray}]{}
{pattern = grid,\ pattern color = lightgray}
& \Block[tikz={pattern = north west lines,pattern color=blue}]{}
{pattern = north west lines,\ pattern color = blue}
& \Block[tikz={outer color = red!50, inner color=white }]{2-1}
{outer color = red!50,\ inner color = white } \\ 
\Block[tikz={pattern = sixpointed stars, pattern color = blue!15}]{}
{pattern = sixpointed stars,\ pattern color = blue!15}
\end{NiceTabular}
\end{verbatim}

---

51 And not by inserting @{} on both sides of the preamble of the array. As a consequence, the length of the \texttt{\hline} is not modified and may appear too long, in particular when using square brackets.

52 See \url{https://tex.stackexchange.com/questions/528975/error-loading-tikz-in-ieeeaccess-class}

53 By default, \texttt{nicematrix} only loads \texttt{pgf}, which is a sub-layer of Tikz.
17.2 Notes in the tabulars

The tools provided by nicematrix for the composition of the tabular notes have been presented in the section 12 p. 32.

Let’s consider that we wish to number the notes of a tabular with stars.\footnote{Of course, it’s realistic only when there is very few notes in the tabular.}

First, we write a command \texttt{\stars} similar the well-known commands \texttt{\arabic}, \texttt{\alph}, \texttt{\Alph}, etc. which produces a number of stars equal to its argument \footnote{In fact: the value of its argument.}

\begin{verbatim}
\ExplSyntaxOn
\NewDocumentCommand \stars { m } { \prg_replicate:nn { \value { #1 } } { $ \star $ } }
\ExplSyntaxOff
\end{verbatim}

Of course, we change the style of the labels with the key \texttt{notes/style}. However, it would be interesting to change also some parameters in the type of list used to compose the notes at the end of the tabular. First, we required a composition flush right for the labels with the setting \texttt{align=right}. Moreover, we want the labels to be composed on a width equal to the width of the widest label. The widest label is, of course, the label with the greatest number of stars. We know that number: it is equal to \texttt{\value{tabularnote}} (because \texttt{tabularnote} is the \LaTeX{} counter used by \texttt{\tabularnote} and, therefore, at the end of the tabular, its value is equal to the total number of tabular notes). We use the key \texttt{widest*} of \texttt{enumitem} in order to require a width equal to that value: \texttt{widest*=\value{tabularnote}}.

\begin{verbatim}
\NiceMatrixOptions
{ notes =
  { style = \stars{#1} ,
    enumitem-keys =
    { widest* = \value{tabularnote} ,
      align = right
    }
  }
}
\end{verbatim}

\NiceTabular{{}llr{}}
\toprule Last name & First name & Birth day \\
\midrule
Achard{\tabularnote}{Achard is an old family of the Poitou.} & Jacques & 5 juin 1962 \\
Lefebvre{\tabularnote}{The name Lefebvre is an alteration of the name Lefebure.} & Mathilde & 23 mai 1988 \\
\end{NiceTabular}
<table>
<thead>
<tr>
<th>Last name</th>
<th>First name</th>
<th>Birth day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achard</td>
<td>Jacques</td>
<td>June 5, 2005</td>
</tr>
<tr>
<td>Lefebvre</td>
<td>Mathilde</td>
<td>January 23, 1975</td>
</tr>
<tr>
<td>Vanesse</td>
<td>Stephany</td>
<td>October 30, 1994</td>
</tr>
<tr>
<td>Dupont</td>
<td>Chantal</td>
<td>January 15, 1998</td>
</tr>
</tbody>
</table>

* Achard is an old family of the Poitou.
** The name Lefebvre is an alteration of the name Lefebure.

### 17.3 Dotted lines

An example with the resultant of two polynomials:

\[ \begin{vNiceArray}{cccc:ccc}[columns-width=6mm]
\begin{array}{cccc:ccc}
& & & & & & \\
a_0 & & b_0 & & & & \\
a_1 & & b_1 & & & & \\
\vdots & & \vdots & & & & \\
a_p & & a_0 & & b_0 & & \\
& & & & & \vdots & \\
& & & & & a_1 & \\
& & & & & b_1 & & \\
& & & & & b_q & & \\
\end{array}
\end{vNiceArray} \]

An example for a linear system:

\[
\begin{pNiceArray}{*6c|c}[nullify-dots,last-col,code-for-last-col=\scriptstyle]
\begin{array}{cccccccc}
1 & 1 & 1 & \cdots & & 1 & 0 & 0 & \\ \\
0 & 1 & 0 & \cdots & & 0 & & L_2 \gets L_2-L_1 & \\ \\
0 & 0 & 1 & \cdots & & \vdots & & L_3 \gets L_3-L_1 & \\ \\
& & & \cdots & & & \vdots & \vdots & \vdots & \\ \\
0 & & & \cdots & & 0 & 1 & 0 & L_n \gets L_n-L_1 & \\
\end{array}
\end{pNiceArray}
\]
17.4 Dotted lines which are no longer dotted

The option `line-style` controls the style of the lines drawn by \Ldots, \Cdots, etc. Thus, it’s possible with these commands to draw lines which are not longer dotted.

\begin{pNiceMatrix}[last-row,last-col,nullify-dots,xdots/line-style={dashed,blue}]
1 & & & \Vdots & & & & \Vdots \\
& \Ddots[\textstyle\text{line-style=standard}] & \\
& & 1 \\
\Cdots[\text{color=blue,\text{line-style=dashed}}] & & & \blue 0 & \Cdots & & & \blue 1 & & & \Cdots & \blue \leftarrow i \\
& & & & 1 \\
& & &\Vdots & & \Ddots[\textstyle\text{line-style=standard}] & & \Vdots \\
& & & & & & 1 \\
\Cdots & & & \blue 1 & \Cdots & & \Cdots & \blue 0 & & & \Cdots & \blue \leftarrow j \\
& & & & & & & & & \Ddots[\textstyle\text{line-style=standard}] \\
& & & \Vdots & & & & \Vdots & & & 1 \\
& & & \blue \overset{\uparrow}{\text{i}} & & & & \blue \overset{\uparrow}{\text{j}} \\
\end{pNiceMatrix}

In fact, it’s even possible to draw solid lines with the commands \Cdots, \Vdots, etc.\footnote{In this document, the Tikz library arrows.meta has been loaded, which impacts the shape of the arrow tips.}

\begin{NiceMatrix}[first-row,first-col]
& & \Ldots[\text{line-style={solid,\leftrightarrow},\text{shorten=0pt}}]^n \text{\textsize columns} \& \\
& 1 & 1 & 1 & \Ldots & 1 \\
& 1 & 1 & 1 & \& 1 \\
\Vdots[\text{line-style={solid,\leftrightarrow}}]_{n \text{\textsize rows}} & 1 & 1 & 1 & \& 1 \\
& 1 & 1 & 1 & \& 1 \\
\end{NiceMatrix}
17.5 Dashed rules

In the following example, we use the command \Block to draw dashed rules. For that example, Tikz should be loaded (by \usepackage{tikz}).

\begin{pNiceMatrix}
\Block[borders=bottom,right,tikz=dashed]{2-2}{}
1 & 2 & 0 & 0 & 0 & 0 \\
4 & 5 & 0 & 0 & 0 & 0 \\
0 & 0 & \Block[borders=bottom,top,right,left,tikz=dashed]{}{2-2}{}
7 & 1 & 0 & 0 & 0 \\
0 & 0 & -1 & 2 & 0 & 0 \\
0 & 0 & 0 & k & 0 & \Block[borders=left,top,tikz=dashed]{}{2-2}{}
3 & 4 \\
0 & 0 & 0 & k & 0 & 1 & 4
\end{pNiceMatrix}

17.6 Stacks of matrices

We often need to compose mathematical matrices on top on each other (for example for the resolution of linear systems).

In order to have the columns aligned one above the other, it’s possible to fix a width for all the columns. That’s what is done in the following example with the environment \NiceMatrixBlock and its option auto-columns-width.

\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
{light-syntax,}
\setlength{\extrarowheight}{1mm}
\begin{NiceArray}{rrrr|rrr}
12 & -8 & 7 & 5 & 3 & 1 & 2 \\
3 & -18 & 12 & 1 & 4 & 5 & 6 \\
-3 & -46 & 29 & -2 & -15 & 7 & 8 \\
9 & 10 & -5 & 4 & 7 & 8 & 9
\end{NiceArray}
\end{NiceMatrixBlock}
\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
\{ \\
\hspace{-3.5pt} \begin{pNiceArray}{rrrr|r} \\
12 & -8 & 7 & 5 & 3 ; \\
0 & 64 & -41 & 1 & 19 \{ L_2 \gets L_1-4L_2 \}; \\
0 & -192 & 123 & -3 & -57 \{ L_3 \gets L_1+4L_3 \}; \\
0 & -64 & 41 & -1 & -19 \{ L_4 \gets 3L_1-4L_4 \}; \\
\end{pNiceArray} \\
\end{NiceMatrixBlock}

\setlength{\extrarowheight}{1mm}

However, one can see that the last matrix is not perfectly aligned with others. That's why, in LaTeX, the parenthesis have not exactly the same width (smaller parenthesis are a bit slimer).

In order to solve that problem, it's possible to require the delimiters to be composed with the maximal width, thanks to the boolean key \texttt{delimiters/max-width}.

\begin{NiceMatrixBlock}[auto-columns-width] 
\NiceMatrixOptions \\
\{ \\
\hspace{-3.5pt} \begin{pNiceArray}{rrrr|r} \\
12 & -8 & 7 & 5 & 3 ; \\
0 & 64 & -41 & 1 & 19 ; \\
0 & 0 & 0 & 0 \{ L_3 \gets 3L_2 + L_3 \} ; \\
\end{pNiceArray} \\
\end{NiceMatrixBlock}

\begin{NiceMatrixBlock}[auto-columns-width]
\NiceMatrixOptions
\{ \\
\hspace{-3.5pt} \begin{pNiceArray}{rrrr|r} \\
12 & -8 & 7 & 5 & 3 ; \\
0 & 64 & -41 & 1 & 19 ; \\
\end{pNiceArray} \\
\end{NiceMatrixBlock}
\end{pNiceArray}

\begin{NiceMatrix}
\begin{align*}
&\begin{pmatrix}
12 & -8 & 7 & 5 & 3 \\
3 & -18 & 12 & 1 & 4 \\
-3 & -46 & 29 & -2 & -15 \\
9 & 10 & -5 & 4 & 7 \\
\end{pmatrix} \\
&\begin{pmatrix}
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
0 & -192 & 123 & -3 & -57 \\
0 & -64 & 41 & -1 & -19 \\
\end{pmatrix}
\quad L_2 \gets L_1 - 4L_2 \\
&\begin{pmatrix}
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
0 & 0 & 0 & 0 & 0 \\
\end{pmatrix}
\quad L_3 \gets L_1 + 4L_3 \\
&\begin{pmatrix}
12 & -8 & 7 & 5 & 3 \\
0 & 64 & -41 & 1 & 19 \\
0 & 0 & 0 & 0 & 0 \\
\end{pmatrix}
\quad L_4 \gets 3L_1 - 4L_4
\end{align*}
\end{NiceMatrix}

If you wish an alignment of the different matrices without the same width for all the columns, you can construct a unique array and place the parenthesis with commands \SubMatrix in the \CodeAfter. Of course, that array can’t be broken by a page break.

\setlength{\extrarowheight}{1mm}
\begin{NiceMatrix}[ r, last-col=6, code-for-last-col = \scriptstyle \color{blue} ]
12 & -8 & 7 & 5 & 3 \\
3 & -18 & 12 & 1 & 4 & \\
-3 & -46 & 29 & -2 & -15 & \\
9 & 10 & -5 & 4 & 7 & \\
\end{NiceMatrix}
\CodeAfter [sub-matrix/vlines=4]
\SubMatrix({1-1}{4-5})
\SubMatrix({5-1}{8-5})
\SubMatrix({9-1}{11-5})
\SubMatrix({12-1}{13-5})
\end{NiceMatrix}
\begin{NiceArray}{rrrr}
& 12 & -8 & 7 & 5 \cr & 3 & -18 & 12 & 1 \cr & -3 & 46 & 29 & -2 \cr & 9 & 10 & -5 & 4 \cr & 12 & -8 & 7 & 5 \cr & 0 & 64 & -41 & 1 \cr & 0 & -192 & 123 & -3 \cr & 0 & -64 & 41 & -1 \cr & 12 & -8 & 7 & 5 \cr & 0 & 64 & -41 & 1 \cr \end{NiceArray}

\begin{array}{c}
L_2 \gets L_1 - 4L_2 \\
L_3 \gets L_1 + 4L_3 \\
L_4 \gets 3L_1 - 4L_4 \\
L_3 \gets 3L_2 + L_3 \\
\end{array}

In this tabular, the instructions \texttt{\SubMatrix} are executed after the composition of the tabular and, thus, the vertical rules are drawn without adding space between the columns.

In fact, it’s possible, with the key \texttt{vlines-in-sub-matrix}, to choice a letter in the preamble of the array to specify vertical rules which will be drawn in the \texttt{\SubMatrix} only (by adding space between the columns).

\setlength{\extrarowheight}{1mm}
\begin{NiceArray}{rrrr}
& 12 & -8 & 7 & 5 \cr & 3 & -18 & 12 & 1 \cr & -3 & 46 & 29 & -2 \cr & 9 & 10 & -5 & 4 \cr & 12 & -8 & 7 & 5 \cr & 0 & 64 & -41 & 1 \cr & 0 & -192 & 123 & -3 \cr & 0 & -64 & 41 & -1 \cr & 12 & -8 & 7 & 5 \cr & 0 & 64 & -41 & 1 \cr \end{NiceArray}

\texttt{\SubMatrix(1-1){4-5}}
\texttt{\SubMatrix(5-1){8-5}}
\texttt{\SubMatrix(9-1){11-5}}
\texttt{\SubMatrix(12-1){13-5}}
\end{NiceArray}
17.7 How to highlight cells of a matrix

In order to highlight a cell of a matrix, it’s possible to “draw” that cell with the key draw of the command \Block (this is one of the uses of a mono-cell block\(^{57}\)).

\[
\begin{pNiceArray}{>{\strut}cccc}
[margin,rules/color=blue]
\Block[draw]{}{a_{11}} & a_{12} & a_{13} & a_{14} \\
a_{21} & \Block[draw]{}{a_{22}} & a_{23} & a_{24} \\
a_{31} & a_{32} & \Block[draw]{}{a_{33}} & a_{34} \\
a_{41} & a_{42} & a_{43} & \Block[draw]{}{a_{44}} \\
\end{pNiceArray}
\]

We should remark that the rules we have drawn are drawn after the construction of the array and thus, they don’t spread the cells of the array. We recall that, on the other side, the commands \hline and \Hline, the specifier “|” and the options hlines, vlines, hvlines and hvlines-except-borders spread the cells.\(^{58}\)

It’s possible to color a row with \rowcolor in the code-before (or with \rowcolor in the first cell of the row if the key colortbl-like is used—even when colortbl is not loaded).

\[
\begin{pNiceArray}{>{\strut}cccc}
[margin, extra-margin=2pt,colortbl-like]
\rowcolor{red!15}A_{11} & A_{12} & A_{13} & A_{14} \\
A_{21} & \rowcolor{red!15}A_{22} & A_{23} & A_{24} \\
A_{31} & A_{32} & \rowcolor{red!15}A_{33} & A_{34} \\
A_{41} & A_{42} & A_{43} & \rowcolor{red!15}A_{44}
\end{pNiceArray}
\]

\(^{57}\)We recall that, if the first mandatory argument of the command \Block is left empty, that means that the block is a mono-cell block.

\(^{58}\)For the command \cline, see the remark p. 8.
However, it’s not possible to do a fine tuning. That’s why we describe now a method to highlight a row of the matrix.

That example and the following ones require Tikz (by default, \texttt{nicematrix} only loads PGF, which is a sub-layer of Tikz) and the Tikz library \texttt{fit}. The following lines in the preamble of your document do the job:

\begin{verbatim}
\usepackage{tikz}
\usetikzlibrary{fit}
\end{verbatim}

We create a rectangular Tikz node which encompasses the nodes of the second row by using the tools of the Tikz library \texttt{fit}. Those nodes are not available by default in the \texttt{CodeBefore} (for efficiency). We have to require their creation with the key \texttt{create-cell-nodes} of the keyword \texttt{CodeBefore}.

\begin{verbatim}
\tikzset{highlight/.style={rectangle,
               fill=red!15,
               rounded corners = 0.5 mm,
               inner sep=1pt,
               fit=#1}}
\end{verbatim}

\begin{NiceMatrix}
[create-cell-nodes]
\CodeBefore
\tikz 
\node [highlight = (2-1) (2-3)] {} ;
\Body
0 & \Cdots & 0 \\
1 & \Cdots & 1 \\
0 & \Cdots & 0 \\
\endNiceMatrix

We consider now the following matrix. If we want to highlight each row of this matrix, we can use the previous technique three times.

\begin{verbatim}
\begin{NiceArray}{ccc}[last-col]
\CodeBefore [create-cell-nodes]
\begin{tikzpicture}
\node [highlight = (1-1) (1-3)] {} ;
\node [highlight = (2-1) (2-3)] {} ;
\node [highlight = (3-1) (3-3)] {} ;
\end{tikzpicture}
\Body
a & a + b & a + b + c & L_1 \\
a & a & a + b & L_2 \\
a & a & a & L_3 \\
\endNiceArray
\end{verbatim}

\begin{verbatim}
\begin{NiceArray}{ccc}[last-col]
\CodeBefore [create-cell-nodes]
\begin{tikzpicture}
\node [highlight = (1-1) (1-3)] {} ;
\node [highlight = (2-1) (2-3)] {} ;
\node [highlight = (3-1) (3-3)] {} ;
\end{tikzpicture}
\Body
a & a + b & a + b + c & L_1 \\
a & a & a + b & L_2 \\
a & a & a & L_3 \\
\endNiceArray
\end{verbatim}

\begin{verbatim}
\begin{NiceArray}{ccc}[last-col]
\CodeBefore [create-cell-nodes]
\begin{tikzpicture}
\node [highlight = (1-1) (1-3)] {} ;
\node [highlight = (2-1) (2-3)] {} ;
\node [highlight = (3-1) (3-3)] {} ;
\end{tikzpicture}
\Body
a & a + b & a + b + c & L_1 \\
a & a & a + b & L_2 \\
a & a & a & L_3 \\
\endNiceArray
\end{verbatim}

\end{verbatim}
The result may seem disappointing. We can improve it by using the “medium nodes” instead of the “normal nodes”.

```latex
\begin{pNiceArray}{ccc}
& & L_1 \\
& a + b & a + b + c \\
& a & a + b \\
L_2 & a & a \\
L_3 & a & a \\
\end{pNiceArray}
```

17.8 **Utilisation of SubMatrix in the CodeBefore**

In the following example, we illustrate the mathematical product of two matrices. The whole figure is an environment `{NiceArray}` and the three pairs of parenthesis have been added with `\SubMatrix` in the `CodeBefore`.

![Mathematical product of two matrices](image)
18 Implementation

By default, the package `nicematrix` doesn’t patch any existing code.

However, when the option `renew-dots` is used, the commands \cdots, \ldots, \dots, \vdots, \ddots and \iddots are redefined in the environments provided by `nicematrix` as explained previously. In the same way, if the option `renew-matrix` is used, the environment \{matrix\} of amsmath is redefined.

On the other hand, the environment \{array\} is never redefined.

Of course, the package `nicematrix` uses the features of the package `array`. It tries to be independent of its implementation. Unfortunately, it was not possible to be strictly independent. For example, the package `nicematrix` relies upon the fact that the package \{array\} uses \ialign to begin the \halign.

Declaration of the package and packages loaded

The prefix `nicematrix` has been registered for this package.

See: http://mirrors.ctan.org/macros/latex/contrib/l3kernel/l3prefixes.pdf
<@@=nicematrix>

First, we load `pgfcore` and the module `shapes`. We do so because it’s not possible to use `\usepgfmodule` in `\ExplSyntaxOn`.

1. `\RequirePackage{pgfcore}`
2. `\usepgfmodule{shapes}`

We give the traditional declaration of a package written with the L3 programming layer.

1. `\ RequirePackage{13keys2e}`
2. `\ProvidesExp1Package{nicematrix}
3. \{nicematrix\}
4. \{\myfiledate\}
5. \{\myfileversion\}
6. \{Enhanced arrays with the help of PGF/TikZ\}

The command for the treatment of the options of `\usepackage` is at the end of this package for technical reasons.
We load some packages. The package xparse is still loaded for use on Overleaf. However, since oct. 2021, Overleaf uses TeXLive 2021 and we will be able to delete that row.

\RequirePackage{xparse}
\RequirePackage{array}
\RequirePackage{amsmath}
\cs_new_protected:Npn \@@_error:n { \msg_error:n { nicematrix } }
\cs_new_protected:Npn \@@_error:nn { \msg_error:n { nicematrix } }
\cs_new_protected:Npn \@@_error:nnn { \msg_error:nnn { nicematrix } }
\cs_new_protected:Npn \@@_fatal:n { \msg_fatal:n { nicematrix } }
\cs_new_protected:Npn \@@_fatal:nn { \msg_fatal:nnn { nicematrix } }
\cs_new_protected:Npn \@@_msg_new:nn { \msg_new:nnn { nicematrix } }
\cs_new_protected:Npn \@@_msg_new:nnn { \msg_new:nnnn { nicematrix } }
\cs_new_protected:Npn \@@_msg_redirect_name:nn { \msg_redirect_name:nnn { nicematrix } }
\bool_new:N \c_@@_arydshln_loaded_bool
\bool_new:N \c_@@_booktabs_loaded_bool
\bool_new:N \c_@@_enumitem_loaded_bool
\bool_new:N \c_@@_tabularx_loaded_bool
\bool_new:N \c_@@_tikz_loaded_bool
\bool_new:N \c_@@_varwidth_loaded_bool
\hook_gput_code:nnn { begindocument } { . }
\@ifpackageloaded { varwidth } { \bool_set_true:N \c_@@_varwidth_loaded_bool } { }
\@ifpackageloaded { arydshln } { \bool_set_true:N \c_@@_arydshln_loaded_bool } { }
\@ifpackageloaded { booktabs } { \bool_set_true:N \c_@@_booktabs_loaded_bool } { }
\@ifpackageloaded { enumitem } { \bool_set_true:N \c_@@_enumitem_loaded_bool } { }
\@ifpackageloaded { tabularx } { \bool_set_true:N \c_@@_tabularx_loaded_bool } { }
\@ifpackageloaded { tikz } { }

In some constructions, we will have to use a \texttt{pgfpicture} which \emph{must} be replaced by a \texttt{tikzpicture} if Tikz is loaded. However, this switch between \texttt{pgfpicture} and \texttt{tikzpicture} can’t be done dynamically with a conditional because, when the Tikz library \texttt{external} is loaded by the user, the pair \texttt{\begin{tikzpicture}-\end{tikzpicture}} must be statically “visible” (even when externalization is not activated).

That’s why we create \texttt{\c_@@_pgfortikzpicture_tl} and \texttt{\c_@@_endpgfortikzpicture_tl} which will be used to construct in a \texttt{\AtBeginDocument} the correct version of some commands. The tokens \texttt{\exp_not:N} are mandatory.

\bool_set_true:N \c_@@_tikz_loaded_bool
\tl_const:Nn \c_@@_pgfortikzpicture_tl { \exp_not:N \tikzpicture }
\tl_const:Nn \c_@@_endpgfortikzpicture_tl { \exp_not:N \endtikzpicture }
\tl_const:Nn \c_@@_pgfortikzpicture_tl { \exp_not:N \pgfpicture }
\tl_const:Nn \c_@@_endpgfortikzpicture_tl { \exp_not:N \endpgfpicture }
We test whether the current class is \texttt{revtex4-1} (deprecated) or \texttt{revtex4-2} because these classes redefine \texttt{array} (of \texttt{array}) in a way incompatible with our programmation. At the date January 2021, the current version \texttt{revtex4-2} is 4.2e (compatible with \texttt{booktabs}).

```latex
\bool_new:N \c_@@_revtex_bool
@ifclassloaded { revtex4-1 }
{ \bool_set_true:N \c_@@_revtex_bool }
{ }
@ifclassloaded { revtex4-2 }
{ \bool_set_true:N \c_@@_revtex_bool }
{ }
```

Maybe one of the previous classes will be loaded inside another class... We try to detect that situation.

\cs_if_exist:NT \rvtx@ifformat@geq { \bool_set_true:N \c_@@_revtex_bool }
\cs_generate_variant:Nn \tl_if_single_token_p:n { V }

The following regex will be used to modify the preamble of the array when the key \texttt{colortbl-like} is used.

\regex_const:Nn \c_@@_columncolor_regex { \c { columncolor } }

If the final user uses \texttt{nicematrix}, PGF/Tikz will write instruction \texttt{\pgfsyspdfmark} in the aux file. If he changes its mind and no longer loads \texttt{nicematrix}, an error may occur at the next compilation because of remanent instructions \texttt{\pgfsyspdfmark} in the aux file. With the following code, we try to avoid that situation.

\cs_new_protected:Npn \@@_provide_pgfsyspdfmark:
{ \iow_now:Nn \@mainaux
  { \ExplSyntaxOn
    \cs_if_free:NT \pgfsyspdfmark
    { \cs_set_eq:NN \pgfsyspdfmark \@gobblethree }
    \ExplSyntaxOff
  }
  \cs_gset_eq:NN \@@_provide_pgfsyspdfmark: \prg_do_nothing:
}

We define a command \texttt{\iddots} similar to \texttt{\ddots} (\ldots{} but with dots going forward (\ldots{}). We use \texttt{\ProvidesDocumentCommand} and so, if the command \texttt{\iddots} has already been defined (for example by the package \texttt{mathdots}), we don’t define it again.

\ProvideDocumentCommand \iddots { }
{ \mathinner
  \{ \tex_mkern:D 1 mu \box_move_up:nn { 1 pt } \{ \hbox:n \{ . \} } \tex_mkern:D 2 mu \box_move_up:nn { 4 pt } \{ \hbox:n \{ . \} } \tex_mkern:D 2 mu \box_move_up:nn { 7 pt } \{ \vbox:n \{ \kern 7 pt \hbox:n \{ . \} } \tex_mkern:D 1 mu \}
}

This definition is a variant of the standard definition of \texttt{\ddots}.

In the aux file, we will have the references of the PGF/Tikz nodes created by \texttt{nicematrix}. However, when \texttt{booktabs} is used, some nodes (more precisely, some \texttt{row} nodes) will be defined twice because
their position will be modified. In order to avoid an error message in this case, we will redefine \pfgutil@check@rerun in the aux file.

\begin{Verbatim}
\@ifpackageloaded { booktabs }
\{ \iof_now:Nn \@mainaux \nicematrix@redefine@check@rerun \}
\}
\cs_set_protected:Npn \nicematrix@redefine@check@rerun
\{ \cs_set_eq:NN \@@_old_pgfutil@check@rerun \pgfutil@check@rerun
\}
\cs_set_protected:Npn \pgfutil@check@rerun ##1 ##2
\{ \str_if_eq:eeF { nm- } { \tl_range:nnn { ##1 } 1 3 } \}
\{ \@@_old_pgfutil@check@rerun { ##1 } { ##2 } \}
\}
\end{Verbatim}

The new version of \pfgutil@check@rerun will not check the PGF nodes whose names start with \texttt{nm-} (which is the prefix for the nodes created by \nicematrix).

\begin{Verbatim}
\hook_gput_code:nnn { begindocument } { . }
\{ \iof_now:Nn \@mainaux \nicematrix@redefine@check@rerun \}
\}
\cs_set_protected:Npn \nicematrix@redefine@check@rerun
\{ \cs_set_eq:NN \@@_old_pgfutil@check@rerun \pgfutil@check@rerun
\}
\cs_set_protected:Npn \pgfutil@check@rerun ##1 ##2
\{ \str_if_eq:eeF { nm- } { \tl_range:nnn { ##1 } 1 3 } \}
\{ \@@_old_pgfutil@check@rerun { ##1 } { ##2 } \}
\}
\end{Verbatim}

We have to know whether \texttt{colortbl} is loaded in particular for the redefinition of \texttt{everycr}.

\begin{Verbatim}
\bool_new:N \c_@@_colortbl_loaded_bool
\hook_gput_code:nnn { begindocument } { . }
\{ \iofpackageloaded { colortbl }
\{ \bool_set_true:N \c_@@_colortbl_loaded_bool \}
\}
\cs_set_protected:Npn \CT@arc@ { }
\cs_set:Npn \arrayrulecolor #1 # { \CT@arc { #1 } }
\cs_set:Npn \CT@arc #1 #2
\{ \dim_compare:nNnT \baselineskip = \c_zero_dim \noalign
\{ \cs_gset:Npn \CT@arc@ { \color #1 { #2 } } \}
\}
\end{Verbatim}

\texttt{Idem for CT\texttt{drs\texttt{}}.}

\begin{Verbatim}
\cs_set:Npn \doublerulesepcolor #1 # { \CT@drs { #1 } }
\cs_set:Npn \CT@drs #1 #2
\{ \dim_compare:nNnT \baselineskip = \c_zero_dim \noalign
\{ \cs_gset:Npn \CT@drsc@ { \color #1 { #2 } } \}
\}
\cs_set:Npn \hline
\{ \noalign { \ifnum 0 = `} \fi \}
\cs_set_eq:NN \hskip \vskip
\cs_set_eq:NN \vrule \hrule
\cs_set_eq:NN \@width \@height
\futurelet \reserved@a \futurelet \reserved@b \futurelet \reserved@c
\futurelet \reserved@d \futurelet \reserved@e
\futurelet \reserved@f \futurelet \reserved@g
\futurelet \reserved@h \futurelet \reserved@i
\futurelet \reserved@j \futurelet \reserved@k
\futurelet \reserved@l \futurelet \reserved@m
\futurelet \reserved@n \futurelet \reserved@o
\futurelet \reserved@p \futurelet \reserved@q
\futurelet \reserved@r \futurelet \reserved@s
\futurelet \reserved@t \futurelet \reserved@u
\futurelet \reserved@v \futurelet \reserved@w
\futurelet \reserved@x \futurelet \reserved@y
\futurelet \reserved@z
\}
\end{Verbatim}

We have to redefine \texttt{cline} for several reasons. The command \texttt{@@\_cline} will be linked to \texttt{cline} in the beginning of \texttt{NiceArrayWithDelims}. The following commands must \texttt{not} be protected.

\begin{Verbatim}
\cs_set:Npn \@@_standard_cline #1 { \@@_standard_cline:w #1 \q_stop }
\cs_set:Npn \@@_standard_cline:w #1-#2 \q_stop
\}
\end{Verbatim}
Our \everycr has been modified. In particular, the creation of the row node is in the \everycr (maybe we should put it with the incrementation of \c@iRow). Since the following \cr correspond to a “false row”, we have to nullify \everycr.
\everycr { }
\cr
\noalign { \skip_vertical:N -\arrayrulewidth }
}

The following version of \cline spreads the array of a quantity equal to \arrayrulewidth as does \hline. It will be loaded excepted if the key standard-cline has been used.
\cs_set:Npn \@@_cline
We have to act in a fully expandable way since there may be \noalign (in the \multispan) to detect. That’s why we use \@@_cline_i:en.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
The command \cline_i:nn has two arguments. The first is the number of the current column (it must be used in that column). The second is a standard argument of \cline of the form i-j or the form i.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
Now, #1 is the number of the current column and we have to draw a line from the column #2 to the column #3 (both included).
\int_compare:nNnT { #1 } < { #2 }
\multispan { \int_eval:n { #2 - #1 } } &
\multispan { \int_eval:n { #3 - #2 + 1 } }
\CT@arc@
\leaders \hrule \@height \arrayrulewidth \hfill
\skip_horizontal:N \c_zero_dim
}

You look whether there is another \cline to draw (the final user may put several \cline).
\peek_meaning_remove_ignore_spaces:NTF \cline
{ & \@@_cline_i:en \int_eval:n { #3 + 1 } }
\everycr { } \cr
}
\cs_generate_variant:Nn \@@_cline_i:nn { e n }

The following command is a small shortcut.
\cs_new:Npn \@@_math_toggle_token:
\int_compare:nNnT \l_@@_first_col_int = 0 { \omit & }
\int_compare:nNnT { #1 } > 1 { \multispan { \int_eval:n { #1 - 1 } } } &
\multispan { \int_eval:n { #2 - #1 + 1 } }
{ }
\CT@arc@
\leaders \hrule \@height \arrayrulewidth \hfill
The following \skip_horizontal:N \c_zero_dim is to prevent a potential \unskip to delete the \leaders\59
\skip_horizontal:N \c_zero_dim
}

The following version of \cline spreads the array of a quantity equal to \arrayrulewidth as does \hline. It will be loaded excepted if the key standard-cline has been used.
\cs_set:Npn \@@_cline
We have to act in a fully expandable way since there may be \noalign (in the \multispan) to detect. That’s why we use \@@_cline_i:en.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
The command \cline_i:nn has two arguments. The first is the number of the current column (it must be used in that column). The second is a standard argument of \cline of the form i-j or the form i.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
Now, #1 is the number of the current column and we have to draw a line from the column #2 to the column #3 (both included).
\int_compare:nNnT { #1 } < { #2 }
\multispan { \int_eval:n { #2 - #1 } } &
\multispan { \int_eval:n { #3 - #2 + 1 } }
\CT@arc@
\leaders \hrule \@height \arrayrulewidth \hfill
\skip_horizontal:N \c_zero_dim
}

You look whether there is another \cline to draw (the final user may put several \cline).
\peek_meaning_remove_ignore_spaces:NTF \cline
{ & \@@_cline_i:en \int_eval:n { #3 + 1 } }
\everycr { } \cr
}
\cs_generate_variant:Nn \@@_cline_i:nn { e n }

The following command is a small shortcut.
\cs_new:Npn \@@_math_toggle_token:
\int_compare:nNnT \l_@@_first_col_int = 0 { \omit & }
\int_compare:nNnT { #1 } > 1 { \multispan { \int_eval:n { #1 - 1 } } } &
\multispan { \int_eval:n { #2 - #1 + 1 } }
{ }
\CT@arc@
\leaders \hrule \@height \arrayrulewidth \hfill
The following \skip_horizontal:N \c_zero_dim is to prevent a potential \unskip to delete the \leaders\59
\skip_horizontal:N \c_zero_dim
}

Our \everycr has been modified. In particular, the creation of the row node is in the \everycr (maybe we should put it with the incrementation of \c@iRow). Since the following \cr correspond to a “false row”, we have to nullify \everycr.
\everycr { }
\cr
\noalign { \skip_vertical:N -\arrayrulewidth }
}

The following version of \cline spreads the array of a quantity equal to \arrayrulewidth as does \hline. It will be loaded excepted if the key standard-cline has been used.
\cs_set:Npn \@@_cline
We have to act in a fully expandable way since there may be \noalign (in the \multispan) to detect. That’s why we use \@@_cline_i:en.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
The command \cline_i:nn has two arguments. The first is the number of the current column (it must be used in that column). The second is a standard argument of \cline of the form i-j or the form i.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
Now, #1 is the number of the current column and we have to draw a line from the column #2 to the column #3 (both included).
\int_compare:nNnT { #1 } < { #2 }
\multispan { \int_eval:n { #2 - #1 } } &
\multispan { \int_eval:n { #3 - #2 + 1 } }
\CT@arc@
\leaders \hrule \@height \arrayrulewidth \hfill
\skip_horizontal:N \c_zero_dim
}

You look whether there is another \cline to draw (the final user may put several \cline).
\peek_meaning_remove_ignore_spaces:NTF \cline
{ & \@@_cline_i:en \int_eval:n { #3 + 1 } }
\everycr { } \cr
}
\cs_generate_variant:Nn \@@_cline_i:nn { e n }

The following command is a small shortcut.
\cs_new:Npn \@@_math_toggle_token:
\int_compare:nNnT \l_@@_first_col_int = 0 { \omit & }
\int_compare:nNnT { #1 } > 1 { \multispan { \int_eval:n { #1 - 1 } } } &
\multispan { \int_eval:n { #2 - #1 + 1 } }
{ }
\CT@arc@
\leaders \hrule \@height \arrayrulewidth \hfill
The following \skip_horizontal:N \c_zero_dim is to prevent a potential \unskip to delete the \leaders\59
\skip_horizontal:N \c_zero_dim
}

Our \everycr has been modified. In particular, the creation of the row node is in the \everycr (maybe we should put it with the incrementation of \c@iRow). Since the following \cr correspond to a “false row”, we have to nullify \everycr.
\everycr { }
\cr
\noalign { \skip_vertical:N -\arrayrulewidth }
}

The following version of \cline spreads the array of a quantity equal to \arrayrulewidth as does \hline. It will be loaded excepted if the key standard-cline has been used.
\cs_set:Npn \@@_cline
We have to act in a fully expandable way since there may be \noalign (in the \multispan) to detect. That’s why we use \@@_cline_i:en.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
The command \cline_i:nn has two arguments. The first is the number of the current column (it must be used in that column). The second is a standard argument of \cline of the form i-j or the form i.
\cs_set:Npn \@@_cline_i:en\@@_first_col_int
Now, #1 is the number of the current column and we have to draw a line from the column #2 to the column #3 (both included).
\int_compare:nNnT { #1 } < { #2 }
\multispan { \int_eval:n { #2 - #1 } } &
\multispan { \int_eval:n { #3 - #2 + 1 } }
\CT@arc@
\leaders \hrule \@height \arrayrulewidth \hfill
\skip_horizontal:N \c_zero_dim
}

You look whether there is another \cline to draw (the final user may put several \cline).
\peek_meaning_remove_ignore_spaces:NTF \cline
{ & \@@_cline_i:en \int_eval:n { #3 + 1 } }
\everycr { } \cr
}
\cs_generate_variant:Nn \@@_cline_i:nn { e n }

The following command is a small shortcut.
\cs_new:Npn \@@_math_toggle_token:
The column S of siunitx

We want to know whether the package siunitx is loaded and, if it is loaded, we redefine the S columns of siunitx.

The command \@@_renew_NC@rewrite@S: will be used in each environment of nicematrix in order to “rewrite” the S column in each environment.

Parameters

The following counter will count the environments \{NiceArray}. The value of this counter will be used to prefix the names of the Tikz nodes created in the array.

The following command is only a syntaxic shortcut. It must not be protected (it will be used in names of PGF nodes).
The command \NiceMatrixLastEnv is not used by the package \nicematrix. It’s only a facility given to the final user. It gives the number of the last environment (in fact the number of the current environment but it’s meant to be used after the environment in order to refer to that environment — and its nodes — without having to give it a name). This command must be expandable since it will be used in pgf nodes.

\NewExpandableDocumentCommand \NiceMatrixLastEnv { }
\{ \int_use:N \g_@@_env_int \}

The following command is only a syntaxic shortcut. The q in qpoint means quick.

\cs_new_protected:Npn \@@_qpoint:n #1
{ \pgfpointanchor { \@@_env: - #1 } { center } }

The following counter will count the environments \{NiceMatrixBlock\}.

\int_new:N \g_@@_NiceMatrixBlock_int

The dimension \l_@@_columns_width_dim will be used when the options specify that all the columns must have the same width (but, if the key columns-width is used with the special value auto, the boolean \l_@@_auto_columns_width_bool also will be raised).

\dim_new:N \l_@@_columns_width_dim
\dim_set:Nn \l_@@_columns_width_dim { -1 cm }

The following counters will be used to count the numbers of rows and columns of the array.

\int_new:N \g_@@_row_total_int
\int_new:N \g_@@_col_total_int

The following counter corresponds to the key \nb-rows of the command \RowStyle.

\int_new:N \l_@@_key_nb_rows_int

The following token list will contain the type of horizontal alignment of the current cell as provided by the corresponding column. The possible values are r, l, c. For example, a column p[l]{3cm} will provide the value l for all the cells of the column.

\str_new:N \l_@@_hpos_cell_str
\str_set:Nn \l_@@_hpos_cell_str { c }

When there is a mono-column block (created by the command \Block), we want to take into account the width of that block for the width of the column. That’s why we compute the width of that block in the \g_@@_blocks_wd_dim and, after the construction of the box \l_@@_cell_box, we change the width of that box to take into account the length \g_@@_blocks_wd_dim.

\dim_new:N \g_@@_blocks_wd_dim

Idem pour the mono-row blocks.

\dim_new:N \g_@@_blocks_ht_dim
\dim_new:N \g_@@_blocks_dp_dim

The following dimension correspond to the key \width (which may be fixed in \NiceMatrixOptions but also in an environment \{NiceTabular\}).

\dim_new:N \l_@@_width_dim
The sequence `\g_@@_names_seq` will be the list of all the names of environments used (via the option `name`) in the document: two environments must not have the same name. However, it’s possible to use the option `allow-duplicate-names`.

We want to know whether we are in an environment of `nicematrix` because we will raise an error if the user tries to use nested environments.

If the user uses `{NiceArray}` or `{NiceTabular}` the flag `\l_@@_NiceArray_bool` will be raised.

In fact, if there is delimiters in the preamble of `{NiceArray}` (eg: `[cccc]`), this boolean will be set to false.

If the user uses `{NiceTabular}` or `{NiceTabular*}`, we will raise the following flag.

If the user uses an environment without preamble, we will raise the following flag.

The following boolean will be raised when the command `\rotate` is used.

In a cell, it will be possible to know whether we are in a cell of a column of type `X` thanks to that flag.

We will write in `\g_@@_aux_tl` all the instructions that we have to write on the `aux` file for the current environment. The contain of that token list will be written on the `aux` file at the end of the environment (in an instruction `\tl_gset:cn { c_@@_ \int_use:N \g_@@_env_int _ tl }`).

The letter used for the vlines which will be drawn only in the sub-matrices. `vlism` stands for vertical lines in sub-matrices.

The list of the columns where vertical lines in sub-matrices (vlism) must be drawn. Of course, the actual value of this sequence will be known after the analyse of the preamble of the array.

The following colors will be used to memorize the color of the potential “first col” and the potential “first row”.

The letter used for the vlines which will be drawn only in the sub-matrices. `vlism` stands for vertical lines in sub-matrices.
The following string is the name of the current environment or the current command of \nicematrix (despite its name which contains \texttt{env}).

\begin{verbatim}
\str_new:N \g_@@_name_env_str
\end{verbatim}

The following string will contain the word \texttt{command} or \texttt{environment} whether we are in a command of \nicematrix or in an environment of \nicematrix. The default value is \texttt{environment}.

\begin{verbatim}
\tl_set:Nn \g_@@_com_or_env_str \{ environment \}
\end{verbatim}

The following command will be able to reconstruct the full name of the current command or environment (despite its name which contains \texttt{env}). This command must \texttt{not} be protected since it will be used in error messages and we have to use \texttt{\str_if_eq:VnTF} and not \texttt{\tl_if_eq:NnTF} because we need to be fully expandable).

\begin{verbatim}
\cs_new:Npn \@@_full_name_env:
{\str_if_eq:VnTF \g_@@_com_or_env_str \{ command \}{ command \space \c_backslash_str \g_@@_name_env_str }
{ environment \space \{ \g_@@_name_env_str \} }}
\end{verbatim}

The following token list corresponds to the option \texttt{code-after} (it's also possible to set the value of that parameter with the keyword \texttt{\CodeAfter}). That parameter is \texttt{public}.

\begin{verbatim}
\tl_new:N \g_nicematrix_code_after_tl
\end{verbatim}

For the key \texttt{code} of the command \texttt{\SubMatrix} (itself in the main \texttt{\CodeAfter}), we will use the following token list.

\begin{verbatim}
\tl_new:N \l_@@_code_tl
\end{verbatim}

The following token list has a function similar to \texttt{\g_nicematrix_code_after_tl} but it is used internally by \nicematrix. In fact, we have to distinguish between \texttt{\g_nicematrix_code_after_tl} and \texttt{\g_@@_internal_code_after_tl} because we must take care of the order in which instructions stored in that parameters are executed.

\begin{verbatim}
\tl_new:N \g_@@_internal_code_after_tl
\end{verbatim}

The counters \texttt{\l_@@_old_iRow_int} and \texttt{\l_@@_old_jCol_int} will be used to save the values of the potential \LaTeX counters \texttt{iRow} and \texttt{jCol}. These \LaTeX counters will be restored at the end of the environment.

\begin{verbatim}
\int_new:N \l_@@_old_iRow_int
\int_new:N \l_@@_old_jCol_int
\end{verbatim}

The \TeX counters \texttt{c@iRow} and \texttt{c@jCol} will be created in the beginning of \texttt{\NiceArrayWithDelims} (if they don't exist previously).

The following token list corresponds to the key \texttt{rules/color} available in the environments.

\begin{verbatim}
\tl_new:N \l_@@_rules_color_tl
\end{verbatim}

The sum of the weights of all the \texttt{X}-columns in the preamble. The weight of a \texttt{X}-column is given as optional argument between square brackets. The default value, of course, is 1.

\begin{verbatim}
\int_new:N \g_@@_total_X_weight_int
\end{verbatim}

If there is at least one \texttt{X}-column in the preamble of the array, the following flag will be raised via the aux file. The length \texttt{\l_@@_X_columns_dim} will be the width of X-columns of weight 1 (the width of a column of weight \texttt{n} will be that dimension multiplied by \texttt{n}). That value is computed after the construction of the array during the first compilation in order to be used in the following run.

\begin{verbatim}
\bool_new:N \l_@@_X_columns_aux_bool
\dim_new:N \l_@@_X_columns_dim
\end{verbatim}
This boolean will be used only to detect in an expandable way whether we are at the beginning of the (potential) column zero, in order to raise an error if \Hdotsfor is used in that column.

\bool_new:N \g_@@_after_col_zero_bool

A kind of false row will be inserted at the end of the array for the construction of the col nodes (and also to fix the width of the columns when columns-width is used). When this special row will be created, we will raise the flag \g_@@_row_of_col_done_bool in order to avoid some actions set in the redefinition of \everycr when the last \cr of the \halign will occur (after that row of col nodes).

\bool_new:N \g_@@_row_of_col_done_bool

It’s possible to use the command \NotEmpty to specify explicitly that a cell must be considered as non empty by nicematrix (the Tikz nodes are constructed only in the non empty cells).

\bool_new:N \g_@@_not_empty_cell_bool

\l_@@_code_before_tl may contain two types of informations:

- A code-before written in the aux file by a previous run. When the aux file is read, this code-before is stored in \g_@@_code_before_i_tl (where i is the number of the environment) and, at the beginning of the environment, it will be put in \l_@@_code_before_tl.

- The final user can explicitly add material in \l_@@_code_before_tl by using the key code-before or the keyword \CodeBefore (with the keyword \Body).

\tl_new:N \l_@@_code_before_tl
\bool_new:N \l_@@_code_before_bool

The following token list will contain the code inserted in each cell of the current row (this token list will be cleared at the beginning of each row).

\tl_new:N \g_@@_row_style_tl

The following dimensions will be used when drawing the dotted lines.

\dim_new:N \l_@@_x_initial_dim
\dim_new:N \l_@@_y_initial_dim
\dim_new:N \l_@@_x_final_dim
\dim_new:N \l_@@_y_final_dim

The L3 programming layer provides scratch dimensions \l_tmpa_dim and \l_tmpb_dim. We creates two more in the same spirit.

\dim_zero_new:N \l_@@_tmpc_dim
\dim_zero_new:N \l_@@_tmpd_dim

Some cells will be declared as “empty” (for example a cell with an instruction \Cdots).

\bool_new:N \g_@@_empty_cell_bool

The following dimensions will be used internally to compute the width of the potential “first column” and “last column”.

\dim_new:N \g_@@_width_last_col_dim
\dim_new:N \g_@@_width_first_col_dim

The following sequence will contain the characteristics of the blocks of the array, specified by the command \Block. Each block is represented by 6 components surrounded by curly braces: {(imin)\{jimin\}{imax\{jmax\}}{options}\{contents\}. The variable is global because it will be modified in the cells of the array.

\seq_new:N \g_@@_blocks_seq
We also manage a sequence of the positions of the blocks. In that sequence, each block is represented by only five components: \{(imin)\{jmin\}{imax}\{jmax\}\{name\}. A block with the key hvlines won’t appear in that sequence (otherwise, the lines in that block would not be drawn!).

\seq_new:N \g_@@_pos_of_blocks_seq

In fact, this sequence will also contain the positions of the cells with a \diagbox. The sequence \g_@@_pos_of_blocks_seq will be used when we will draw the rules (which respect the blocks).

We will also manage a sequence for the positions of the dotted lines. These dotted lines are created in the array by \Dots, \VDots, \HDots, etc. However, their positions, that is to say, their extremities, will be determined only after the construction of the array. In this sequence, each item contains five components: \{(imin)\{jmin\}{imax}\{jmax\}\{name\}.

\seq_new:N \g_@@_pos_of_xdots_seq

The sequence \g_@@_pos_of_xdots_seq will be used when we will draw the rules required by the key hvlines (these rules won’t be drawn within the virtual blocks corresponding to the dotted lines).

The final user may decide to “stroke” a block (using, for example, the key _draw=red!15 when using the command \Block). In that case, the rules specified, for instance, by hvlines must not be drawn around the block. That’s why we keep the information of all that stroken blocks in the following sequence.

\seq_new:N \g_@@_pos_of_stroken_blocks_seq

If the user has used the key corners (or the key hvlines-except-corners, even though that key is deprecated), all the cells which are in an (empty) corner will be stored in the following sequence.

\seq_new:N \l_@@_corners_cells_seq

The list of the names of the potential \SubMatrix in the \CodeAfter of an environment. Unfortunately, that list has to be global (we have to use it inside the group for the options of a given \SubMatrix).

\seq_new:N \g_@@_submatrix_names_seq

The following flag will be raised if the key width is used in an environment \{NiceTabular\} (not in a command \NiceMatrixOptions). You use it to raise an error when this key is used while no column X is used.

\bool_new:N \l_@@_width_used_bool

The sequence \g_@@_multicolumn_cells_seq will contain the list of the cells of the array where a command \multicolumn{\text{n}}{...}{...} with \text{n} > 1 is issued. In \g_@@_multicolumn_sizes_seq, the “sizes” (that is to say the values of \text{n}) correspondant will be stored. These lists will be used for the creation of the “medium nodes” (if they are created).

\seq_new:N \g_@@_multicolumn_cells_seq
\seq_new:N \g_@@_multicolumn_sizes_seq

The following counters will be used when searching the extremities of a dotted line (we need these counters because of the potential “open” lines in the \SubMatrix—the \SubMatrix in the code-before).

\int_new:N \l_@@_row_min_int
\int_new:N \l_@@_row_max_int
\int_new:N \l_@@_col_min_int
\int_new:N \l_@@_col_max_int

The following sequence will be used when the command \SubMatrix is used in the \CodeBefore (and not in the \CodeAfter). It will contain the position of all the sub-matrices specified in the code-before. Each sub-matrix is represented by an “object” of the forme \{(i)\{j\}{k}\{l\} where \text{i} and \text{j} are the number of row and column of the upper-left cell and \text{k} and \text{l} the number of row and column of the lower-right cell.

\seq_new:N \g_@@_submatrix_seq

We are able to determine the number of columns specified in the preamble (for the environments with explicit preamble of course and without the potential exterior columns).

\int_new:N \g_@@_static_num_of_col_int
The following parameters correspond to the keys \texttt{fill}, \texttt{draw}, \texttt{tikz}, \texttt{borders}, and \texttt{rounded-corners} of the command \texttt{\Block}.

\begin{verbatim}
300  \tl_new:N \l_@@_fill_tl
301  \tl_new:N \l_@@_draw_tl
302  \seq_new:N \l_@@_tikz_seq
303  \clist_new:N \l_@@_borders_clist
304  \dim_new:N \l_@@_rounded_corners_dim
\end{verbatim}

The last parameter has no direct link with the [empty] corners of the array (which are computed and taken into account by \texttt{nicematrix} when the key \texttt{corners} is used).

The following token list correspond to the key \texttt{color} of the command \texttt{\Block}.

\begin{verbatim}
305  \tl_new:N \l_@@_color_tl
\end{verbatim}

Here is the dimension for the width of the rule when a block (created by \texttt{\Block}) is stroked.

\begin{verbatim}
306  \dim_new:N \l_@@_line_width_dim
\end{verbatim}

The parameters of the horizontal position of the label of a block. If the user uses the key \texttt{c} or \texttt{C}, the value is \texttt{c}. If the user uses the key \texttt{l} or \texttt{L}, the value is \texttt{l}. If the user uses the key \texttt{r} or \texttt{R}, the value is \texttt{r}. If the user has used a capital letter, the boolean \texttt{\l_@@_hpos_of_block_cap_bool} will be raised (in the second pass of the analyze of the keys of the command \texttt{\Block}).

\begin{verbatim}
307  \str_new:N \l_@@_hpos_block_str
308  \str_set:Nn \l_@@_hpos_block_str { c }
309  \bool_new:N \l_@@_hpos_of_block_cap_bool
\end{verbatim}

For the vertical position, the possible values are \texttt{c}, \texttt{t} and \texttt{b}. Of course, it would be interesting to program a key \texttt{T} and a key \texttt{B}.

\begin{verbatim}
310  \tl_new:N \l_@@_vpos_of_block_tl
311  \tl_set:Nn \l_@@_vpos_of_block_tl { c }
\end{verbatim}

Used when the key \texttt{draw-first} is used for \texttt{\Ddots} or \texttt{\Iddots}.

\begin{verbatim}
312  \bool_new:N \l_@@_draw_first_bool
\end{verbatim}

The following flag corresponds to the keys \texttt{vlines} and \texttt{hlines} of the command \texttt{\Block} (the key \texttt{hvlines} is the conjunction of both).

\begin{verbatim}
313  \bool_new:N \l_@@_vlines_block_bool
314  \bool_new:N \l_@@_hlines_block_bool
\end{verbatim}

The blocks which use the key \texttt{-} will store their content in a box. These boxes are numbered with the following counter.

\begin{verbatim}
315  \int_new:N \g_@@_block_box_int
316  \dim_new:N \l_@@_submatrix_extra_height_dim
317  \dim_new:N \l_@@_submatrix_left_xshift_dim
318  \dim_new:N \l_@@_submatrix_right_xshift_dim
319  \clist_new:N \l_@@_hlines_clist
320  \clist_new:N \l_@@_vlines_clist
321  \clist_new:N \l_@@_submatrix_hlines_clist
322  \clist_new:N \l_@@_submatrix_vlines_clist
\end{verbatim}

The following flag will be used by (for instance) \texttt{\@@_vline_ii}: When \texttt{\l_@@_dotted_bool} is \texttt{true}, a dotted line (with our system) will be drawn.

\begin{verbatim}
323  \bool_new:N \l_@@_dotted_bool
\end{verbatim}

Variables for the exterior rows and columns

The keys for the exterior rows and columns are \texttt{first-row}, \texttt{first-col}, \texttt{last-row} and \texttt{last-col}. However, internally, these keys are not coded in a similar way.
• First row
The integer \l_@@_first_row_int is the number of the first row of the array. The default value is 1, but, if the option first-row is used, the value will be 0.

\begin{verbatim}
\int_new:N \l_@@_first_row_int
\int_set:Nn \l_@@_first_row_int 1
\end{verbatim}

• First column
The integer \l_@@_first_col_int is the number of the first column of the array. The default value is 1, but, if the option first-col is used, the value will be 0.

\begin{verbatim}
\int_new:N \l_@@_first_col_int
\int_set:Nn \l_@@_first_col_int 1
\end{verbatim}

• Last row
The counter \l_@@_last_row_int is the number of the potential “last row”, as specified by the key last-row. A value of −2 means that there is no “last row”. A value of −1 means that there is a “last row” but we don’t know the number of that row (the key last-row has been used without value and the actual value has not still been read in the aux file).

\begin{verbatim}
\int_new:N \l_@@_last_row_int
\int_set:Nn \l_@@_last_row_int { -2 }
\end{verbatim}

If, in an environment like \{pNiceArray\}, the option last-row is used without value, we will globally raise the following flag. It will be used to know if we have, after the construction of the array, to write in the aux file the number of the “last row”.

\begin{verbatim}
\bool_new:N \l_@@_last_row_without_value_bool
\end{verbatim}

Idem for \l_@@_last_col_without_value_bool

\begin{verbatim}
\bool_new:N \l_@@_last_col_without_value_bool
\end{verbatim}

• Last column
For the potential “last column”, we use an integer. A value of −2 means that there is no last column. A value of −1 means that we are in an environment without preamble (e.g. \{bNiceMatrix\}) and there is a last column but we don’t know its value because the user has used the option last-col without value. A value of 0 means that the option last-col has been used in an environment with preamble (like \{pNiceArray\}): in this case, the key was necessary without argument.

\begin{verbatim}
\int_new:N \l_@@_last_col_int
\int_set:Nn \l_@@_last_col_int { -2 }
\end{verbatim}

However, we have also a boolean. Consider the following code:

\begin{verbatim}
\begin{pNiceArray}{cc}[last-col]
1 & 2 \\
3 & 4
\end{pNiceArray}
\end{verbatim}

\footnote{We can’t use \l_@@_last_row_int for this usage because, if nicematrix has read its value from the aux file, the value of the counter won’t be −1 any longer.}
In such a code, the "last column" specified by the key last-col is not used. We want to be able to detect such a situation and we create a boolean for that job.

\bool_new:N \g_@@_last_col_found_bool

This boolean is set to false at the end of \@@_pre_array_ii:

Some utilities

\cs_set_protected:Npn \@@_cut_on_hyphen:w #1-#2\q_stop
\tl_set:Nn \l_tmpa_tl { #1 }
\tl_set:Nn \l_tmpb_tl { #2 }

The following takes as argument the name of a clist and which should be a list of intervals of integers. It expands that list, that is to say, it replaces (by a sort of mapcan or flat_map) the interval by the explicit list of the integers.

\cs_new_protected:Npn \@@_expand_clist:N #1
\clist_if_in:NnF #1 { all }
{ \clist_clear:N \l_tmpa_clist \clist_map_inline:Nn #1
\tl_if_in:nnTF { ##1 } { - }
{ \@@_cut_on_hyphen:w ##1 \q_stop }
\tl_set:Nn \l_tmpa_tl { ##1 }
\tl_set:Nn \l_tmpb_tl { ##1 }
\int_step_inline:nnn { \l_tmpa_tl } { \l_tmpb_tl }
{ \clist_put_right:Nn \l_tmpa_clist { ####1 } }
\tl_set_eq:NN #1 \l_tmpa_clist }

The command \tabularnote

The LaTeX counter \texttt{tabularnote} will be used to count the tabular notes during the construction of the array (this counter won't be used during the composition of the notes at the end of the array). You use a LaTeX counter because we will use \texttt{refstepcounter} in order to have the tabular notes referenceable.

\newcounter { tabularnote }

We will store in the following sequence the tabular notes of a given array.

\seq_new:N \g_@@_tabularnotes_seq

However, before the actual tabular notes, it's possible to put a text specified by the key \texttt{tabularnote} of the environment. The token list \texttt{\l_@@_tabularnote_tl} corresponds to the value of that key.

\tl_new:N \l_@@_tabularnote_tl

The following counter will be used to count the number of successive tabular notes such as in \texttt{\tabularnote{Note 1}\tabularnote{Note 2}\tabularnote{Note 3}}. In the tabular, the labels of those nodes are composed as a comma separated list (e.g. \texttt{a,b,c}).

\int_new:N \l_@@_number_of_notes_int
The following function can be redefined by using the key `notes/style`.

\cs_new:Npn \@@_notes_style:n #1 { \textit { \alph { #1 } } }

The following function can be redefined by using the key `notes/label-in-tabular`.

\cs_new:Npn \@@_notes_label_in_tabular:n #1 { \textsuperscript { #1 } }

The following function can be redefined by using the key `notes/label-in-list`.

\cs_new:Npn \@@_notes_label_in_list:n #1 { \textsuperscript { #1 } }

We define \thetabularnote because it will be used by LaTeX if the user want to reference a footnote which has been marked by a \label. The TeX group is for the case where the user has put an instruction such as \color{red} in \@@_notes_style:n.

\cs_set:Npn \thetabularnote { { \@@_notes_style:n { tabularnote } } }

The tabular notes will be available for the final user only when \enumitem is loaded. Indeed, the tabular notes will be composed at the end of the array with a list customized by \enumitem (a list \tabularnotes in the general case and a list \tabularnotes* if the key \para is in force). However, we can test whether \enumitem has been loaded only at the beginning of the document (we want to allow the user to load \enumitem after \nicematrix).

\hook_gput_code:nnn { begindocument } { . } { \bool_if:nTF { ! \c_@@_enumitem_loaded_bool } { \NewDocumentCommand \tabularnote { m } { \@@_error:n { enumitem~not~loaded } } } { } }

The type of list \tabularnotes will be used to format the tabular notes at the end of the array in the general case and \tabularnotes* will be used if the key \para is in force.

\newlist { tabularnotes } { enumerate } { 1 }
\setlist [ tabularnotes ] { topsep = 0pt , noitemsep , leftmargin = * , align = left , labelsep = 0pt , label = \@@_notes_label_in_list:n \@@_notes_style:n { tabularnotesi } } ,
\newlist { tabularnotes* } { enumerate* } { 1 }
\setlist [ tabularnotes* ] { afterlabel = \nobreak , itemjoin = \quad , label = \@@_notes_label_in_list:n \@@_notes_style:n { tabularnotes*i } } }

The command \tabularnote is available in the whole document (and not only in the environments of \nicematrix) because we want it to be available in the caption of a \{table\} (before the following \{NiceTabular\} or \{NiceArray\}). That’s also the reason why the variables \c@tabularnote and \g_@@_tabularnotes_seq will be cleared at the end of the environment of \nicematrix (and not at the beginning).

Unfortunately, if the package \caption is loaded, the command \caption evaluates its argument twice and since it is not aware (of course) of \tabularnote, the command \tabularnote is, in fact, not usable in \caption when caption is loaded.\footnote{We should try to find a solution to that problem.}
\NewDocumentCommand \tabularnote { m } 
\bool_if:nTF { ! \l_@@_NiceArray_bool && \l_@@_in_env_bool } 
\l_@@_error:n { \tabularnote-forbidden } 
\l_@@_number_of_notes_int is used to count the number of successive tabular notes such as in \tabularnote(Note 1)\tabularnote(Note 2)\tabularnote(Note 3). We will have to compose the labels of theses notes as a comma separated list (e.g. \textsuperscript{a,b,c}).
We expand the content of the note at the point of use of \tabularnote as does \footnote.
If the following token is not a \tabularnote, we have finished the sequence of successive commands \tabularnote and we have to format the labels of these tabular notes (in the array). We compose those labels in a box \l_tmpa_box because we will do a special construction in order to have this box in a overlapping position if we are at the end of a cell.
We remind that it is the command \@@_notes_label_in_tabular:n that will (most of the time) put the labels in a \textsuperscript.
We use \refstepcounter in order to have the (last) tabular note referenceable (with the standard command \label) and that’s why we have to go back with a decrementation of the counter \tabularnote first.
If the command \tabularnote is used exactly at the end of the cell, the \unskip (inserted by \array) will delete the skip we insert now and the label of the footnote will be composed in an overlapping position (by design).

Command for creation of rectangle nodes
The following command should be used in a \texttt{pgfpicture}. It creates a rectangle (empty but with a name).
#1 is the name of the node which will be created; #2 and #3 are the coordinates of one of the corner of the rectangle; #4 and #5 are the coordinates of the opposite corner.
The command `\@@_pgf_rect_node:nnn` is a variant of `\@@_pgf_rect_node:nnnnn`: it takes two PGF points as arguments instead of the four dimensions which are the coordinates.

The options

By default, the commands `\cellcolor` and `\rowcolor` are available for the user in the cells of the tabular (the user may use the commands provided by `\colortbl`). However, if the key `colortbl-like` is used, these commands are available.

By default, the behaviour of `\cline` is changed in the environments of `nicematrix`: a `\cline` spreads the array by an amount equal to `\arrayrulewidth`. It’s possible to disable this feature with the key `\l_@@_standard_line_bool`.

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\bool_new:N \l_@@_standard_cline_bool

The following dimensions correspond to the options cell-space-top-limit and co (these parameters are inspired by the package cellspace).
\dim_new:N \l_@@_cell_space_top_limit_dim
\dim_new:N \l_@@_cell_space_bottom_limit_dim

The following dimension is the distance between two dots for the dotted lines (when line-style is equal to standard, which is the initial value). The initial value is 0.45 em but it will be changed if the option small is used.
\dim_new:N \l_@@_inter_dots_dim
\hook_gput_code:nnn { begindocument } { . }
\{ \dim_set:Nn \l_@@_inter_dots_dim { 0.45 \text{ em} } \}

We use a hook only by security in case revtex4-1 is used (even though it is obsolete).

The following dimension is the minimal distance between a node (in fact an anchor of that node) and a dotted line (we say “minimal” because, by definition, a dotted line is not a continuous line and, therefore, this distance may vary a little).
\dim_new:N \l_@@_xdots_shorten_dim
\hook_gput_code:nnn { begindocument } { . }
\{ \dim_set:Nn \l_@@_xdots_shorten_dim { 0.3 \text{ em} } \}

We use a hook only by security in case revtex4-1 is used (even though it is obsolete).

The following dimension is the radius of the dots for the dotted lines (when line-style is equal to standard, which is the initial value). The initial value is 0.53 pt but it will be changed if the option small is used.
\dim_new:N \l_@@_radius_dim
\hook_gput_code:nnn { begindocument } { . }
\{ \dim_set:Nn \l_@@_radius_dim { 0.53 \text{ pt} } \}

We use a hook only by security in case revtex4-1 is used (even though it is obsolete).

The token list \l_@@_xdots_line_style_tl corresponds to the option tikz of the commands \Cdots, \Ldots, etc. and of the options line-style for the environments and \NiceMatrixOptions. The constant \c_@@_standard_tl will be used in some tests.
\tl_new:N \l_@@_xdots_line_style_tl
\tl_const:Nn \c_@@_standard_tl { standard }
\tl_set_eq:NN \l_@@_xdots_line_style_tl \c_@@_standard_tl

The boolean \l_@@_light_syntax_bool corresponds to the option light-syntax.
\bool_new:N \l_@@_light_syntax_bool

The string \l_@@_baseline_tl may contain one of the three values t, c or b as in the option of the environment \{array\}. However, it may also contain an integer (which represents the number of the row to which align the array).
\tl_new:N \l_@@_baseline_tl
\tl_set:Nn \l_@@_baseline_tl c

The flag \l_@@_exterior_arraycolsep_bool corresponds to the option exterior-arraycolsep. If this option is set, a space equal to \arraycolsep will be put on both sides of an environment \{NiceArray\} (as it is done in \{array\} of array).
\bool_new:N \l_@@_exterior_arraycolsep_bool

The flag \l_@@_parallelize_diags_bool controls whether the diagonals are parallelized. The initial value is true.
\bool_new:N \l_@@_parallelize_diags_bool
\bool_set_true:N \l_@@_parallelize_diags_bool
The following parameter correspond to the key `corners`. The elements of that `clist` must be in NW, SW, NE and SE.

\clist_new:N \l_@@_corners_clist

\dim_new:N \l_@@_notes_above_space_dim
\hook_gput_code:nnn { begindocument } { . }
{ \dim_set:Nn \l_@@_notes_above_space_dim { 1 mm } }

We use a hook only by security in case `revtex4-1` is used (even though it is obsolete).

The flag `\l_@@_nullify_dots_bool` corresponds to the option `nullify-dots`. When the flag is down, the instructions like `\vdots` are inserted within a `\hphantom` (and so the constructed matrix has exactly the same size as a matrix constructed with the classical `{matrix}` and `\ldots`, `\vdots`, etc.).

\bool_new:N \l_@@_nullify_dots_bool

The following flag corresponds to the key `respect-arraystretch` (that key has an effect on the blocks).

\bool_new:N \l_@@_respect_arraystretch_bool

The following flag will be used when the current options specify that all the columns of the array must have the same width equal to the largest width of a cell of the array (except the cells of the potential exterior columns).

\bool_new:N \l_@@_auto_columns_width_bool

The following boolean corresponds to the key `create-cell-nodes` of the keyword `\CodeBefore`.

\bool_new:N \g_@@_recreate_cell_nodes_bool

The string `\l_@@_name_str` will contain the optional name of the environment: this name can be used to access to the Tikz nodes created in the array from outside the environment.

\str_new:N \l_@@_name_str
\tl_set:Nn \l_@@_end_of_row_tl { ; }

The boolean `\l_@@_medium_nodes_bool` will be used to indicate whether the “medium nodes” are created in the array. Idem for the “large nodes”.

\bool_new:N \l_@@_medium_nodes_bool
\bool_new:N \l_@@_large_nodes_bool

The boolean `\l_@@_except_borders_bool` will be raised when the key `hvlines-except-borders` will be used (but that key has also other effects).

\bool_new:N \l_@@_except_borders_bool

The dimension `\l_@@_left_margin_dim` correspond to the option `left-margin`. Idem for the right margin. These parameters are involved in the creation of the “medium nodes” but also in the placement of the delimiters and the drawing of the horizontal dotted lines (`\hdottedline`).

\dim_new:N \l_@@_left_margin_dim
\dim_new:N \l_@@_right_margin_dim

The dimensions `\l_@@_extra_left_margin_dim` and `\l_@@_extra_right_margin_dim` correspond to the options `extra-left-margin` and `extra-right-margin`.

\dim_new:N \l_@@_extra_left_margin_dim
\dim_new:N \l_@@_extra_right_margin_dim

The token list `\l_@@_end_of_row_tl` corresponds to the option `end-of-row`. It specifies the symbol used to mark the ends of rows when the light syntax is used.

\tl_new:N \l_@@_end_of_row_tl
\tl_set:Nn \l_@@_end_of_row_tl { ; }

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The following parameter is for the color the dotted lines drawn by \Cdots, \Ldots, \Vdots, \Ddots, \Iddots and \Hdots for but not the dotted lines drawn by \hdottedline and ".
\tl_new:N \l_@@_xdots_color_tl

The following token list corresponds to the key delimiters/color.
\tl_new:N \l_@@_delimiters_color_tl

Sometimes, we want to have several arrays vertically juxtaposed in order to have an alignment of the columns of these arrays. To achieve this goal, one may wish to use the same width for all the columns (for example with the option columns-width or the option auto-columns-width of the environment \{NiceMatrixBlock\}). However, even if we use the same type of delimiters, the width of the delimiters may be different from an array to another because the width of the delimiter is function of its size. That's why we create an option called delimiters/max-width which will give to the delimiters the width of a delimiter (of the same type) of big size. The following boolean corresponds to this option.
\bool_new:N \l_@@_delimiters_max_width_bool

\keys_define:nn { NiceMatrix / xdots }
\keys_define:nn { NiceMatrix / rules }

We can't use \c_@@_tikz_loaded_bool to test whether \tikz is loaded because \NiceMatrixOptions may be used in the preamble of the document.
\keys_define:nn { NiceMatrix / rules }

We use a hook only by security in case revtex4-1 is used (even though it is obsolete).
\keys_define:nn { NiceMatrix / xdots }
\keys_define:nn { NiceMatrix / rules }

The options down and up are not documented for the final user because he should use the syntax with ^ and _.
\keys_define:nn { NiceMatrix / rules }
\keys_define:nn { NiceMatrix / xdots }

The key draw-first, which is meant to be used only with \Ddots and \Iddots, which be catched when \Ddots or \Iddots is used (during the construction of the array and not when we draw the dotted lines).
\keys_define:nn { NiceMatrix / rules }
\keys_define:nn { NiceMatrix / xdots }


First, we define a set of keys \texttt{``NiceMatrix / Global''} which will be used (with the mechanism of \texttt{\hspace{1em}\inherit:n}) by other sets of keys.

\begin{verbatim}
\keys_define:nn { NiceMatrix / Global }
{    \custom_line .code:n = \@@_custom_line:n { #1 } ,
    delimiters .code:n = \keys_set:nn { NiceMatrix / delimiters } { #1 } ,
    rules .code:n = \keys_set:nn { NiceMatrix / rules } { #1 } ,
    rules .value_required:n = true ,
    standard-cline .bool_set:N = \l_@@_standard_cline_bool ,
    standard-cline .default:n = true ,
    cell-space-top-limit .dim_set:N = \l_@@_cell_space_top_limit_dim ,
    cell-space-top-limit .value_required:n = true ,
    cell-space-bottom-limit .dim_set:N = \l_@@_cell_space_bottom_limit_dim ,
    cell-space-bottom-limit .value_required:n = true ,
    cell-space-limits .meta:n =
    {        cell-space-top-limit = #1 ,
        cell-space-bottom-limit = #1 ,
    } ,
    cell-space-limits .value_required:n = true ,
    xdots .code:n = \keys_set:nn { NiceMatrix / xdots } { #1 } ,
    light-syntax .bool_set:N = \l_@@_light_syntax_bool ,
    light-syntax .default:n = true ,
    end-of-row .tl_set:N = \l_@@_end_of_row_tl ,
    end-of-row .value_required:n = true ,
    first-col .code:n = \int_zero:N \l_@@_first_col_int ,
    first-row .code:n = \int_zero:N \l_@@_first_row_int ,
    last-row .int_set:N = \l_@@_last_row_int ,
    last-row .default:n = -1 ,
    code-for-first-col .tl_set:N = \l_@@_code_for_first_col_tl ,
    code-for-first-col .value_required:n = true ,
    code-for-last-col .tl_set:N = \l_@@_code_for_last_col_tl ,
    code-for-last-col .value_required:n = true ,
    code-for-first-row .tl_set:N = \l_@@_code_for_first_row_tl ,
    code-for-first-row .value_required:n = true ,
    code-for-last-row .tl_set:N = \l_@@_code_for_last_row_tl ,
    code-for-last-row .value_required:n = true ,
    hlines .clist_set:N = \l_@@_hlines_clist ,
    vlines .clist_set:N = \l_@@_vlines_clist ,
    hlines .default:n = all ,
    vlines .default:n = all ,
    vlines-in-sub-matrix .code:n =
    {        \tl_if_single_token:nTF { #1 }
            { \tl_set:Nn \l_@@_letter_vlism_tl { #1 } }
            { \@@_error:n { One-letter-allowed } }
    } ,
    vlines-in-sub-matrix .value_required:n = true ,
    hvlines .code:n =
    { \clist_set:Nn \l_@@_vlines_clist { all } \clist_set:Nn \l_@@_hlines_clist { all } } ,
    hvlines-except-borders .code:n =
    { \clist_set:Nn \l_@@_vlines_clist { all } \clist_set:Nn \l_@@_hlines_clist { all } \bool_set_true:N \l_@@_except_borders_bool } ,
    parallelize-diags .bool_set:N = \l_@@_parallelize_diags_bool ,
}
\end{verbatim}

With the option \texttt{renew-dots}, the command \texttt{\cdots}, \texttt{\ldots}, \texttt{\vdots}, \texttt{\ddots}, etc. are redefined and
behave like the commands $\textbackslash\text{Cdots}$, $\textbackslash\text{Ldots}$, $\textbackslash\text{Vdots}$, $\textbackslash\text{Ddots}$, etc.

renew-dots .bool_set:N = \l_@@_renew_dots_bool ,
renew-dots .value_forbidden:n = true ,
nullify-dots .bool_set:N = \l_@@_nullify_dots_bool ,
create-medium-nodes .bool_set:N = \l_@@_medium_nodes_bool ,
create-large-nodes .bool_set:N = \l_@@_large_nodes_bool ,
create-extra-nodes .meta:n =
{ create-medium-nodes , create-large-nodes },
left-margin .dim_set:N = \l_@@_left_margin_dim ,
left-margin .default:n = \arraycolsep ,
right-margin .dim_set:N = \l_@@_right_margin_dim ,
right-margin .default:n = \arraycolsep ,
margin .meta:n = { left-margin = #1 , right-margin = #1 },
margin .default:n = \arraycolsep ,
extra-left-margin .dim_set:N = \l_@@_extra_left_margin_dim ,
extra-right-margin .dim_set:N = \l_@@_extra_right_margin_dim ,
extra-margin .meta:n =
{ extra-left-margin = #1 , extra-right-margin = #1 },
extra-margin .value_required:n = true ,
respect-arraystretch .bool_set:N = \l_@@_respect_arraystretch_bool ,
respect-arraystretch .default:n = true
}

We define a set of keys used by the environments of nicematrix (but not by the command \NiceMatrixOptions).

\keys_define:nn { NiceMatrix / Env }
{

The key hvlines-except-corners is now deprecated (use hvlines and corners instead).

hvlines-except-corners .code:n =
{
  \@@_error:n { hvlines-except-corners }
  \group_begin:
  \globaldefs = 1
  \@@_msg_redirect_name:nn { hvlines-except-corners } { none }
  \group_end:
  \clist_set:Nn \l_@@_corners_clist { #1 }
  \clist_set:Nn \l_@@_vlines_clist { all }
  \clist_set:Nn \l_@@_hlines_clist { all }
},
hvlines-except-corners .default:n = ( NW , SW , NE , SE ),
corners .clist_set:N = \l_@@_corners_clist ,
corners .default:n = ( NW , SW , NE , SE ),
code-before .code:n =
{ \tl_if_empty:nF { #1 }
  \{ \tl_put_right:Nn \l_@@_code_before_tl { #1 }
    \bool_set_true:N \l_@@_code_before_bool
  } ,
}

The options c, t and b of the environment \{NiceArray\} have the same meaning as the option of the classical environment \{array\}.

c .code:n = \tl_set:Nn \l_@@_baseline_tl c ,
t .code:n = \tl_set:Nn \l_@@_baseline_tl t ,
b .code:n = \tl_set:Nn \l_@@_baseline_tl b ,
baseline .tl_set:N = \l_@@_baseline_tl ,
baseline .value_required:n = true ,
columns-width .code:n = \tl_if_eq:nTF { #1 } { auto }
  { \bool_set_true:N \l_@@_auto_columns_width_bool }
We test whether we are in the measuring phase of an environment of `amsmath` (always loaded by `nicematrix`) because we want to avoid a fallacious message of duplicate name in this case.

\begin{verbatim}
\keys_define:nn { NiceMatrix / notes }
{
  para . \bool_set:N = \l_@@_notes_para_bool ,
  para . \default:n = true ,
  code-before . \tl_set:N = \l_@@_notes_code_before_tl ,
  code-before . \value_required:n = true ,
  code-after . \tl_set:N = \l_@@_notes_code_after_tl ,
  code-after . \value_required:n = true ,
  bottomrule . \bool_set:N = \l_@@_notes_bottomrule_bool ,
  bottomrule . \default:n = true ,
  style . \cs_set:Nn \@@_notes_style:n { #1 } ,
  style . \value_required:n = true ,
  label-in-tabular . \code:n =
  \cs_set:Nn \@@_notes_label_in_tabular:n { \l_@@_notes_label_in_tabular:n { #1 } ,
  label-in-tabular . \value_required:n = true ,
  label-in-list . \code:n =
  \cs_set:Nn \@@_notes_label_in_list:n { \l_@@_notes_label_in_list:n { #1 } ,
  label-in-list . \value_required:n = true ,
  enumitem-keys . \code:n =
  \hook_gput_code:nnn { begindocument } { . } ,
    { \bool_if:NT \c_@@_enumitem_loaded_bool
        \setlist* [ tabularnotes ] { #1 } }
  }
  ,
  enumitem-keys . \value_required:n = true ,
  enumitem-keys-para . \code:n =
  \hook_gput_code:nnn { begindocument } { . } ,
    { \bool_if:NT \c_@@_enumitem_loaded_bool
        \setlist* [ tabularnotes* ] { #1 } }
  }
  ,
  enumitem-keys-para . \value_required:n = true ,
  unknown . \code:n = \@@_error:n { Unknown-key-for-notes }
}
\keys_define:nn { NiceMatrix / delimiters }
{
  max-width . \bool_set:N = \l_@@_delimiters_max_width_bool ,
\end{verbatim}
We begin the construction of the major sets of keys (used by the different user commands and environments).

\keys_define:nn { \NiceMatrix }
{
  \NiceMatrixOptions .inherit:n =
  \{ \NiceMatrix / Global \},
  \NiceMatrixOptions / xdots .inherit:n = \NiceMatrix / xdots ,
  \NiceMatrixOptions / rules .inherit:n = \NiceMatrix / rules ,
  \NiceMatrixOptions / notes .inherit:n = \NiceMatrix / notes ,
  \NiceMatrixOptions / delimiters .inherit:n = \NiceMatrix / delimiters ,
  \NiceMatrixOptions / sub-matrix .inherit:n = \NiceMatrix / sub-matrix ,
  \SubMatrix / rules .inherit:n = \NiceMatrix / rules ,
  \CodeAfter / xdots .inherit:n = \NiceMatrix / xdots ,
  \NiceMatrix .inherit:n =
  \{
    \NiceMatrix / Global ,
    \NiceMatrix / Env ,
  \},
  \NiceMatrix / xdots .inherit:n = \NiceMatrix / xdots ,
  \NiceMatrix / rules .inherit:n = \NiceMatrix / rules ,
  \NiceMatrix / delimiters .inherit:n = \NiceMatrix / delimiters ,
  \NiceTabular .inherit:n =
  \{
    \NiceMatrix / Global ,
    \NiceMatrix / Env ,
  },
  \NiceTabular / xdots .inherit:n = \NiceMatrix / xdots ,
  \NiceTabular / rules .inherit:n = \NiceMatrix / rules ,
  \NiceTabular / delimiters .inherit:n = \NiceMatrix / delimiters ,
  \NiceArray .inherit:n =
  \{
    \NiceMatrix / Global ,
    \NiceMatrix / Env ,
  },
  \NiceArray / xdots .inherit:n = \NiceMatrix / xdots ,
  \NiceArray / rules .inherit:n = \NiceMatrix / rules ,
  \NiceArray / delimiters .inherit:n = \NiceMatrix / delimiters ,
  \pNiceArray .inherit:n =
  \{
    \NiceMatrix / Global ,
    \NiceMatrix / Env ,
  },
  \pNiceArray / xdots .inherit:n = \NiceMatrix / xdots ,
  \pNiceArray / rules .inherit:n = \NiceMatrix / rules ,
  \pNiceArray / delimiters .inherit:n = \NiceMatrix / delimiters ,
}\
\keys_define:nn { \NiceMatrix / \NiceMatrixOptions }
{
  width .code:n = \dim_set:Nn \l_@@_width_dim { #1 } ,
  width .value_required:n = true ,
  last-col .code:n = \tl_if_empty:nF { #1 } \{ #1 
  \{ \l_00\_error:n \{ last-col\-non\-empty\-for\-\NiceMatrixOptions \} \}
  \int_zero:N \l_00\_last\_col_int,
  small .bool_set:N = \l_00\_small\_bool ,
  small .value_forbidden:n = true ,
}

We finalise the definition of the set of keys “\NiceMatrix / \NiceMatrixOptions” with the options specific to \NiceMatrixOptions.
With the option `renew-matrix`, the environment \{matrix\} of \texttt{amsmath} and its variants are redefined to behave like the environment \{NiceMatrix\} and its variants.

The option `exterior-arraycolsep` will have effect only in \{NiceArray\} for those who want to have for \{NiceArray\} the same behaviour as \{array\}.

If the option `columns-width` is used, all the columns will have the same width.

Usually, an error is raised when the user tries to give the same name to two distincts environments of \texttt{nicematrix} (theses names are global and not local to the current \TeX{} scope). However, the option `allow-duplicate-names` disables this feature.

By default, the specifier used in the preamble of the array (for example in \{pNiceArray\}) to draw a vertical dotted line between two columns is the colon ":". However, it's possible to change this letter with `letter-for-dotted-lines` and, by the way, the letter ":" will remain free for other packages (for example \texttt{arydshln}).
We finalise the definition of the set of keys “NiceMatrix / NiceArray” with the options specific to \{NiceArray\}.

\keys_define:nn { NiceMatrix / NiceArray }

{ width .code:n = \tl_if_empty:nF {#1} { \@@_error:n { last-col~non~empty~for~NiceArray } } \int_zero:N \l_@@_last_col_int , notes / para .bool_set:N = \l_@@_notes_para_bool , notes / para .default:n = true , notes / bottomrule .bool_set:N = \l_@@_notes_bottomrule_bool , notes / bottomrule .default:n = true , tabularnote .tl_set:N = \l_@@_tabularnote_tl , tabularnote .value_required:n = true , l .code:n = \@@_error:n { r-or-l-with-preamble } , r .code:n = \@@_error:n { r-or-l-with-preamble } , unknown .code:n = \@@_error:n { Unknown-key-for-NiceArray } }

We finalise the definition of the set of keys “NiceMatrix / NiceTabular” with the options specific to \{NiceTabular\}.

\keys_define:nn { NiceMatrix / NiceTabular }

{ width .code:n = \dim_set:Nn \l_@@_width_dim { #1 } \bool_set_true:N \l_@@_width_used_bool , width .value_required:n = true , notes / para .bool_set:N = \l_@@_notes_para_bool , notes / para .default:n = true , notes / bottomrule .bool_set:N = \l_@@_notes_bottomrule_bool , notes / bottomrule .default:n = true , tabularnote .tl_set:N = \l_@@_tabularnote_tl , tabularnote .value_required:n = true , last-col .code:n = \tl_if_empty:nF {#1} \int_set:Nn \l_@@_last_col_int { #1 } } ,
Important code used by \{NiceArrayWithDelims\}

The pseudo-environment \@@_cell_begin:w–\@@_cell_end: will be used to format the cells of the array. In the code, the affectations are global because this pseudo-environment will be used in the cells of a \halign (via an environment \{array\}).

\cs_new_protected:Npn \@@_cell_begin:w
\{\gl_@@_post_action_cell_tl\}

The token list \g_@@_post_action_cell_tl will be set during the composition of the box \l_@@_cell_box and will be used after the composition in order to modify that box (that’s why it’s called a post-action).

\tl_gclear:N \g_@@_post_action_cell_tl

At the beginning of the cell, we link \CodeAfter to a command which does begins with \ (whereas the standard version of \CodeAfter begins does not).

\cs_set_eq:NN \CodeAfter \@@_CodeAfter_i:

We increment \c@jCol, which is the counter of the columns.

\int_gincr:N \c@jCol

Now, we increment the counter of the rows. We don’t do this incrementation in the \everycr because some packages, like arydshln, create special rows in the \halign that we don’t want to take into account.

\int_compare:nNnT \c@jCol = 1
\{\int_compare:nNnT \l_@@_first_col_int = 1 \@@_begin_of_row: \}

The content of the cell is composed in the box \l_@@_cell_box. The \hbox_set_end: corresponding to this \hbox_set:Nw will be in the \@@_cell_end: (and the potential \c_math_toggle_token also).

\hbox_set:Nw \l_@@_cell_box
\bool_if:NF \l_@@_NiceTabular_bool
\{ \c_math_toggle_token
\bool_if:NT \l_@@_small_bool \scriptstyle
\}

For unexplained reason, with XeTeX (and not with the other engines), the environments of nicematrix were all composed in black and do not take into account the color of the encompassing text. As a workaround, you peek the color in force at the beginning of the environment and we use it now (in each cell of the array).

\color { nicematrix }
\g_@@_row_style_tl

We will call corners of the matrix the cases which are at the intersection of the exterior rows and exterior columns (of course, the four corners doesn’t always exist simultaneously).

The codes \l_@@_code_for_first_row_tl and \al don’t apply in the corners of the matrix.
The following macro \@@_begin_of_row is usually used in the cell number 1 of the row. However, when the key first-col is used, \@@_begin_of_row is executed in the cell number 0 of the row.

The following code is used in each cell of the array. It actualises quantities that, at the end of the array, will give informations about the vertical dimension of the two first rows and the two last rows. If the user uses the last-row, some lines of code will be dynamically added to this command.
The token list \texttt{\g@@post_action_cell_tl} is (potentially) set during the composition of the box \texttt{\l@@cell_box} and is used now after the composition in order to modify that box.

We want to compute in \texttt{\g@@max_cell_width_dim} the width of the widest cell of the array (except the cells of the “first column” and the “last column”).

The following computations are for the “first row” and the “last row”.

If the cell is empty, or may be considered as if, we must not create the PGF node, for two reasons:

- it’s a waste of time since such a node would be rather pointless;
- we test the existence of these nodes in order to determine whether a cell is empty when we search the extremities of a dotted line.

However, it’s very difficult to determine whether a cell is empty. Up to now we use the following technic:

- if the width of the box \texttt{\l@@cell_box} (created with the content of the cell) is equal to zero, we consider the cell as empty (however, this is not perfect since the user may have used a \texttt{\rlap}, a \texttt{\llap} or a \texttt{\mathclap} of \texttt{mathtools}. 

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• the cells with a command \Ldots or \Cdots, \Vdots, etc., should also be considered as empty:
  if nullify-dots is in force, there would be nothing to do (in this case the previous commands
  only write an instruction in a kind of \CodeAfter); however, if nullify-dots is not in force, a
  phantom of \Ldots, \Cdots, \Vdots is inserted and its width is not equal to zero; that’s why
  these commands raise a boolean \g_@@_empty_cell_bool and we begin by testing this boolean.

\bool_if:NTF \g_@@_empty_cell_bool
  \g_@@_empty_cell_bool
  \bool_lazy_or:nnTF \g_@@_not_empty_cell_bool
    \dim_compare_p:nNn { \box_wd:N \l_@@_cell_box } > \c_zero_dim
  \@@_node_for_cell:
    \box_use_drop:N \l_@@_cell_box
\int_gset:Nn \g_@@_col_total_int { \int_max:nn \g_@@_col_total_int \c@jCol }
\bool_gset_false:N \g_@@_empty_cell_bool
\bool_gset_false:N \g_@@_not_empty_cell_bool

The following command creates the PGF name of the node with, of course, \l_@@_cell_box as the
content.

\cs_new_protected:Npn \@@_node_for_cell:
  \pgfpicture
  \pgfsetbaseline \c_zero_dim
  \pgfrememberpicturepositiononpagetrue
  \pgfset
    { inner~sep = \c_zero_dim ,
      minimum~width = \c_zero_dim }
  \pgfnode
    { rectangle }
    { base }
    \box_use_drop:N \l_@@_cell_box
  \@@_env: - \int_use:N \c@iRow - \int_use:N \c@jCol
\endpgfpicture

As its name says, the following command is a patch for the command \@@_node_for_cell:. This
patch will be appended on the left of \@@_node_for_the_cell: when the construction of the cell
nodes (of the form (i-j)) in the \CodeBefore is required.

\cs_new_protected:Npn \@@_patch_node_for_cell:n #1
  \hbox_set:Nn \l_@@_cell_box
  { \box_move_up:nn { \box_ht:N \l_@@_cell_box}
    \box_overlap_left:n
    \pgfsys@markposition
    { \j@env: - \int_use:N \c@iRow - \int_use:N \c@jCol - NW }

I don’t know why the following adjustment is needed when the compilation is done with XeLaTeX
or with the classical way latex, divps, ps2pdf (or Adobe Distiller). However, it seems to work.
We have no explanation for the different behaviour between the \TeX engines...

The second argument of the following command `\@@_instruction_of_type:nnn` defined below is the type of the instruction (Cdots, Vdots, Ddots, etc.). The third argument is the list of options. This command writes in the corresponding \g@@@@type_lines_tl the instruction which will actually draw the line after the construction of the matrix.

For example, for the following matrix,

\begin{pNiceMatrix}
1 & 2 & 3 & 4 \\ 
5 & \Cdots & & 6 \\ 
7 & \Cdots[color=red] \\
\end{pNiceMatrix}

the content of \g@@@@Cdots_lines_tl will be:
`\@@_draw_Cdots:nnn {2}{2}{}`
`\@@_draw_Cdots:nnn {3}{2}{color=red}`

The first argument is a boolean which indicates whether you must put the instruction on the left or on the right on the list of instructions.
\_@\_baseline_tl may have the value t, c or b. However, if the value is b, we compose the array (of array) with the option t and the right translation will be done further. Remark that \str_if_eq:VnTF is fully expandable and you need something fully expandable here.

We keep in memory the standard version of \ialign because we will redefine \ialign in the environment \NiceArrayWithDelims but restore the standard version for use in the cells of the array.

The following command creates a row node (and not a row of nodes!).

The \bbox:n (or \bbox) is mandatory.

The following must not be protected because it begins with \noalign.

We don’t draw now the rules of the key hlines (or hvlines) but we reserve the vertical space for these rules (the rules will be drawn by PGF).
The counter \c@iRow has the value $-1$ only if there is a “first row” and that we are before that “first row”, i.e. just before the beginning of the array.

\begin{Verbatim}
\int_compare:nNnT \c@iRow > { -1 }
\end{Verbatim}

The command \CT@arc@ is a command of colortbl which sets the color of the rules in the array. The package nicematrix uses it even if colortbl is not loaded. We use a TeX group in order to limit the scope of \CT@arc@.

\begin{Verbatim}
\{ \hrule height \arrayrulewidth width \c_zero_dim \\
\}
\end{Verbatim}

The command \@@_newcolumntype is the command \newcolumntype of array without the warnings for redefinitions of columns types (we will use it to redefine the columns types w and W).

\begin{Verbatim}
\cs_set_protected:Npn \@@_newcolumntype #1
\{\cs_set:cpn { NC@ find@ #1 } ##1 #1 { \NC@ { ##1 } }
\peek_meaning:NTF [\newcol@ #1
\{ \newcol@ #1 [ 0 ] }
\}
\end{Verbatim}

When the key renew-dots is used, the following code will be executed.

\begin{Verbatim}
\cs_set_protected:Npn \@@_renew_dots:
\{\cs_set_eq:NN \ldots \@@_Ldots
\cs_set_eq:NN \cdots \@@_Cdots
\cs_set_eq:NN \vdots \@@_Vdots
\cs_set_eq:NN \ddots \@@_Ddots
\cs_set_eq:NN \iddots \@@_Iddots
\cs_set_eq:NN \dots \@@_Ldots
\cs_set_eq:NN \hdotsfor \@@_Hdotsfor:
\}
\end{Verbatim}

When the key colortbl-like is used, the following code will be executed.

\begin{Verbatim}
\cs_new_protected:Npn \@@_colortbl_like:
\{\cs_set_eq:NN \cellcolor \@@_cellcolor_tabular
\cs_set_eq:NN \rowcolor \@@_rowcolor_tabular
\cs_set_eq:NN \columncolor \@@_columncolor_preamble
\}
\end{Verbatim}

The following code \@@_pre_array_ii: is used in \{NiceArrayWithDelims\}. It exists as a standalone macro only for legibility.

\begin{Verbatim}
\cs_new_protected:Npn \@@_pre_array_ii:
\{\xglobal \colorlet { nicematrix } { . }
\}
\end{Verbatim}

For unexplained reason, with XeTeX (and not with the other engines), the environments of nicematrix were all composed in black and do not take into account the color of the encompassing text. As a workaround, you peek the color in force at the beginning of the environment and we will it in each cell.

\begin{Verbatim}
\xglobal \colorlet { nicematrix } { . }
\end{Verbatim}

The number of letters X in the preamble of the array.

\begin{Verbatim}
\int_gzero:N \g_@@_total_X_weight_int
\@@_expand_clist:N \l_@@_hlines_clist
\@@_expand_clist:N \l_@@_vlines_clist
\end{Verbatim}
If `booktabs` is loaded, we have to patch the macro \texttt{\@BTnormal} which is a macro of `booktabs`. The macro \texttt{\@BTnormal} draws an horizontal rule but it occurs after a vertical skip done by a low level TeX command. When this macro \texttt{\@BTnormal} occurs, the \texttt{row} node has yet been inserted by `nicematrix` before the vertical skip (and thus, at a wrong place). That why we decide to create a new \texttt{row} node (for the same row). We patch the macro \texttt{\@BTnormal} to create this \texttt{row} node. This new \texttt{row} node will overwrite the previous definition of that \texttt{row} node and we have managed to avoid the error messages of that redefinition\footnote{cf. `nicematrix@redefine@check@rerun`}.

\begin{verbatim}
\bool_if:NT \c_@@_booktabs_loaded_bool
  { \tl_put_left:Nn \@BTnormal \@@_create_row_node: }
\box_clear_new:N \l_@@_cell_box
\normalbaselines
\end{verbatim}

If the option \texttt{small} is used, we have to do some tuning. In particular, we change the value of \texttt{\arraystretch} (this parameter is used in the construction of \texttt{\@arstrutbox} in the beginning of \texttt{\{array\}}).

\begin{verbatim}
\bool_if:NT \l_@@_small_bool
  {
    \cs_set_nopar:Npn \arraystretch { 0.47 }
    \dim_set:Nn \arraycolsep { 1.45 pt }
  }
\end{verbatim}

\begin{verbatim}
\bool_if:NT \g_@@_recreate_cell_nodes_bool
  {
    \tl_put_right:Nn \@@_begin_of_row:
      { \pgfsys@markposition
        \@@_env: - row - \int_use:N \c@iRow - base }
  }
\end{verbatim}

The environment \texttt{\{array\}} uses internally the command \texttt{\ialign}. We change the definition of \texttt{\ialign} for several reasons. In particular, \texttt{\ialign} sets \texttt{\everycr} to \{\} and we need to have to change the value of \texttt{\everycr}.

\begin{verbatim}
\cs_set_nopar:Npn \ialign
  { \bool_if:NTF \c_@@_colortbl_loaded_bool
    { \CT@everycr
      { \noalign { \cs_gset_eq:NN \CT@row@color \prg_do_nothing: }
        \@@_everycr:
      }
    }
    \tabskip = \c_zero_skip
  }
\end{verbatim}

The box \texttt{\arstrutbox} is a box constructed in the beginning of the environment \texttt{\{array\}}. The construction of that box takes into account the current value of \texttt{\arraystretch}\footnote{The option \texttt{small} of `nicematrix` changes (among others) the value of \texttt{\arraystretch}. This is done, of course, before the call of \texttt{\{array\}}.} and \texttt{\extrarowheight} (of \texttt{array}). That box is inserted (via \texttt{\arstrut}) in the beginning of each row of the array. That’s why we use the dimensions of that box to initialize the variables which will be the dimensions of the potential first and last row of the environment. This initialization must be done after the creation of \texttt{\arstrutbox} and that’s why we do it in the \texttt{\ialign}.

\begin{verbatim}
\dim_gzero_new:N \g_@@_dp_row_zero_dim
\dim_gzero_new:N \g_@@_ht_row_zero_dim
\dim_gzero_new:N \g_@@_dp_row_zero_dim { \box_dp:N \arstrutbox }
\dim_gzero_new:N \g_@@_ht_row_zero_dim { \box_ht:N \arstrutbox }
\end{verbatim}
After its first use, the definition of \ialign will revert automatically to its default definition. With this programmation, we will have, in the cells of the array, a clean version of \ialign.

We keep in memory the old versions or \ldots, \cdots, etc. only because we use them inside \phantom commands in order that the new commands \Ldots, \Cdots, etc. give the same spacing (except when the option nullify-dots is used).

We redefine \multicolumn and, since we want \multicolumn to be available in the potential environments \{tabular\} nested in the environments of \nicematrix, we patch \{tabular\} to go back to the original definition.

We redefine \multicolumn and, since we want \multicolumn to be available in the potential environments \{tabular\} nested in the environments of \nicematrix, we patch \{tabular\} to go back to the original definition.
At the end of the environment `{array}`, \texttt{\c@iRow} will be the total number of rows. \texttt{\g_@@_row_total_int} will be the number of rows excepted the last row (if \texttt{\l_@@_last_row_bool} has been raised with the option `last-row`).

\begin{verbatim}
\int_gzero_new:N \g_@@_row_total_int
\end{verbatim}

The counter \texttt{\c@jCol} will be used to count the columns of the array. Since we want to know the total number of columns of the matrix, we also create a counter \texttt{\g_@@_col_total_int}. These counters are updated in the command \texttt{\@@_cell_begin:w} executed at the beginning of each cell.

\begin{verbatim}
\int_gzero_new:N \g_@@_col_total_int
\cs_set_eq:NN \@ifnextchar \new@ifnextchar
\@@_renew_NC@rewrite@S:
\bool_gset_false:N \g_@@_last_col_found_bool
\end{verbatim}

During the construction of the array, the instructions \texttt{\Cdots}, \texttt{\Ldots}, etc. will be written in token lists \texttt{\g_@@_Cdots_lines_tl}, etc. which will be executed after the construction of the array.

\begin{verbatim}
\tl_gclear_new:N \g_@@_Cdots_lines_tl
\tl_gclear_new:N \g_@@_Ldots_lines_tl
\tl_gclear_new:N \g_@@_Vdots_lines_tl
\tl_gclear_new:N \g_@@_Ddots_lines_tl
\tl_gclear_new:N \g_@@_Iddots_lines_tl
\tl_gclear_new:N \g_@@_HVdotsfor_lines_tl
\tl_gclear_new:N \g_nicematrix_code_before_tl
\end{verbatim}

This is the end of \texttt{\@@_pre_array_ii}.

The command \texttt{\@@_pre_array} will be executed after analyse of the keys of the environment.

\begin{verbatim}
\cs_new_protected:Npn \@@_pre_array: 
\end{verbatim}

We recall that \texttt{\l_@@_last_row_int} and \texttt{\l_@@_last_column_int} are not the numbers of the last row and last column of the array. There are only the values of the keys `last-row` and `last-column` (maybe the user has provided erroneous values). The meaning of that counters does not change during the environment of \texttt{nicematrix}. There is only a slight adjustment: if the user have used one of those keys without value, we provide now the right value as read on the aux file (of course, it’s possible only after the first compilation).

\begin{verbatim}
\int_compare:nNnT \l_@@_last_row_int = {-1} 
\int_compare:nNnT \l_@@_last_col_int = {-1} 
\int_compare:nNnT \l_@@_last_row_int > {-2} 
\end{verbatim}

If there is a exterior row, we patch a command used in \texttt{\@@_cell_begin:w} in order to keep track of some dimensions needed to the construction of that “last row”.

\begin{verbatim}
\tl_put_right:Nn \@@_update_for_first_and_last_row: 
\end{verbatim}
\dim_gset:Nn \g_@@_ht_last_row_dim { \dim_max:nn \g_@@_ht_last_row_dim { \box_ht:N \l_@@_cell_box } }
\dim_gset:Nn \g_@@_dp_last_row_dim { \dim_max:nn \g_@@_dp_last_row_dim { \box_dp:N \l_@@_cell_box } }
}

\seq_gclear:N \g_@@_cols_vlism_seq
\seq_gclear:N \g_@@_submatrix_seq

Now the CodeBefore.
\bool_if:NT \l_@@_code_before_bool \@@_exec_code_before:

The value of \g_@@_pos_of_blocks_seq has been written on the aux file and loaded before the (potential) execution of the CodeBefore. Now, we clear that variable because it will be reconstructed during the creation of the array.
\seq_gclear:N \g_@@_pos_of_blocks_seq

Idem for other sequences written on the aux file.
\seq_gclear_new:N \g_@@_multicolumn_cells_seq
\seq_gclear_new:N \g_@@_multicolumn_sizes_seq

The code in \@@_pre_array_ii: is used only here.
\@@_pre_array_ii:

The array will be composed in a box (named \l_@@_the_array_box) because we have to do manipulations concerning the potential exterior rows.
\box_clear_new:N \l_@@_the_array_box

The preamble will be constructed in \g_@@_preamble_tl.
\@@_construct_preamble:

Now, the preamble is constructed in \g_@@_preamble_tl.

We compute the width of both delimiters. We remember that, when the environment \{NiceArray\} is used, it’s possible to specify the delimiters in the preamble (eg [ccc]).
\dim_zero_new:N \l_@@_left_delim_dim
\dim_zero_new:N \l_@@_right_delim_dim
\bool_if:NTF \l_@@_NiceArray_bool {
  \dim_gset:Nn \l_@@_left_delim_dim { 2 \arraycolsep }
  \dim_gset:Nn \l_@@_right_delim_dim { 2 \arraycolsep }
}
\bool_if:NTF \l_@@_NiceArray_bool {
  \dim_gset:Nn \l_@@_left_delim_dim { 2 \arraycolsep }
  \dim_gset:Nn \l_@@_right_delim_dim { 2 \arraycolsep }
}

The command \bBigg@ is a command of amsmath.
\hbox_set:Nn \l_tmpa_box { $ \bBigg@ 5 \g_@@_left_delim_tl $ }
\dim_set:Nn \l_@@_left_delim_dim { \box_wd:N \l_tmpa_box }
\hbox_set:Nn \l_tmpa_box { $ \bBigg@ 5 \g_@@_right_delim_tl $ }
\dim_set:Nn \l_@@_right_delim_dim { \box_wd:N \l_tmpa_box }

Here is the beginning of the box which will contain the array. The \hbox_set_end: corresponding to this \hbox_set:Nn will be in the second part of the environment (and the closing \c_math_toggle_token also).
\hbox_set:N \l_@@_the_array_box
The following command \ @@_pre_array_i:w will be used when the keyword \CodeBefore is present at the beginning of the environment.

\cs_new_protected:Npn \@@_pre_array_i:w #1 \Body
{
  \tl_put_right:Nn \l_@@_code_before_tl { #1 }
  \bool_set_true:N \l_@@_code_before_bool
}

We go on with \ @@_pre_array: which will (among other) execute the \CodeBefore (specified in the key code-before or after the keyword \CodeBefore). By definition, the \CodeBefore must be executed before the body of the array...

\@@_pre_array:

The \CodeBefore

The following command will be executed if the \CodeBefore has to be actually executed.

\cs_new_protected:Npn \@@_pre_code_before:
{
  First, we give values to the LaTeX counters iRow and jCol. We remind that, in the \CodeBefore (and in the \CodeAfter) they represent the numbers of rows and columns of the array (without the potential last row and last column). The value of \g_@@_row_total_int is the number of the last row (with potentially a last exterior row) and \g_@@_col_total_int is the number of the last column (with potentially a last exterior column).

\int_set:Nn \c@iRow { \seq_item:Nn \c_@@_size_seq 2 }
\int_set:Nn \c@jCol { \seq_item:Nn \c_@@_size_seq 5 }
\int_set_eq:NN \g_@@_row_total_int { \seq_item:Nn \c_@@_size_seq 3 }
\int_set_eq:NN \g_@@_col_total_int { \seq_item:Nn \c_@@_size_seq 6 }

Now, we will create all the col nodes and row nodes with the informations written in the aux file. You use the technique described in the page 1229 of pgfmanual.pdf, version 3.1.4b.

\pgfsys@markposition { \@@_env: - position }
\pgfsys@getposition { \@@_env: - position } \@@_picture_position:
\pgfpicture
\pgfrelevantforpicturesizefalse

First, the recreation of the row nodes.

\int_step_inline:nnn \l_@@_first_row_int { \g_@@_row_total_int + 1 }
{
  \pgfsys@getposition { \@@_env: - row - #1 } \@@_node_position:
  \pgfcoordinate { \@@_env: - row - #1 } \@@_node_position:
  \pgfpointdiff \@@_picture_position: \@@_node_position: }

Now, the recreation of the col nodes.

\int_step_inline:nnn \l_@@_first_col_int { \g_@@_col_total_int + 1 }
{
  \pgfsys@getposition { \@@_env: - col - #1 } \@@_node_position:
  \pgfcoordinate { \@@_env: - col - #1 } \@@_node_position:
  \pgfpointdiff \@@_picture_position: \@@_node_position: }

Now, you recreate the diagonal nodes by using the row nodes and the col nodes.

\@@_create_diag_nodes:
Now, the creation of the cell nodes (i-j), and, maybe also the “medium nodes” and the “large nodes”.

\bool_if:NT \g_@@_recreate_cell_nodes_bool \@@_recreate_cell_nodes: \endpgfpicture

Now, the recreation of the nodes of the blocks which have a name.

\bool_if:NT \c_@@_tikz_loaded_bool
\tikzset
\{\every_picture / .style = { overlay, name-prefix = \@@_env: - }\}
\cs_set_eq:NN \cellcolor \@@_cellcolor
\cs_set_eq:NN \rectanglecolor \@@_rectanglecolor
\cs_set_eq:NN \roundedrectanglecolor \@@_roundedrectanglecolor
\cs_set_eq:NN \rowcolor \@@_rowcolor
\cs_set_eq:NN \rowcolors \@@_rowcolors
\cs_set_eq:NN \rowlistcolors \@@_rowlistcolors
\cs_set_eq:NN \arraycolor \@@_arraycolor
\cs_set_eq:NN \columncolor \@@_columncolor
\cs_set_eq:NN \chessboardcolors \@@_chessboardcolors
\cs_set_eq:NN \SubMatrix \@@_SubMatrix_in_code_before
\cs_new_protected:Npn \@@_exec_code_before:
\exp_last_unbraced:NV \@@_CodeBefore_keys: \l_@@_code_before_tl \q_stop
\@@_actually_color:
\bool_if:NT \l_@@_NiceTabular_bool \c_math_toggle_token
\group_end:
\bool_if:NT \g_@@_recreate_cell_nodes_bool
\{ \tl_put_left:Nn \@@_node_for_cell: \@@_patch_node_for_cell: \}

We compose the \CodeBefore in math mode in order to nullify the spaces put by the user between instructions in the code-before.

\bool_if:NT \l_@@_NiceTabular_bool \c_math_toggle_token
Here is the \CodeBefore. The construction is a bit complicated because \l_@@_code_before_tl may begin with keys between square brackets. Moreover, after the analyze of those keys, we sometimes have to decide to do not execute the rest of \l_@@_code_before_tl (when it is asked for the creation of cell nodes in the \CodeBefore). That’s why we begin with a \q_stop: it will be used to discard the rest of \l_@@_code_before_tl.

\exp_last_unbraced:NV \@@_CodeBefore_keys: \l_@@_code_before_tl \q_stop

Now, all the cells which are specified to be colored by instructions in the \CodeBefore will actually be colored. It’s a two-stages mechanism because we want to draw all the cells with the same color at the same time to absolutely avoid thin white lines in some PDF viewers.

\bool_if:NT \l_@@_NiceTabular_bool \c_math_toggle_token
\group_end:
\bool_if:NT \g_@@_recreate_cell_nodes_bool
\{ \tl_put_left:Nn \@@_node_for_cell: \@@_patch_node_for_cell: \}

\keys_define:nn { NiceMatrix / CodeBefore }
\{ create-cell-nodes .bool_gset:N = \g_@@_recreate_cell_nodes_bool ,
create-cell-nodes .default:n = true ,
sub-matrix .code:n = \keys_set:nn { NiceMatrix / sub-matrix } { #1 } ,
sub-matrix .value_required:n = true ,
delimiters / color .tl_set:N = \l_@@_delimiters_color_tl ,
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We have extracted the options of the keyword `\CodeBefore` in order to see whether the key `create-cell-nodes` has been used. Now, you can execute the rest of the `\CodeAfter`, excepted, of course, if we are in the first compilation.

By default, if the user uses the `\CodeBefore`, only the `col` nodes, `row` nodes and `diag` nodes are available in that `\CodeBefore`. With the key `create-cell-nodes`, the cell nodes, that is to say the nodes of the form (i-j) (but not the extra nodes) are also available because those nodes also are recreated and that recreation is done by the following command.
The following command is called \texttt{\_create_one_block_node:nnnnn} but, in fact, it creates a node only if the last argument \texttt{(#5)} which is the name of the block, is not empty.\footnote{Moreover, there is also in the list \texttt{\_pos_of_blocks_seq} the positions of the dotted lines (created by \texttt{\Cdots}, etc.) and, for these entries, there is, of course, no name (the fifth component is empty).}
The environment \texttt{NiceArrayWithDelims}

\begin{verbatim}
\NewDocumentEnvironment { NiceArrayWithDelims } { m m O { } m ! O { } t \CodeBefore }
\begin{NiceArrayWithDelims}
\tl_gset:Nn \g_@@_left_delim_tl { #1 }
\tl_gset:Nn \g_@@_right_delim_tl { #2 }
\tl_gset:Nn \g_@@_preamble_tl { #4 }
\int_gzero:N \g_@@_block_box_int
\dim_zero:N \g_@@_width_last_col_dim
\dim_zero:N \g_@@_width_first_col_dim
\bool_gset_false:N \g_@@_row_of_col_done_bool
\str_if_empty:NT \g_@@_name_env_str
{ \str_gset:Nn \g_@@_name_env_str { NiceArrayWithDelims } }
\bool_if:NTF \l_@@_NiceTabular_bool
\mode_leave_vertical:
@@_test_if_math_mode:
\bool_if:NT \l_@@_in_env_bool { @@_fatal:n { Yet~in~env } }
\bool_set_true:N \l_@@_in_env_bool
\cs_gset_eq:NN \@@_old_CT@arc@ \CT@arc@
\cs_if_exist:NT \tikz@library@external@loaded
{ \tikzexternaldisable
\cs_if_exist:NT \ifstandalone
{ \tikzset { external / optimize = false } }
}
\int_gincr:N \g_@@_env_int
\bool_if:NT \l_@@_block_auto_columns_width_bool
{ \dim_gzero_new:N \g_@@_max_cell_width_dim }
\seq_gclear:N \g_@@_blocks_seq
\seq_gclear:N \g_@@_pos_of_blocks_seq
\seq_gclear:N \g_@@_pos_of_stroken_blocks_seq
\seq_gclear:N \g_@@_pos_of_xdots_seq
\tl_gclear_new:N \g_@@_code_before_tl
\end{NiceArrayWithDelims}
\end{verbatim}

The aim of the following \texttt{bgroup} (the corresponding \texttt{egroup} is, of course, at the end of the environment) is to be able to put an exposant to a matrix in a mathematical formula.

\begin{verbatim}
\begin{bgroup}
\tl_gset:Nn \g_@@_left_delim_tl { #1 }
\tl_gset:Nn \g_@@_right_delim_tl { #2 }
\tl_gset:Nn \g_@@_preamble_tl { #4 }
\int_gzero:N \g_@@_block_box_int
\dim_zero:N \g_@@_width_last_col_dim
\dim_zero:N \g_@@_width_first_col_dim
\str_if_empty:NT \g_@@_name_env_str
{ \str_gset:Nn \g_@@_name_env_str { NiceArrayWithDelims } }
\tl_gset:Nn \g_@@_code_before_tl { #3 }
\end{bgroup}
\end{verbatim}

The command \texttt{\CT@arc@} contains the instruction of color for the rules of the array\textsuperscript{65}. This command is used by \texttt{\CT@arc@} but we use it also for compatibility with color\texttt{tab}. But we want also to be able to use color for the rules of the array when color\texttt{tab} is not loaded. That’s why we do the following instruction which is in the patch of the beginning of arrays done by color\texttt{tab}. Of course, we restore the value of \texttt{\CT@arc@} at the end of our environment.

\begin{verbatim}
\cs_gset_eq:NN \@@_old_CT@arc@ \CT@arc@
\cs_if_exist:NT \tikz@library@external@loaded
{ \tikzexternaldisable
\cs_if_exist:NT \ifstandalone
{ \tikzset { external / optimize = false } }
}
\end{verbatim}

We deactivate Tikz externalization because we will use PGF pictures with the options \texttt{overlay} and \texttt{remember picture} (or equivalent forms). We deactivate with \texttt{tikzexternaldisable} and not with \texttt{\tikzset{external/export=false}} which is not equivalent.

\begin{verbatim}
\cs_if_exist:NT \tikz@library@external@loaded
{ \tikzexternaldisable
\cs_if_exist:NT \ifstandalone
{ \tikzset { external / optimize = false } }
}
\end{verbatim}

We increment the counter \texttt{\g_@@_env_int} which counts the environments of the package.

\begin{verbatim}
\int_gincr:N \g_@@_env_int
\bool_if:NT \l_@@_block_auto_columns_width_bool
{ \dim_gzero_new:N \g_@@_max_cell_width_dim }
\end{verbatim}

The sequence \texttt{\g_@@_blocks_seq} will contain the caracteristics of the blocks (specified by \texttt{\Block}) of the array. The sequence \texttt{\g_@@_pos_of_blocks_seq} will contain only the position of the blocks (except the blocks with the key \texttt{hvlines}).

\begin{verbatim}
\seq_gclear:N \g_@@_blocks_seq
\seq_gclear:N \g_@@_pos_of_blocks_seq
\end{verbatim}

In fact, the sequence \texttt{\g_@@_pos_of_blocks_seq} will also contain the positions of the cells with a \texttt{\diagbox}. 

\begin{verbatim}
\seq_gclear:N \g_@@_pos_of_stroken_blocks_seq
\seq_gclear:N \g_@@_pos_of_xdots_seq
\tl_gclear_new:N \g_@@_code_before_tl
\end{verbatim}

\textsuperscript{65}e.g. \texttt{\color\[rgb\]{0.5,0.5,0}}

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We load all the informations written in the aux file during previous compilations corresponding to the current environment.

Now, we prepare the token list for the instructions that we will have to write on the aux file at the end of the environment.

The set of keys is not exactly the same for \{NiceArray\} and for the variants of \{NiceArray\} ((pNiceArray), \{bNiceArray\}, etc.) because, for \{NiceArray\}, we have the options \textit{t}, \textit{c}, \textit{b} and \textit{baseline}.

The argument \#6 is the last argument of \{NiceArrayWithDelims\}. With that argument of type “t \CodeBefore”, we test whether there is the keyword \CodeBefore at the beginning of the body of the environment. If that keyword is present, we have now to extract all the content between that keyword \CodeBefore and the (other) keyword \Body. It’s the job that will do the command \@@_pre_array_i:w. After that job, the command \@@_pre_array_i:w will go on with \@@_pre_array:.

End of the construction of the array (in the box \l_@@_the_array_box).

If the user has used the key weight without any column X, we raise an error.

Now, if there is at least one X-column in the environment, we compute the width that those columns will have (in the next compilation). In fact, \l_@@_X_columns_dim will be the width of a column of weight 1. For a X-column of weight \(n\), the width will be \l_@@_X_columns_dim multiplied by \(n\).
\tl_gput_right:Nx \g_@@_aux_tl
{
\bool_set_true:N \l_@@_X_columns_aux_bool
\dim_set:Nn \l_@@_X_columns_dim
{
\dim_compare:nNnTF
{\dim_abs:n}{\l_@@_width_dim}{-\box_wd:N \l_@@_the_array_box}
}<
{0.001 pt}
{\dim_use:N \l_@@_X_columns_dim}
{\dim_eval:n}{(\l_@@_width_dim}{\box_wd:N \l_@@_the_array_box)
/\int_use:N \g_@@_total_X_weight_int
+\l_@@_X_columns_dim}
}
}
}

It the user has used the key last-row with a value, we control that the given value is correct (since we have just constructed the array, we know the real number of rows of the array).
\int_compare:nNnT \l_@@_last_row_int > { -2 }
{\bool_if:NF \l_@@_last_row_without_value_bool
{\int_compare:nNnF \l_@@_last_row_int = \c@iRow
{\@@_error:n {Wrong-last-row}
\int_gset_eq:NN \l_@@_last_row_int \c@iRow
}
}
}

Now, the definition of \c@jCol and \g_@@_col_total_int change: \c@jCol will be the number of columns without the “last column”; \g_@@_col_total_int will be the number of columns with this “last column”.
\int_gset_eq:NN \c@jCol \g_@@_col_total_int
\bool_if:nTF \g_@@_last_col_found_bool
{\int_gdecr:N \c@jCol}
{\@@_error:n {last-col-not-used}}
}

We fix also the value of \c@iRow and \g_@@_row_total_int with the same principle.
\int_gset_eq:NN \c@iRow \g_@@_row_total_int
\int_compare:nNnT \l_@@_last_row_int > { -1 }
{\@@_error:n {last-col-not-used}}
}

Now, we begin the real construction in the output flow of TeX. First, we take into account a potential “first column” (we remind that this “first column” has been constructed in an overlapping position and that we have computed its width in \g_@@_width_first_col_dim: see p. 128).
\int_compare:nNnT \l_@@_first_col_int = 0
{\skip_horizontal:N \col@sep
\skip_horizontal:N \g_@@_width_first_col_dim
}

\footnote{We remind that the potential “first column” (exterior) has the number 0.}
The construction of the real box is different when \_@@_NiceArray bool is true (\{NiceArray\} or \{NiceTabular\}) and in the other environments because, in \{NiceArray\} or \{NiceTabular\}, we have no delimiter to put (but we have tabular notes to put). We begin with this case.

\bool_if:NTF \_@@_NiceArray bool
\{ \str_case:VnF \_@@_baseline_tl
\{ b \_@@_use_arraybox_with_notes_b:
c \_@@_use_arraybox_with_notes_c:
\} \_@@_use_arraybox_with_notes:
\}

Now, in the case of an environment \{pNiceArray\}, \{bNiceArray\}, etc. We compute \_\_tmpa_dim which is the total height of the “first row” above the array (when the key first-row is used).

\int_compare:nNnTF \_@@_first_row_int = 0
\{ \dim_set_eq:NN \_tmpa_dim \g_@@_dp_row_zero_dim
\dim_add:Nn \_tmpa_dim \g_@@_ht_row_zero_dim
\}
\dim_zero:N \_tmpa_dim

We compute \_\_tmpb_dim which is the total height of the “last row” below the array (when the key last-row is used). A value of −2 for \_@@_last_row_int means that there is no “last row.”

\int_compare:nNnTF \_@@_last_row_int > { -2 }
\{ \dim_set_eq:NN \_tmpb_dim \g_@@_ht_last_row_dim
\dim_add:Nn \_tmpb_dim \g_@@_dp_last_row_dim
\}
\dim_zero:N \_tmpb_dim
\hbox_set:Nn \_\_tmpa_box
\{ \c_math_toggle_token
\tl_if_empty:NF \_@@_delimiters_color_tl
\{ \color { \_@@_delimiters_color_tl }
\exp_after:wN \left \g_@@_left_delim_tl
\vcenter
\skip_vertical:n { -\_tmpa_dim - \arrayrulewidth }
\hbox
\skip_horizontal:N -\tabcolsep
\skip_horizontal:N -\arraycolsep
\_@@_use_arraybox_with_notes_c:
\bool_if:NTF \_@@_NiceTabular bool
\{ \skip_horizontal:N -\tabcolsep }
\skip_horizontal:N -\arraycolsep
\_@@_use_arraybox_with_notes_c:
\bool_if:NTF \_@@_NiceTabular bool
\{ \skip_horizontal:N -\tabcolsep }
\skip_horizontal:N -\arraycolsep
\}

We take into account the “first row” (we have previously computed its total height in \_\_tmpa_dim). The \hbox:n (or \hbox) is necessary here. There was a bug in the following line (corrected the 2021/11/23).

\skip_vertical:n { -\_tmpa_dim - \arrayrulewidth }
\hbox
\skip_horizontal:N -\tabcolsep
\skip_horizontal:N -\arraycolsep
\_@@_use_arraybox_with_notes_c:
\bool_if:NTF \_@@_NiceTabular bool
\{ \skip_horizontal:N -\tabcolsep }
\skip_horizontal:N -\arraycolsep
\_@@_use_arraybox_with_notes_c:
\bool_if:NTF \_@@_NiceTabular bool
\{ \skip_horizontal:N -\tabcolsep }
\skip_horizontal:N -\arraycolsep
\}

We take into account the “last row” (we have previously computed its total height in \_\_tmpb_dim). There was a bug in the following line (corrected the 2021/11/23).

\skip_vertical:n { -\_tmpb_dim + \arrayrulewidth }

\footnote{A value of −1 for \_\_@@_last_row_int means that there is a “last row” but the user have not set the value with the option last row (and we are in the first compilation).}
Curiously, we have to put again the following specification of color. Otherwise, with XeLaTeX (and not with the other engines), the closing delimiter is not colored.

\l_if_empty:NF \l_@@_delimiters_color_tl
  \l_@@_delimiters_color_tl
  \l @@_delimiters_color_tl
  \l_@@_delimiters_color_tl
  \l_@@_delimiters_color_tl
  \l_@@_delimiters_color_tl
  \c_math_toggle_token

Now, the box \l_tmpa_box is created with the correct delimiters.

We will put the box in the TeX flow. However, we have a small work to do when the option delimiters/max-width is used.

\bool_if:NTF \l_@@_delimiters_max_width_bool
  \@@_put_box_in_flow_bis:nn \g_@@_left_delim_tl \g_@@_right_delim_tl

We take into account a potential “last column” (this “last column” has been constructed in an overlapping position and we have computed its width in \g_@@_width_last_col_dim: see p. 129).

\bool_if:NT \g_@@_last_col_found_bool
  \skip_horizontal:N \g_@@_width_last_col_dim
  \skip_horizontal:N \col@sep

\bool_if:NF \l_@@_Matrix_bool
  \int_compare:nNnT \c@jCol < \g_@@_static_num_of_col_int
  \@@_error:n { columns~not~used }

The aim of the following \egroup (the corresponding \bgroup is, of course, at the beginning of the environment) is to be able to put an exposant to a matrix in a mathematical formula.

\egroup

We want to write on the aux file all the informations corresponding to the current environment.

\iow_now:Nn \@mainaux { \ExplSyntaxOn }
\iow_now:Nn \@mainaux { \char_set_catcode_space:n { 32 } }
\iow_now:Nx \@mainaux { \tl_gset:cn { c_@@_ \int_use:N \g_@@_env_int _ tl } }
\iow_now:Nn \@mainaux { \ExplSyntaxOff }

This is the end of the environment \NiceArrayWithDelims.

We construct the preamble of the array

The transformation of the preamble is an operation in several steps.

The preamble given by the final user is in \g_@@_preamble_tl and the modified version will be stored in \g_@@_preamble_tl also.
First, we will do an “expansion” of the preamble with the tools of the package \texttt{array} itself. This “expansion” will expand all the constructions with \* and with all column types (defined by the user or by various packages using \texttt{\newcolumntype}). Since we use the tools of \texttt{array} to do this expansion, we will have a programming which is not in the style of the L3 programming layer.

We redefine the column types \texttt{w} and \texttt{W}. We use \texttt{\@@_newcolumntype} instead of \texttt{\newcolumntype} because we don’t want warnings for column types already defined. These redefinitions are in fact protections of the letters \texttt{w} and \texttt{W}. We don’t want these columns type expanded because we will do the patch ourselves after. We want to be able to use the standard column types \texttt{w} and \texttt{W} in potential \texttt{\{tabular\}} of \texttt{array} in some cells of our array. That’s why we do those redefinitions in a TeX group.

\begin{verbatim}
\cs_new_protected:Npn \@@_construct_preamble:
{ }
\end{verbatim}

If we are in an environment without explicit preamble, we have nothing to do (excepted the treatment on both sides of the preamble which will be done at the end).

\begin{verbatim}
\bool_if:NF \l_@@_Matrix_bool
{ \@@_newcolumntype w [ 2 ] \{ \@@_w: { ##1 } { ##2 } \}
\@@_newcolumntype W [ 2 ] \{ \@@_W: { ##1 } { ##2 } \}
If the package \texttt{varwidth} has defined the column type \texttt{V}, we protect from expansion by redefining it to \texttt{\@@_V:} (which will be catched by our system).
\cs_if_exist:NT \NC@find@V { \@@_newcolumntype V \{ \@@_V: \} }
\end{verbatim}

First, we have to store our preamble in the token register \texttt{\@temptokena} (those “token registers” are not supported by the L3 programming layer).

\begin{verbatim}
\exp_args:NV \@temptokena \g_@@_preamble_tl
Initialisation of a flag used by \texttt{array} to detect the end of the expansion.
\@tempswatrue
The following line actually does the expansion (it’s has been copied from \texttt{array.sty}). The expanded version is still in \texttt{\temptokena}.
\@whilesw \if@tempswa \fi { \@tempswafalse \the \NC@list }
Now, we have to “patch” that preamble by transforming some columns. We will insert in the TeX flow the preamble in its actual form (that is to say after the “expansion”) following by a marker \texttt{\q_stop} and we will consume these tokens constructing the (new form of the) preamble in \texttt{\g_@@_preamble_tl}. This is done recursively with the command \texttt{\@@_patch_preamble:n}. In the same time, we will count the columns with the counter \texttt{\c@jCol}.

\begin{verbatim}
\int_gzero:N \c@jCol
\tl_gclear:N \g_@@_preamble_tl
\g_tmpb_bool will be raised if you have a | at the end of the preamble.
\bool_gset_false:N \g_tmpb_bool
\tl_gclear:N \g_@@_preamble_tl
\tl_if_eq:NnTF \l_@@_vlines_clist \{ all \}
{ }
\tl_gset:Nn \g_@@_preamble_tl
{ ! { \skip_horizontal:N \arrayrulewidth } }
\clist_if_in:NnT \l_@@_vlines_clist 1
{ ! { \skip_horizontal:N \arrayrulewidth } }
\seq_clear:N \g_@@_cols_vlism_seq
The sequence \texttt{\g_@@_cols_vlism_seq} will contain the numbers of the columns where you will to have to draw vertical lines in the potential sub-matrices (hence the name \texttt{vlism}).
\end{verbatim}

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The counter \l_tmpa_int will count the number of consecutive occurrences of the symbol |.
\int_zero:N \l_tmpa_int

Now, we actually patch the preamble (and it is constructed in \g_@@_preamble_tl).
\exp_after:wN \@@_patch_preamble:n \the \@temptokena \q_stop
\int_gset_eq:NN \g_@@_static_num_of_col_int \c@jCol
\}

Now, we replace \columncolor by @@_columncolor_preamble.
\bool_if:NT \l_@@_colortbl_like_bool
{ \regex_replace_all:NnN \c_@@_columncolor_regex
{ \c{ @@_columncolor_preamble } }
\g_@@_preamble_tl
}

Now, we can close the TeX group which was opened for the redefinition of the columns of type \texttt{w} and \texttt{W}.
\group_end:

If there was delimiters at the beginning or at the end of the preamble, the environment \texttt{NiceArray} is transformed into an environment \texttt{xNiceMatrix}.
\bool_lazy_or:nnT
{ ! \str_if_eq_p:Vn \g_@@_left_delim_tl { . } }
{ ! \str_if_eq_p:Vn \g_@@_right_delim_tl { . } }
{ \bool_set_false:N \l_@@_NiceArray_bool }

We want to remind whether there is a specifier | at the end of the preamble.
\bool_if:NT \g_tmpb_bool { \bool_set_true:N \l_@@_bar_at_end_of_pream_bool }

We complete the preamble with the potential “exterior columns” (on both sides).
\int_compare:nNnTF \l_@@_first_col_int = 0
{ \tl_gput_left:NV \g_@@_preamble_tl \c_@@_preamble_first_col_tl }
{ \bool_lazy_all:nT
{ \l_@@_NiceArray_bool
{ \bool_not_p:n \l_@@_NiceTabular_bool }
{ \tl_if_empty_p:N \l_@@_vlines_clist }
{ \bool_not_p:n \l_@@_exterior_arraycolsep_bool }
}
{ \tl_gput_left:Nn \g_@@_preamble_tl { @ { } } }
}
\int_compare:nNnTF \l_@@_last_col_int > { -1 }
{ \tl_gput_right:NV \g_@@_preamble_tl \c_@@_preamble_last_col_tl }
{ \bool_lazy_all:nT
{ \l_@@_NiceArray_bool
{ \bool_not_p:n \l_@@_NiceTabular_bool }
{ \tl_if_empty_p:N \l_@@_vlines_clist }
{ \bool_not_p:n \l_@@_exterior_arraycolsep_bool }
}
{ \tl_gput_right:Nn \g_@@_preamble_tl { @ { } } }
}

We add a last column to raise a good error message when the user puts more columns than allowed by its preamble. However, for technical reasons, it’s not possible to do that in \texttt{NiceTabular*} (\l_@@_tabular_width_dim=0pt).
\dim_compare:nNnT \l_@@_tabular_width_dim = \c_zero_dim
{ \tl_gput_right:Nn \g_@@_preamble_tl
\}

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The command \_\_\_patch_preamble::n is the main function for the transformation of the preamble. It is recursive.

\cs_new_protected:Npn \_\_\_patch_preamble:n #1
\str_case:nnF { #1 }
\{
\}
c { \_\_\_patch_preamble_i:n #1 }
l { \_\_\_patch_preamble_i:n #1 }
r { \_\_\_patch_preamble_i:n #1 }
> { \_\_\_patch_preamble_ii:nn #1 }
! { \_\_\_patch_preamble_ii:nn #1 }
\ { \_\_\_patch_preamble_ii:nnnn nn #1 }
| { \_\_\_patch_preamble_ii:nnnn nn #1 }
p { \_\_\_patch_preamble_iv:n #1 }
b { \_\_\_patch_preamble_iv:n #1 }
m { \_\_\_patch_preamble_iv:n #1 }
V { \_\_\_patch_preamble_v:n }
\_\_\_v: { \_\_\_patch_preamble_v:n }
V { \_\_\_patch_preamble_v:n }
\_\_\_W: { \_\_\_patch_preamble_vi:nnnn } #1
\_\_\_W: { \_\_\_patch_preamble_vi:nnnn } \cs_set_eq:NN \hss \hfil 
\_\_\_S: { \_\_\_patch_preamble_vii:n }
( { \_\_\_patch_preamble_viii:nn #1 }
) { \_\_\_patch_preamble_viii:nnnn nn #1 }
] { \_\_\_patch_preamble_ix:nn #1 }
X { \_\_\_patch_preamble_x:n }

When tabularx is loaded, a local redefinition of the specifier X is done to replace X by \_\_\_X. Thus, our column type X will be used in the \{NiceTabularX\}.

\_\_\_X { \_\_\_patch_preamble_x:n }

\q_stop \}
\}
\str_case:e:nnF { #1 }
\l_\_\_letter_for_dotted_lines_str { \_\_\_patch_preamble_xii:n #1 }
\l_\_\_letter_vlism_tl
\seq_gput_right:Nx \g_\_\_cols_vlism_seq
\{ \int_eval:n \{ \c@Col + 1 \} 
\tl_gput_right:Nx \g_\_\_preamble_tl
\{ \exp_not:N ! \{ \skip_horizontal:N \arrayrulewidth \} 
\_\_\_patch_preamble:n
\}
\}{ : }
\bool_if:NTF \c_\_\_arydshln_loaded_bool
\{ \tl_gput_right:Nn \g_\_\_preamble_tl \{ : \}
\_\_\_patch_preamble:n
\}
\{ \_\_\_fatal:n \{ colon~without~arydshln \} \}
\}

Now the case of a letter set by the final user for a customized rule. Such customized rule is defined by using the key custom-line in \NiceMatrixOptions. That key takes in as value a list of key=value pairs. Among the keys available in that list, there is the key letter. All the letters defined by this way
by the final user for such customized rules are added in the set of keys \{NiceMatrix/ColumnTypes\}. That set of keys is used to store the characteristics of those types of rules for convenience: the keys of that set of keys won’t never be used as keys by the final user (he will use, instead, letters in the preamble of its array).

```latex
\keys_set_known:nnN \{ NiceMatrix / ColumnTypes \} \{ #1 \} \l_tmpa_tl
\tl_if_empty:NTF \l_tmpa_tl
\@@_patch_preamble:n
{ \@@_fatal:nn \{ unknown-column-type \} \{ #1 \} }
\}
```

Now, we will list all the auxiliary functions for the different types of entries in the preamble of the array.

For \texttt{c}, \texttt{l} and \texttt{r}

```latex
\cs_new_protected:Npn \@@_patch_preamble_i:n #1
{ \tl_gput_right:Nn \g_@@_preamble_tl 
  \begin { \@@_cell_begin:w \str_set:Nn \l_@@_hpos_cell_str \{ #1 \} }
  \str_if_eq:nnTF \l_@@_hpos_cell_str { | } { \exp_not:N ! }
  \exp_not:N ! \skip_horizontal:n
  \}
}
```

We increment the counter of columns and then we test for the presence of a <.

```latex
\int_gincr:N \c@jCol
\@@_patch_preamble_xi:n
```

For \texttt{>}, \texttt{!} and \texttt{@}

```latex
\cs_new_protected:Npn \@@_patch_preamble_ii:nn #1 #2
{ \tl_gput_right:Nn \g_@@_preamble_tl { \#1 \{ \#2 \} }
\@@_patch_preamble:n
}
```

For \texttt{|}

```latex
\cs_new_protected:Npn \@@_patch_preamble_iii:n #1
{ \l_tmpa_int \is the number of successive occurrences of \texttt{|} 
  \int_incr:N \l_tmpa_int
  \@@_patch_preamble_iii_i:n
}
```

\texttt{\l_tmpa_int} is the number of successive occurrences of \texttt{|}

```latex
\int_incr:N \l_tmpa_int
\@@_patch_preamble_iii_i:n
}
\}
```

```latex
\cs_new_protected:Npn \@@_patch_preamble_iii_i:n #1
{ \str_if_eq:nnTF \l_@@_hpos_cell_str \{ \#1 \} \{ \exp_not:N ! \}
  \exp_not:N ! \skip_horizontal:n
  \}
}
```

Here, the command \texttt{\dim_eval:n} is mandatory.

```latex
\dim_eval:n
{ \arrayrulewidth * \l_tmpa_int
  + \doublerulesep * ( \l_tmpa_int - 1)
```
We don’t have provided value for \texttt{start} nor for \texttt{end}, which means that the rule will cover (potentially) all the rows of the array.

For \texttt{p}, \texttt{b} and \texttt{m}. The argument \texttt{#1} is that value: \texttt{p}, \texttt{b} or \texttt{m}.

Now, you look for a potential character \texttt{[} after the letter of the specifier (for the options).
#1 is the optional argument of the specifier (a list of key-value pairs).
#2 is the mandatory argument of the specifier: the width of the column.

The possible values of \l_@@_hpos_col_str are j (for justified which is the initial value), l, c and r (when the user has used the corresponding key in the optional argument of the specifier).

The first argument is the width of the column. The second is the type of environment: \texttt{minipage} or \texttt{varwidth}.

We increment the counter of columns, and then we test for the presence of a $<$. #1 is the optional argument of \texttt{minipage} (or \texttt{varwidth}): t of b. Indeed, for the columns of type m, we use the value b here because there is a special post-action in order to center vertically the box (see #4). #2 is the width of the \texttt{minipage} (or \texttt{varwidth}), that is to say also the width of the column.
#3 is the coding for the horizontal position of the content of the cell (\centering, \raggedright, \raggedleft or nothing). It's also possible to put in that #3 some code to fix the value of l_@@_hpos_cell_str which will be available in each cell of the column.

#4 is an extra-code which contains \@@_center_cell_box: (when the column is a m column) or nothing (in the other cases).

#5 is a code put just before the c (or r or l: see #8).
#6 is a code put just after the c (or r or l: see #8).

#7 is the type of environment: minipage or varwidth.

#8 is the letter c or r or l which is the basic specifier of column which is used in fine.

> { \tl_gput_right:Nn \g_@@_preamble_tl
> { #3

The parameter l_@@_col_width_dim, which is the width of the current column, will be available in each cell of the column. It will be used by the mono-column blocks.

> { \dim_set:Nn l_@@_col_width_dim { #2 }
> \@@_cell_begin:w
> \begin { #7 } #1 } #2

The following lines have been taken from array.sty.

> { \everypar
> { \vrule height \box_ht:N \@arstrutbox width \c_zero_dim
> \everypar { }
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The following command will be used in m-columns in order to center vertically the box. In fact, despite its name, the command does not always center the cell. Indeed, if there is only one row in the cell, it should not be centered vertically. It's not possible to know the number of rows of the cell. However, we consider (as in array) that if the height of the cell is no more that the height of \@arstrutbox, there is only one row.

\cs_new_protected:Npn \@@_center_cell_box:
{
By putting instructions in \texttt{\_\_\_post_action_cell_tl}, we require a post-action of the box \texttt{\_\_\_cell_box}.

For \texttt{V} (similar to the \texttt{V} of \texttt{varwidth}).

For \texttt{w} and \texttt{W}

The parameter \texttt{\_\_\_col_width_dim}, which is the width of the current column, will be available in each cell of the column. It will be used by the mono-column blocks.
We increment the counter of columns and then we test for the presence of a `<.

\int_gincr:N \c@jCol
\@@_patch_preamble_xi:n
}

For \@@_S:. If the user has used S[...], S has been replaced by \@@_S: during the first expansion of the preamble (done with the tools of standard LaTeX and array).

\cs_new_protected:Npn \@@_patch_preamble_vii:n #1
\{\str_if_eq:nnTF { #1 } { [ } { \@@_patch_preamble_vii_i:w [ } \{ \@@_patch_preamble_vii_i:w [ ] { #1 } \}
\cs_new_protected:Npn \@@_patch_preamble_vii_i:w #1
{ \@@_patch_preamble_vii_ii:n { #1 } }
\cs_new_protected:Npn \@@_patch_preamble_vii_ii:n #1
{ We test whether the version of nicematrix is at least 3.0. We will change de programmation of the test further with something like \VersionAtLeast.
\cs_if_exist:NTF \siunitx_cell_begin:w
{ \tl_gput_right:Nn \g_@@_preamble_tl
  { > { \@@_cell_begin:w \keys_set:nn { siunitx } { #1 } \siunitx_cell_begin:w }\c
    < { \siunitx_cell_end: \@@_cell_end: } }
}
We increment the counter of columns and then we test for the presence of a `<.

\int_gincr:N \c@jCol
\@@_patch_preamble_xi:n
\{ \@@_fatal:n \{ Version-of-siunitx-too-old \} \}
}

For (, [ and \{.
\cs_new_protected:Npn \@@_patch_preamble_viii:nn #1 #2
{ \bool_if:NT \l_@@_small_bool \{ \@@_fatal:n \{ Delimiter-with-small \} \}
If we are before the column 1 and not in \{NiceArray\}, we reserve space for the left delimiter.
\int_compare:nNnTF \c@jCol = \c_zero_int
{ \str_if_eq:VnTF \g_@@_left_delim_tl \{ . \}
\{ \tl_gset:Nn \g_@@_left_delim_tl \{ #1 \}
\tl_gset:Nn \g_@@_right_delim_tl \{ . \}
\@@_patch_preamble:n \#2
\}
\}

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For ), ] and \}. We have two arguments for the following command because we directly read the following letter in the preamble (we have to see whether we have an opening delimiter following and we also have to see whether we are at the end of the preamble because, in that case, our letter must be considered as the right delimiter of the environment if the environment is \{NiceArray\}).
For the case of a letter \textit{X}. This specifier may take in an optional argument (between square brackets). That's why we test whether there is a [ after the letter \textit{X}.

The following set of keys is for the specifier \textit{X} in the preamble of the array. Such specifier may have as keys all the keys of \{\textit{WithArrows} / \textit{p-column}\} but also a key as 1, 2, 3, etc. The following set of keys will be used to retrieve that value (in the counter \texttt{\_@@\_weight\_int}).

\begin{verbatim}
\keys_define:nn { WithArrows / X-column }
{ unknown .code:n = \int_set:Nn \l_@@_weight_int { \l_keys_key_str } }
\end{verbatim}

In the following command, \#1 is the list of the options of the specifier \textit{X}.

\texttt{\cs_new_protected:Npn \@@_patch_preamble_x:n \#1}

The possible values of \texttt{\_@@\_hpos\_col\_str} are \texttt{j} (for \textit{justified} which is the initial value), \texttt{l}, \texttt{c} and \texttt{r} (when the user has used the corresponding key in the optional argument of the specifier \textit{X}).

\texttt{\str_set:Nn \l_@@_hpos_col_str { j }}

The possible values of \texttt{\_@@\_vpos\_col\_str} are \texttt{p} (the initial value), \texttt{m} and \texttt{b} (when the user has used the corresponding key in the optional argument of the specifier \textit{X}).

\texttt{\tl_set:Nn \l_@@_vpos_col_str { p }}

The integer \texttt{\_@@\_weight\_int} will be the weight of the \textit{X} column (the initial value is 1). The user may specify a different value (such as 2, 3, etc.) by putting that value in the optional argument of the specifier. The weights of the \textit{X} columns are used in the computation of the actual width of those columns as in \texttt{tabu} of \texttt{tabularray}.

We test whether we know the width of the \textit{X}-columns by reading the \texttt{aux} file (after the first compilation, the width of the \textit{X}-columns is computed and written in the \texttt{aux} file).

\texttt{\bool_if:NTF \_@@\_X\_columns\_aux\_bool}

\begin{verbatim}
\@@_patch_preamble_iv:nn
\end{verbatim}
\{ \l_@@_weight_int \l_@@_X_columns_dim \}
\{ minipage \}
\}
\tl_gput_right:Nn \g_@@_preamble_tl
\{
\l_@@_cell_begin:w 
\bool_set_true:N \l_@@_X_column_bool
\}
The following code will nullify the box of the cell.
\tl_gput_right:Nn \g_@@_post_action_cell_tl
\{ \hbox_set:Nn \l_@@_cell_box { } \}
\begin { minipage } { 5 cm } \arraybackslash
\end { minipage }
\@@_cell_end:
\int_gincr:N \c@jCol 
\@@_patch_preamble_xi:n
\}
\cs_new_protected:Npn \@@_patch_preamble_xii:n #1
\{ \tl_gput_right:Nn \g_@@_preamble_tl
\{ ! { \skip_horizontal:N 2\l_@@_radius_dim } \}
\}
The command \@@_vdottedline:n is protected, and, therefore, won't be expanded before writing on \g_@@_internal_code_after_tl.
\tl_gput_right:Nx \g_@@_internal_code_after_tl
\{ \@@_vdottedline:n { \int_use:N \c@jCol } \}
\@@_patch_preamble:n
\}
\}
\cs_new_protected:Npn \@@_patch_preamble_xiii:n #1
\{ \str_if_eq:nnTF { #1 } { # } { < } \}
\@@_patch_preamble_xi:n
\{ \tl_if_eq:NnTF \l_@@_vlines_clist { all } \}
\{ \tl_gput_right:Nn \g_@@_preamble_tl
\{ ! { \skip_horizontal:N \arrayrulewidth } \}
\}
\exp_args:NNx
\clist_if_in:NnT \l_@@_vlines_clist { \int_eval:n { \c@jCol + 1 } } \}
\{ \tl_gput_right:Nn \g_@@_preamble_tl
\{ ! { \skip_horizontal:N \arrayrulewidth } \}
\}
\@@_patch_preamble:n { #1 }
\}
The redefinition of \multicolumn

The following command must \textit{not} be protected since it begins with \multispan (a TeX primitive).

You do the expansion of the (small) preamble with the tools of \texttt{array}.

Now, we patch the (small) preamble as we have done with the main preamble of the \texttt{array}.

The following lines are an adaptation of the definition of \multicolumn in \texttt{array}.

Now, you do a treatment specific to \texttt{nicematrix} which has no equivalent in the original definition of \multicolumn.
The following lines were in the original definition of \multicolumn.

```
\cs_set:Npn \@sharp { #3 }
\@arstrut
\@preamble
\null
```

We add some lines.

```
\int_gadd:Nn \c@jCol { #1 - 1 }
\int_compare:nNnT \c@jCol > \g_@@_col_total_int
{ \int_gset_eq:NN \g_@@_col_total_int \c@jCol }
\ignorespaces
```

The following commands will patch the (small) preamble of the \multicolumn. All those commands have a \texttt{m} in their name to recall that they deal with the redefinition of \multicolumn.

```
\cs_new_protected:Npn \@@_patch_m_preamble:n #1
{ \str_case:nnF { #1 } { c { \@@_patch_m_preamble_i:n #1 } l { \@@_patch_m_preamble_i:n #1 } r { \@@_patch_m_preamble_i:n #1 } > { \@@_patch_m_preamble_ii:nn #1 } ! { \@@_patch_m_preamble_ii:nn #1 } @ { \@@_patch_m_preamble_ii:nn #1 } | { \@@_patch_m_preamble_iii:n #1 } p { \@@_patch_m_preamble_iv:nnn t #1 } m { \@@_patch_m_preamble_iv:nnn c #1 } b { \@@_patch_m_preamble_iv:nnn b #1 } \@@_v: { \@@_patch_m_preamble_v:nnnn } \@@_W: { \@@_patch_m_preamble_v:nnnn \cs_eq:NN \hss \hfil } \q_stop \} \@@_fatal:nn { unknown-column-type } \} \}
```

For \texttt{c}, \texttt{l} and \texttt{r}

```
\cs_new_protected:Npn \@@_patch_m_preamble_i:n #1
{ \tl_gput_right:Nn \g_@@_preamble_tl
{ > { \@@_cell_begin:w \str_set:Nn \l_@@_hpos_cell_str { #1 } } #1 } < \@@_cell_end: }
```

We test for the presence of a `<`.

```
\@@_patch_m_preamble_x:n
```

For \texttt{>}!, \texttt{@} and \texttt{b}

```
\cs_new_protected:Npn \@@_patch_m_preamble_ii:nn #1 #2
{ \tl_gput_right:Nn \g_@@_preamble_tl \{ #1 \} \#2 \} \@@_patch_m_preamble:n
```

For \texttt{|}

```
\cs_new_protected:Npn \@@_patch_m_preamble_iii:n #1
{ \tl_gput_right:Nn \g_@@_preamble_tl \{ #1 \} \@@_patch_m_preamble:n
```
For p, m and b
\cs_new_protected:Npn \@@_patch_m_preamble_iv:nnn #1 #2 #3
{\tl_gput_right:Nn \g_@@_preamble_tl
{\@@_cell_begin:w
\begin {minipage} \[ #1 \] \dim_eval:n { #3 } \end {minipage}
\mode_leave_vertical:\arraybackslash
\vrule height \box_ht:N \@arstrutbox depth 0 pt width 0 pt
\@@_cell_end:}
}

We test for the presence of a <.
\@@_patch_m_preamble_x:n

For w and W
\cs_new_protected:Npn \@@_patch_m_preamble_v:nnnn #1 #2 #3 #4
{\tl_gput_right:Nn \g_@@_preamble_tl
{\@@_cell_begin:w
\begin {minipage} \[ #3 \] \box_use_drop:N \l_@@_cell_box
\str_set:Nn \l_@@_hpos_cell_str { #3 }
\end {minipage}
\@@_cell_end:
\bool_if:NT \g_@@_rotate_bool \@@_rotate_cell_box:
\@@_adjust_size_box:
\makebox \[ #4 \] \[ #3 \] \box_use_drop:N \l_@@_cell_box}
}

We test for the presence of a <.
\@@_patch_m_preamble_x:n

After a specifier of column, we have to test whether there is one or several <{...} because, after those potential <{...}, we have to insert \vrule height \box_ht:N \@arstrutbox depth 0 pt width 0 pt when the key vlines is used.
\cs_new_protected:Npn \@@_patch_m_preamble_x:n #1
{\str_if_eq:nnTF { #1 } { < } \@@_patch_m_preamble_ix:n
{\tl_if_eq:NnTF \l_@@_vlines_clist \{ all \}
{\tl_gput_right:Nn \g_@@_preamble_tl
\{ \! \{ \skip_horizontal:N \arrayrulewidth \}
\}
\\exp_args:NNx \clist_if_in:NnT \l_@@_vlines_clist \{ \int_eval:n \{ \c@jCol + 1 \}\}
}
The command \@@_put_box_in_flow: puts the box \l_tmpa_box (which contains the array) in the flow. It is used for the environments with delimiters. First, we have to modify the height and the depth to take back into account the potential exterior rows (the total height of the first row has been computed in \l_tmpa_dim and the total height of the potential last row in \l_tmpb_dim).

\cs_new_protected:Npn \@@_put_box_in_flow: 
\begin{pgfpicture}
\@@_qpoint:n { row - 1 }
\dim_gset_eq:NN \g_tmpa_dim \pgf@y
\@@_qpoint:n { row - \int_eval:n { \c@iRow + 1 } }
\dim_gadd:Nn \g_tmpa_dim \pgf@y
\dim_gset:Nn \g_tmpa_dim { 0.5 \g_tmpa_dim }
\end{pgfpicture}

Now, \g_tmpa_dim contains the y-value of the center of the array (the delimiters are centered in relation with this value).
We take into account the position of the mathematical axis.

\[ \dim_gsub:Nn \g_tmpa_dim { \fontdimen22 \textfont2 } \]

Now, \( \g_tmpa_dim \) contains the value of the \( y \) translation we have to do.

\[ \endpgfpicture \]
\[ \box_move_up:nn \g_tmpa_dim { \box_use_drop:N \l_tmpa_box } \]

The following command is always used by \{NiceArrayWithDelims\} (even if, in fact, there is no tabular notes: in fact, it’s not possible to know whether there is tabular notes or not before the composition of the blocks).

\[ \cs_new_protected:Npn \@@_use_arraybox_with_notes_c: { \begin { minipage } [ t ] { \box_wd:N \l_@@_the_array_box } \hbox { \box_use_drop:N \l_@@_the_array_box } \end { minipage } \]
We compose the tabular notes with a list of \texttt{enumitem}. The \texttt{\strut} and the \texttt{\unskip} are designed to give the ability to put a \texttt{\bottomrule} at the end of the notes with a good vertical space.

\begin{verbatim}
\int_compare:nNnT \c@tabularnote > 0
\{
  \bool_if:NTF \l_@@_notes_para_bool
  \{
    \begin { tabularnotes* }
    \seq_map_inline:Nn \g_@@_tabularnotes_seq { \item ##1 } \strut
    \end { tabularnotes* }

    The following \texttt{\par} is mandatory for the event that the user has put \texttt{\footnotesize} (for example) in the notes/code-before.
    \par
    \}
  \}
  \unskip
  \group_end:
  \bool_if:NT \l_@@_notes_bottomrule_bool
  \{
    \bool_if:NTF \c_@@_booktabs_loaded_bool
    \{
    \skip_vertical:N \aboverulesep
    \CT@arc@
    \heavyrulewidth
    \aboverulesep et \heavyrulewidth are parameters defined by \texttt{booktabs}.
    \}
    \}
  \}
\end{verbatim}

The following \texttt{\par} is mandatory for the event that the user has put \texttt{\footnotesize} (for example) in the notes/code-before.

\par
\begin{verbatim}
  \tabularnotes
  \seq_map_inline:Nn \g_@@_tabularnotes_seq { \item ##1 } \strut
  \endtabularnotes

  \begin { tabularnotes* }
  \seq_map_inline:Nn \g_@@_tabularnotes_seq { \item ##1 } \strut
  \end { tabularnotes* }

  The two dimensions \texttt{\aboverulesep} et \texttt{\heavyrulewidth} are parameters defined by \texttt{booktabs}.

  \CT@arc@ is the specification of color defined by \texttt{colortbl} but you use it even if \texttt{colortbl} is not loaded.

  \begin{verbatim}
  { \CT@arc@ \hrule height \heavyrulewidth }
  \end{verbatim}

  The case of \texttt{baseline} equal to \texttt{b}. Remember that, when the key \texttt{b} is used, the \texttt{\{array\}} \texttt{(of array)} is constructed with the option \texttt{t} (and not \texttt{b}). Now, we do the translation to take into account the option \texttt{b}.

  \begin{verbatim}
  \cs_new_protected:Npn \@@_use_arraybox_with_notes_b:
  \{
    \pgfpicture
    \@@_qpoint:n { row - 1 }
    \dim_gset_eq:NN \g_tmpa_dim \pgfy
    \@@_qpoint:n { row - \int_use:N \c@iRow - base }
    \dim_gsub:NN \g_tmpa_dim \pgfy
    \endpgfpicture
    \dim_gadd:NN \g_tmpa_dim \arrayrulewidth
    \int_compare:nNnT \l_@@_first_row_int = 0
    \{
      \dim_gadd:NN \g_tmpa_dim \g_@@_ht_row_zero_dim
      \dim_gadd:NN \g_tmpa_dim \g_@@_dp_row_zero_dim
    \}
    \box_move_up:nn \g_tmpa_dim { \hbox { \@@_use_arraybox_with_notes_c: } }
  \}
\end{verbatim}

Now, the general case.

\begin{verbatim}
\cs_new_protected:Npn \@@_use_arraybox_with_notes:
\{
\end{verbatim}
We convert a value of \( t \) to a value of \( 1 \).

\[
\text{\tl_if_eq:NnT \l_@@_baseline_tl \{ t \} \text{\tl_set:Nn \l_@@_baseline_tl \{ 1 \} }
\]

Now, we convert the value of \( \l_@@_baseline_tl \) (which should represent an integer) to an integer stored in \( \l_{\text{tmpa}} \_\text{int} \).

\[
\text{\pgfpicture}
\text{\@@_qpoint:n \{ row - 1 \}}
\text{\dim_gset_eq:NN \g_{\text{tmpa}} \_\text{dim} \pgf@y}
\text{\str_if_in:NnTF \l_@@_baseline_tl \{ line- \}}
\text{\{ \int_set:Nn \l_{\text{tmpa}} \_\text{int} \}}
\text{\str_range:Nnn \l_@@_baseline_tl \}}
\text{\str_count:V \l_@@_baseline_tl}
\text{\}}
\text{\@@_qpoint:n \{ row - \int_{\text{use}}:N \l_{\text{tmpa}} \_\text{int} \}}
\}
\}
\text{\int_set:Nn \l_{\text{tmpa}} \_\text{int} \}}
\text{\bool_lazy_or:nnT \{ \int_compare_p:nNn \l_{\text{tmpa}} \_\text{int} < \l_@@_{\text{first}} \_\text{row} \_\text{int} \}}
\text{\int_compare_p:nNn \l_{\text{tmpa}} \_\text{int} > \g_@@_{\text{row}} \_\text{total} \_\text{int} \}}
\text{\{ \@\_error:n \{ bad-value-for-baseline \} \int_set:Nn \l_{\text{tmpa}} \_\text{int} 1 \}}
\}
\text{\@@_qpoint:n \{ row - \int_{\text{use}}:N \l_{\text{tmpa}} \_\text{int} - \text{base} \} \}
\}
\text{\dim_gsub:NN \g_{\text{tmpa}} \_\text{dim} \pgf@y}
\text{\endpgfpicture}
\text{\dim_gadd:NN \g_{\text{tmpa}} \_\text{dim} \arrayrulewidth}
\text{\int_compare:nNnT \l_@@_{\text{first}} \_\text{row} \_\text{int} = 0 \}}
\text{\{ \dim_gadd:NN \g_{\text{tmpa}} \_\text{dim} \g_@@_{\text{ht}} \_\text{row} \_\text{zero} \_\text{dim} \}}
\text{\dim_gadd:NN \g_{\text{tmpa}} \_\text{dim} \g_@@_{\text{dp}} \_\text{row} \_\text{zero} \_\text{dim} \}}
\text{\box_move_up:nn \g_{\text{tmpa}} \_\text{dim} \{ \hbox \{ \@\_use_arraybox_with_notes_c: \} \}}
\}
\]

The command \( \@\_\text{put-box-in-flow-bis} \): is used when the option delimiters/max-width is used because, in this case, we have to adjust the widths of the delimiters. The arguments \#1 and \#2 are the delimiters specified by the user.

\cs_new_protected:Npn \@@_\text{put-box-in-flow-bis}:nn \#1 \#2
\{
\text{\endpgfpicture}
\}

We will compute the real width of both delimiters used.

\dim_zero_new:N \l_@@_{\text{real-left}} \_\text{delim} \_\text{dim}
\dim_zero_new:N \l_@@_{\text{real-right}} \_\text{delim} \_\text{dim}
\hbox_set:Nn \l_{\text{tmpb-box}}
\{ \c_math_toggle_token \left \#1 \text{vcenter} \{ \vbox_to_ht:n \{ \box_ht_plus_dp:N \l_{\text{tmpb-box}} \} \} \right . \text{c_math_toggle_token}
Now, we can put the box in the TeX flow with the horizontal adjustments on both sides.

The construction of the array in the environment \{NiceArrayWithDelims\} is, in fact, done by the environment \{@@-light-syntax\} or by the environment \{@@-normal-syntax\} (whether the option light-syntax is in force or not). When the key light-syntax is not used, the construction is a standard environment (and, thus, it’s possible to use verbatim in the array).

First, we test whether the environment is empty. If it is empty, we raise a fatal error (it’s only a security). In order to detect whether it is empty, we test whether the next token is \end and, if it’s the case, we test if this is the end of the environment (if it is not, an standard error will be raised by LaTeX for incorrect nested environments).

Here is the call to \array (we have a dedicated macro \g_@@_array: because of compatibility with the classes revtex4-1 and revtex4-2).

When the key light-syntax is in force, we use an environment which takes its whole body as an argument (with the specifier b of xparse).

First, we test whether the environment is empty. It’s only a security. Of course, this test is more easy than the similar test for the “normal syntax” because we have the whole body of the environment in \#1.

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Now, you extract the \CodeAfter of the body of the environment. Maybe, there is no command \CodeAfter in the body. That’s why you put a marker \CodeAfter after #1. If there is yet a \CodeAfter in #1, this second (or third...) \CodeAfter will be caught in the value of \g_nicematrix_code_after_tl. That doesn’t matter because \CodeAfter will be set to no-op before the execution of \g_nicematrix_code_after_tl.

\@@_light_syntax_i #1 \CodeAfter \q_stop
}

Now, the second part of the environment. It is empty. That’s not surprising because we have caught the whole body of the environment with the specifier b provided by xparse.

{ }
\cs_new_protected:Npn \@@_light_syntax_i #1 \CodeAfter \q_stop
\tl_gput_right:Nn \g_nicematrix_code_after_tl { #2 }

The body of the array, which is stored in the argument #1, is now splitted into items (and not tokens).

\seq_gclear_new:N \g_@@_rows_seq
\tl_set_rescan:Nno \l_@@_end_of_row_tl { } \l_@@_end_of_row_tl
\exp_args:NNV \seq_gset_split:Nnn \g_@@_rows_seq { \l_@@_end_of_row_tl } { #1 }

If the environment uses the option last-row without value (i.e. without saying the number of the rows), we have now the opportunity to know that value. We do it, and so, if the token list \l_@@_code_for_last_row_tl is not empty, we will use directly where it should be.

\int_compare:nNnT \l_@@_last_row_int = { -1 }
\{ \int_set:Nn \l_@@_last_row_int { \seq_count:N \g_@@_rows_seq } \}

Here is the call to \array (we have a dedicated macro \@@_array: because of compatibility with the classes revtex4-1 and revtex4-2).

\exp_args:NV \@@_array: \g_@@_preamble_tl

We need a global affectation because, when executing \l_tmpa_tl, we will exit the first cell of the array.

\seq_gpop_left:NN \g_@@_rows_seq \l_tmpa_tl
\exp_args:NV \@@_line_with_light_syntax_i:n \l_tmpa_tl
\seq_map_function:NN \g_@@_rows_seq \@@_line_with_light_syntax:n
\@@_create_col_nodes:
\endarray
}

\cs_new_protected:Npn \@@_line_with_light_syntax:n #1
{ \tl_if_empty:nF { #1 } { \\ \@@_line_with_light_syntax_i:n { #1 } } }

The following command is used by the code which detects whether the environment is empty (we raise a fatal error in this case: it’s only a security).

\cs_new_protected:Npn \@@_analyze_end:Nn #1 #2
{ \str_if_eq:VnT \g_@@_name_env_str { #2 } { \\ \@@_name_env_str { #2 } } }

We reput in the stream the \end{...} we have extracted and the user will have an error for incorrect nested environments.
The command \@@_create_col_nodes: will construct a special last row. That last row is a false row used to create the \texttt{col} nodes and to fix the width of the columns (when the array is constructed with an option which specifies the width of the columns).

\begin{verbatim}
\cs_new:Npn \@@_create_col_nodes:
\begin{pgfpicture}
\pgfcoordinate { \@@_env: - col - 0 } \pgfpointorigin
\str_if_empty:NF \l_@@_name_str
{ \pgfnodealias { \l_@@_name_str - col - 0 } { \@@_env: - col - 0 } }
\endpgfpicture
\skip_horizontal:N \col@sep
\skip_horizontal:N \g_@@_width_first_col_dim
\omit\&
\omit
\end{pgfpicture}
\end{verbatim}

The following instruction must be put after the instruction \texttt{\omit}.

\begin{verbatim}
\bool_gset_true:N \g_@@_row_of_col_done_bool
\end{verbatim}

First, we put a \texttt{col} node on the left of the first column (of course, we have to do that after the \texttt{\omit}).

\begin{verbatim}
\int_compare:nNnTF \l_@@_first_col_int = 0
{ \bool_if:NT \l_@@_code_before_bool
{ \hbox
{ \skip_horizontal:N -0.5\arrayrulewidth
\pgfsys@markposition { \@@_env: - col - 0 }
\skip_horizontal:N 0.5\arrayrulewidth
} }
\endpgfpicture
\pgfrememberpicturepositiononpagetrue
\pgfcoordinate { \@@_env: - col - 1 } { \pgfpoint { - 0.5 \arrayrulewidth } \c_zero_dim }
\str_if_empty:NF \l_@@_name_str
{ \pgfnodealias { \l_@@_name_str - col - 1 } { \@@_env: - col - 1 } }
\endpgfpicture
\begin{verbatim}
\bool_gset_true:N \l_@@_code_before_bool
{ \hbox
{ \skip_horizontal:N 0.5\arrayrulewidth
\pgfsys@markposition { \@@_env: - col - 1 }
\skip_horizontal:N -0.5\arrayrulewidth
} }
\endpgfpicture
\pgfrememberpicturepositiononpagetrue
\pgfcoordinate { \@@_env: - col - 1 } \c_zero_dim
\begin{verbatim}
\str_if_empty:NF \l_@@_name_str
{ \pgfnodealias { \l_@@_name_str - col - 1 } { \@@_env: - col - 1 } }
\endpgfpicture
\end{verbatim}

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We compute in \texttt{g_tmpa_skip} the common width of the columns (it’s a skip and not a dimension). We use a global variable because we are in a cell of an \texttt{halign} and because we have to use this variable in other cells (of the same row). The affectation of \texttt{g_tmpa_skip}, like all the affectations, must be done after the \texttt{omit} of the cell.

We give a default value for \texttt{g_tmpa_skip} (0 pt plus 1 fill) but it will just after be erased by a fixed value in the concerned cases.

\begin{verbatim}
\skip_gset:Nn \g_tmpa_skip { 0 pt~plus 1 fill }
\bool_if:NF \l_@@_auto_columns_width_bool {
\dim_compare:nNnT \l_@@_columns_width_dim > \c_zero_dim }
{ \bool_lazy_and:nnTF \l_@@_auto_columns_width_bool {
\bool_not_p:n \l_@@_block_auto_columns_width_bool }
{ \skip_gset_eq:NN \g_tmpa_skip \g_@@_max_cell_width_dim }
{ \skip_gset_eq:NN \g_tmpa_skip \l_@@_columns_width_dim }
\skip_gadd:Nn \g_tmpa_skip { 2 \col@sep }
}
\skip_horizontal:N \g_tmpa_skip
\hbox
{ \bool_if:NT \l_@@_code_before_bool
{ \hbox
{ \skip_horizontal:N -0.5\arrayrulewidth
\pgfsys@markposition { \@@_env: - col - 2 }
\skip_horizontal:N 0.5\arrayrulewidth
}
\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgfcoordinate { \@@_env: - col - \int_eval:n { \g_tmpa_int + 1 } }
\skip_horizontal:N -0.5\arrayrulewidth
\pgfsys@markposition { \@@_env: - col - 2 }
\skip_horizontal:N 0.5\arrayrulewidth
\endpgfpicture
}
\endverbatim

We begin a loop over the columns. The integer \texttt{g_tmpa_int} will be the number of the current column. This integer is used for the Tikz nodes.

\begin{verbatim}
\int_gset:Nn \g_tmpa_int 1
\bool_if:NTF \g_@@_last_col_found_bool
{ \prg_replicate:nn { \int_max:nn { \g_@@_col_total_int - 3 } 0 } }
{ \prg_replicate:nn { \int_max:nn { \g_@@_col_total_int - 2 } 0 } }
{ \omit
\int_gincr:N \g_tmpa_int
\int_gincr:N \g_tmpa_int
\int_gincr:N \g_tmpa_int
\endverbatim

The incrementation of the counter \texttt{g_tmpa_int} must be done after the \texttt{omit} of the cell.

\begin{verbatim}
\skip_horizontal:N \g_tmpa_skip
\bool_if:NT \l_@@_code_before_bool
{ \hbox
{ \skip_horizontal:N -0.5\arrayrulewidth
\pgfsys@markposition { \@@_env: - col - \int_eval:n { \g_tmpa_int + 1 } }
\skip_horizontal:N 0.5\arrayrulewidth
}
\endverbatim
We create the col node on the right of the current column.

\begin{picture}
\pgfrememberpicturepositiononpagetrue
\pgfcoordinate { \@@_env: - col - \int_eval:n { \g_tmpa_int + 1 } }
{ \pgfpoint { - 0.5 \arrayrulewidth } \c_zero_dim }
\str_if_empty:NF \l_@@_name_str
{ \pgfnodealias
{ \l_@@_name_str - col - \int_eval:n { \g_tmpa_int + 1 } }
{ \@@_env: - col - \int_eval:n { \g_tmpa_int + 1 } }
}
\endpgfpicture
\&
\omit

The two following lines have been added on 2021-12-15 to solve a bug mentioned by Joao Luis Soares by mail.

\int_compare:nNnT \g_@@_col_total_int = 1
{ \skip_gset:Nn \g_tmpa_skip { 0 pt plus 1 fill } }
\skip_horizontal:N \g_tmpa_skip
\int_gincr:N \g_tmpa_int
\bool_lazy_all:nT
{ \l_@@_NiceArray_bool \bool_not_p:n \l_@@_NiceTabular_bool }
{ \clist_if_empty_p:N \l_@@_vlines_clist }
{ \bool_not_p:n \l_@@_exterior_arraycolsep_bool }
{ ! \l_@@_bar_at_end_of_pream_bool }
{ \skip_horizontal:N -\col@sep }
\bool_if:NT \l_@@_code_before_bool
{ \hbox
{ \skip_horizontal:N -0.5\arrayrulewidth }
\bool_lazy_and:nnT \l_@@_Matrix_bool \l_@@_NiceArray_bool
{ \skip_horizontal:N -\arraycolsep }
\pgfsys@markposition
{ \@@_env: - col - \int_eval:n { \g_tmpa_int + 1 } }
\skip_horizontal:N 0.5\arrayrulewidth
\bool_lazy_and:nnT \l_@@_Matrix_bool \l_@@_NiceArray_bool
{ \skip_horizontal:N \arraycolsep }
}
\end{picture}

With an environment \{Matrix\}, you want to remove the exterior \arraycolsep but we don’t know the number of columns (since there is no preamble) and that’s why we can’t put \@{} at the end of the preamble. That’s why we remove a \arraycolsep now.

\bool_lazy_and:nnT \l_@@_Matrix_bool \l_@@_NiceArray_bool
{ \skip_horizontal:N -\arraycolsep }
\pgfsys@markposition
{ \@@_env: - col - \int_eval:n { \g_tmpa_int + 1 } }
\skip_horizontal:N 0.5\arrayrulewidth
\bool_lazy_and:nnT \l_@@_Matrix_bool \l_@@_NiceArray_bool
{ \skip_horizontal:N \arraycolsep }

\end{picture}
Here is the preamble for the “first column” (if the user uses the key first-col)
\tl_const:Nn \c_@@_preamble_first_col_tl
{ }
At the beginning of the cell, we link \CodeAfter to a command which do begins with \ (whereas the standard version of \CodeAfter begins does not).
\cs_set_eq:NN \CodeAfter \@@_CodeAfter_i:
\bool_gset_true:N \g_@@_after_col_zero_bool
\@@_begin_of_row:
The contents of the cell is constructed in the box \l_@@_cell_box because we have to compute some dimensions of this box.
\bbox_set:Nw \l_@@_cell_box
\@@_math_toggle_token:
\bool_if:NT \l_@@_small_bool \scriptstyle
We insert \l_@@_code_for_first_col_tl... but we don't insert it in the potential “first row” and in the potential “last row”:
\bool_lazy_and:nnT
{ \int_compare_p:nNn \c@iRow > 0 }

Be careful: despite this letter \l the cells of the “first column” are composed in a R \hbox_overlap_left:n manner since they are composed in a \hbox_overlap_left:n.  

We actualise the width of the “first column” because we will use this width after the construction of the array. 

The content of the cell is inserted in an overlapping position.  

Here is the preamble for the “last column” (if the user uses the key last-col).  

At the beginning of the cell, we link \CodeAfter to a command which do begins with \ (whereas the standard version of \CodeAfter begins does not).  

With the flag \g_@@_last_col_found_bool, we will know that the “last column” is really used.  

The contents of the cell is constructed in the box \l_tmpa_box because we have to compute some dimensions of this box.
We insert \l_@@_code_for_last_col_tl... but we don’t insert it in the potential “first row” and in the potential “last row”:

\begin{code}
\int_compare:nNnT \c@iRow > 0
\{
  \bool_lazy_or:nnT
  { \int_compare_p:nNn \l_@@_last_row_int < 0 }
  { \int_compare_p:nNn \c@iRow < \l_@@_last_row_int }
  \l_@@_code_for_last_col_tl
  \xglobal \colorlet { nicematrix-last-col } { . }
\}
\end{code}

\begin{code}
\dim_compare:nNnT { \box_wd:N \l_@@_cell_box } > \c_zero_dim
\{
  \skip_horizontal:N \l_@@_right_delim_dim
  \skip_horizontal:N \l_@@_right_margin_dim
  \skip_horizontal:N \l_@@_extra_right_margin_dim
  \@@_node_for_cell:
\}
\bool_gset_false:N \g_@@_empty_cell_bool
\end{code}

We actualise the width of the “last column” because we will use this width after the construction of the array.

\begin{code}
\dim_gset:Nn \g_@@_width_last_col_dim
\{
  \dim_max:nn \g_@@_width_last_col_dim { \box_wd:N \l_@@_cell_box } 
\}
\end{code}

The content of the cell is inserted in an overlapping position.

\begin{code}
\hbox_overlap_right:n
\{
  \dim_compare:nNnT { \box_wd:N \l_@@_cell_box } > \c_zero_dim
  \{
    \skip_horizontal:N \l_@@_right_delim_dim
    \skip_horizontal:N \l_@@_right_margin_dim
    \skip_horizontal:N \l_@@_extra_right_margin_dim
    \@@_node_for_cell:
  \}
\bool_gset_false:N \g_@@_empty_cell_bool
\end{code}

The environment \texttt{NiceArray} is constructed upon the environment \texttt{NiceArrayWithDelims} but, in fact, there is a flag \l_@@_NiceArray_bool. In \texttt{NiceArrayWithDelims}, some special code will be executed if this flag is raised.

\begin{code}
\NewDocumentEnvironment { NiceArray } { }
\{
  \bool_set_true:N \l_@@_NiceArray_bool
  \str_if_empty:NT \g_@@_name_env_str
  { \str_gset:Nn \g_@@_name_env_str { NiceArray } }
\end{code}

We put . and . for the delimiters but, in fact, that doesn’t matter because these arguments won’t be used in \texttt{NiceArrayWithDelims} (because the flag \l_@@_NiceArray_bool is raised).

\begin{code}
\NiceArrayWithDelims . .
\end{code}

We create the variants of the environment \texttt{NiceArrayWithDelims}.

\begin{code}
\cs_new_protected:Npn \@@_def_env:nnn #1 #2 #3
\{
\end{code}
\textbf{The environment \texttt{NiceMatrix} and its variants}

The following command will be linked to \texttt{NotEmpty} in the environments of \texttt{nicematrix}.

\textbf{\{NiceTabular\}, \{NiceTabularX\} and \{NiceTabular*\}}

If the dimension \texttt{\_\_\_width_dim} is equal to 0 pt, that means that it has not be set by a previous use of \texttt{NiceMatrixOptions}.
The following code prevents the expansion of the 'X' columns with the definition of that columns in \texttt{tabularX} (this would result in an error in \texttt{NiceTabularX}).

After the construction of the array

When the option \texttt{last-col} is used in the environments with explicit preambles (like \texttt{NiceArray}, \texttt{pNiceArray}, etc.) a special type of column is used at the end of the preamble in order to compose the cells in an overlapping position (with \texttt{\hbox\_overlap\_right:n}) but (if \texttt{last-col} has been used), we don't have the number of that last column. However, we have to know that number for the color of the potential \texttt{\Vdots} drawn in that last column. That's why we fix the correct value of \texttt{l\_\_last\_col\_int} in that case.

If we are in an environment without preamble (like \texttt{NiceMatrix} or \texttt{pNiceMatrix}) and if the option \texttt{last-col} has been used without value we also fix the real value of \texttt{l\_\_last\_col\_int}.

It's also time to give to \texttt{l\_\_last\_row\_int} its real value.
We write also the potential content of \g@@pos_of_blocks_seq. It will be used to recreate the blocks with a name in the \CodeBefore and also if the command \rowcolors is used with the key \respect-blocks).

Now, you create the diagonal nodes by using the row nodes and the col nodes.

We create the aliases using last for the nodes of the cells in the last row and the last column.
By default, the diagonal lines will be parallelized. There are two types of diagonals lines: the Ddots diagonals and the Iddots diagonals. We have to count both types in order to know whether a diagonal is the first of its type in the current NiceArray environment.

\bool_if:NT \l_@@_parallelize_diags_bool
{
\int_gzero_new:N \g_@@_ddots_int
\int_gzero_new:N \g_@@_iddots_int

The dimensions \g_@@_delta_x_one_dim and \g_@@_delta_y_one_dim will contain the $\Delta x$ and $\Delta y$ of the first Ddots diagonal. We have to store these values in order to draw the others Ddots diagonals parallel to the first one. Similarly \g_@@_delta_x_two_dim and \g_@@_delta_y_two_dim are the $\Delta x$ and $\Delta y$ of the first Iddots diagonal.

\dim_gzero_new:N \g_@@_delta_x_one_dim
\dim_gzero_new:N \g_@@_delta_y_one_dim
\dim_gzero_new:N \g_@@_delta_x_two_dim
\dim_gzero_new:N \g_@@_delta_y_two_dim

\int_zero_new:N \l_@@_initial_i_int
\int_zero_new:N \l_@@_initial_j_int
\int_zero_new:N \l_@@_final_i_int
\int_zero_new:N \l_@@_final_j_int
\bool_set_false:N \l_@@_initial_open_bool
\bool_set_false:N \l_@@_final_open_bool

If the option small is used, the values \l_@@_radius_dim and \l_@@_inter_dots_dim (used to draw the dotted lines created by \hdottedline and \vdottedline and also for all the other dotted lines when line-style is equal to standard, which is the initial value) are changed.

\bool_if:NT \l_@@_small_bool
{\dim_set:Nn \l_@@_radius_dim { 0.37 pt }\dim_set:Nn \l_@@_inter_dots_dim { 0.25 em }}

The dimension \l_@@_xdots_shorten_dim corresponds to the option xdots/shorten available to the user. That’s why we give a new value according to the current value, and not an absolute value.

\dim_set:Nn \l_@@_xdots_shorten_dim { 0.6 \l_@@_xdots_shorten_dim }

Now, we actually draw the dotted lines (specified by \Cdots, \Vdots, etc.).

\@@_draw_dotted_lines:

The following computes the “corners” (made up of empty cells) but if there is no corner to compute, it won’t do anything. The corners are computed in \l_@@_corners_cells_seq which will contain all the cells which are empty (and not in a block) considered in the corners of the array.

\@@_compute_corners:

The sequence \g_@@_pos_of_blocks_seq must be “adjusted” (for the case where the user have written something like Block{1->}).

\@@_adjust_pos_of_blocks_seq:
\tl_if_empty:NF \l_@@_hlines_clist \@@_draw_hlines:
\tl_if_empty:NF \l_@@_vlines_clist \@@_draw_vlines:

Now, the internal code-after and then, the \CodeAfter.

\bool_if:NT \c_@@_tikz_loaded_bool
{
 \tikzset
\tikzset
\tikzset

\textsuperscript{68} It’s possible to use the option parallelize-diags to disable this parallelization.
When light-syntax is used, we insert systematically a \CodeAfter in the flow. Thus, it’s possible to have two instructions \CodeAfter and the second may be in \g_nicematrix_code_after_tl. That’s why we set \Code-after to be no-op now.

We clear the list of the names of the potential \SubMatrix that will appear in the \CodeAfter (unfortunately, that list has to be global).

And here’s the \CodeAfter. Since the \CodeAfter may begin with an “argument” between square brackets of the options, we extract and treat that potential “argument” with the command \@@_CodeAfter_keys:.

\g_nicematrix_code_before_tl is for instructions in the cells of the array such as \rowcolor and \cellcolor (when the key colortbl-like is in force). These instructions will be written on the aux file to be added to the code-before in the next run.

The command \rowcolor in tabular will in fact use \rectanglecolor in order to follow the behaviour of \rowcolor of colortbl. That’s why there may be a command \rectanglecolor in \g_nicematrix_code_before_tl. In order to avoid an error during the expansion, we define a protected version of \rectanglecolor.

The command \CT@arc@ contains the instruction of color for the rules of the array. This command is used by \CT@arc@ but we use it also for compatibility with colortbl. But we want also to be able to use color for the rules of the array when colortbl is not loaded. That’s why we do the following instruction which is in the patch of the end of arrays done by colortbl.

\hfill \footnote{\texttt{\color[rgb]{0.5,0.5,0}}}

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The following command will extract the potential options (between square brackets) at the beginning of the `\CodeAfter` (that is to say, when `\CodeAfter` is used, the options of that “command” `\CodeAfter`). Idem for the `\CodeBefore`.

```latex
\NewDocumentCommand \@@_CodeAfter_keys: { O { } } \{ \keys_set:nn { NiceMatrix / CodeAfter } { #1 } \}
```

We remind that the first mandatory argument of the command `\Block` is the size of the block with the special format `i-j`. However, the user is allowed to omit `i` or `j` (or both). This will be interpreted as: the last row (resp. column) of the block will be the last row (resp. column) of the block (without the potential exterior row—resp. column—of the array). By convention, this is stored in `\g_@@_pos_of_blocks_seq` (and `\g_@@_blocks_seq`) as a number of rows (resp. columns) for the block equal to 100. It’s possible, after the construction of the array, to replace these values by the correct ones (since we know the number of rows and columns of the array).

```latex
\cs_new_protected:Npn \@@_adjust_pos_of_blocks_seq:
\seq_gset_map_x:NNn \g_@@_pos_of_blocks_seq \g_@@_pos_of_blocks_seq
{ \@@_adjust_pos_of_blocks_seq_i:nnnnn ##1 }
```

The following command must not be protected.

```latex
\cs_new:Npn \@@_adjust_pos_of_blocks_seq_i:nnnnn #1 #2 #3 #4 #5
\{ #1 \}
\{ #2 \}
\{ \int_compare:nNnTF { #3 } > { 99 } \{ \int_use:N \c@iRow \} \{ #3 \} \}
\{ \int_compare:nNnTF { #4 } > { 99 } \{ \int_use:N \c@jCol \} \{ #4 \} \}
\{ #5 \}
```

We recall that, when externalization is used, `\tikzpicture` and `\endtikzpicture` (or `\pgfpicture` and `\endpgfpicture`) must be directly “visible”. That’s why we have to define the adequate version of `\@@_draw_dotted_lines`: whether Tikz is loaded or not (in that case, only PGF is loaded).

```latex
\hook_gput_code:nnn { begindocument } { . }
```

The following command must not be protected because it will appear in the construction of the command `\@@_draw_dotted_lines`.

```latex
\cs_new_protected:Npx \@@_draw_dotted_lines:
\{ \c_@@_pgfortikzpicture_tl \@@_draw_dotted_lines_i: \c_@@_endpgfortikzpicture_tl \}
```

The following command must be protected because it will appear in the construction of the command `\@@_draw_dotted_lines`.

```latex
\cs_new_protected:Npn \@@_draw_dotted_lines_i:
\{ \pgfrememberpicturepositiononpagetrue \pgf@relevantforpicturesizefalse \g_@@_HVdotsfor_lines_tl \g_@@_Vdots_lines_tl \g_@@_Ddots_lines_tl \g_@@_Iddots_lines_tl \g_@@_Cdots_lines_tl \}
```

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We define a new PGF shape for the diag nodes because we want to provide an anchor called \texttt{.5} for those nodes.

\begin{verbatim}
\pgfdeclareshape { @@_diag_node }
{
  \savedanchor { \five }
  {
    \dim_gset_eq:NN \pgf@x \l_tmpa_dim
    \dim_gset_eq:NN \pgf@y \l_tmpb_dim
  }
  \anchor { 5 } { \five }
  \anchor { center } { \pgfpointorigin }
}
\end{verbatim}

The following command creates the diagonal nodes (in fact, if the matrix is not a square matrix, not all the nodes are on the diagonal).

\begin{verbatim}
\cs_new_protected:Npn \@@_create_diag_nodes:
{
\pgfpicture
\pgfrememberpicturepositiononpagetrue
\int_step_inline:nn { \int_max:nn \c@iRow \c@jCol }
{
  \@@_qpoint:n { col - \int_min:nn { ##1 } { \c@jCol + 1 } }
  \dim_set_eq:NN \l_tmpa_dim \pgf@x
  \@@_qpoint:n { row - \int_min:nn { ##1 } { \c@iRow + 1 } }
  \dim_set_eq:NN \l_tmpb_dim \pgf@y
  \@@_qpoint:n { col - \int_min:nn { ##1 + 1 } { \c@jCol + 1 } }
  \dim_set_eq:NN \l_@@_tmpc_dim \pgf@x
  \@@_qpoint:n { row - \int_min:nn { ##1 + 1 } { \c@iRow + 1 } }
  \dim_set_eq:NN \l_@@_tmpd_dim \pgf@y
  \pgftransformshift { \pgfpoint \l_tmpa_dim \l_tmpb_dim }
  \pgfnode { @@_diag_node } { center } { } { \@@_env: - ##1 } { }
  \str_if_empty:NF \l_@@_name_str { \pgfnodealias { \l_@@_name_str - ##1 } { \@@_env: - ##1 } }
}
\end{verbatim}

Now, \texttt{l\_tmpa\_dim} and \texttt{l\_tmpb\_dim} become the width and the height of the node (of shape \texttt{@à\_diag\_node}) that we will construct.

\begin{verbatim}
\dim_set:Nn \l_\texttt{tmpa\_dim} { ( \l_\texttt{tmpc\_dim} - \l\_\texttt{tmpa\_dim} ) / 2 }
\dim_set:Nn \l_\texttt{tmpb\_dim} { ( \l_\texttt{tmpd\_dim} - \l\_\texttt{tmpb\_dim} ) / 2 }
\pgfnode { @@\_diag\_node } { center } { } { \\@\_env: - \#1 } { }
\str_if_empty:NF \l_\texttt{name\_str} { \pgfnodealias { \l_\texttt{name\_str} - \#1 } { \\@\_env: - \#1 } }
\end{verbatim}

Now, the last node. Of course, that is only a \texttt{coordinate} because there is not \texttt{.5} anchor for that node.

\begin{verbatim}
\\@\_qpoint:n { col - \int_min:nn \l_\texttt{tmpa\_int} { \\@\_env: N \l\_\texttt{tmpa\_int} } { \\@\_env: \texttt{last} } }
\pgfnodealias { \\@\_env: - \last }
\str_if_empty:NF \l_\texttt{name\_str} { \\@\_env: - \texttt{eval} } { }
\str_if_empty:NF \l_\texttt{name\_str} { }
\end{verbatim}
We draw the dotted lines

A dotted line will be said open in one of its extremities when it stops on the edge of the matrix and closed otherwise. In the following matrix, the dotted line is closed on its left extremity and open on its right.

\[
\begin{pmatrix}
a + b + c & a + b & a \\
a & \ldots & \ldots \\
a & a + b & a + b + c \\
\end{pmatrix}
\]

The command \texttt{\@@\_find\_extremities\_of\_line:nnnn} takes four arguments:

- the first argument is the row of the cell where the command was issued;
- the second argument is the column of the cell where the command was issued;
- the third argument is the \textit{x}-value of the orientation vector of the line;
- the fourth argument is the \textit{y}-value of the orientation vector of the line.

This command computes:

- \texttt{l\_@@\_initial\_i\_int} and \texttt{l\_@@\_initial\_j\_int} which are the coordinates of one extremity of the line;
- \texttt{l\_@@\_final\_i\_int} and \texttt{l\_@@\_final\_j\_int} which are the coordinates of the other extremity of the line;
- \texttt{l\_@@\_initial\_open\_bool} and \texttt{l\_@@\_final\_open\_bool} to indicate whether the extremities are open or not.

```
cs_new_protected:Npn \@@_find_extremities_of_line:nnnn #1 #2 #3 #4
{
  First, we declare the current cell as “dotted” because we forbid intersections of dotted lines.

  \cs_set:cpn { @@ _ dotted _ #1 - #2 } { }

  \int_set:Nn \l_@@_initial_i_int { #1 }
  \int_set:Nn \l_@@_initial_j_int { #2 }
  \int_set:Nn \l_@@_final_i_int { #1 }
  \int_set:Nn \l_@@_final_j_int { #2 }
  \bool_set_false:N \l_@@_stop_loop_bool
  \bool_do_until:Nn \l_@@_stop_loop_bool
  {
    \int_add:Nn \l_@@_final_i_int { #3 }
    \int_add:Nn \l_@@_final_j_int { #4 }
  }
```

We will do two loops: one when determining the initial cell and the other when determining the final cell. The boolean \texttt{l\_@@\_stop\_loop\_bool} will be used to control these loops. In the first loop, we search the “final” extremity of the line.
We test if we are still in the matrix.

\bool_set_false:N \l_@@_final_open_bool
\int_compare:nNnTF \l_@@_final_i_int > \l_@@_row_max_int
{
  \int_compare:nNnTF { #3 } = 1
  { \bool_set_true:N \l_@@_final_open_bool }
  \int_compare:nNnTF \l_@@_final_j_int > \l_@@_col_max_int
  { \bool_set_true:N \l_@@_final_open_bool }
}
\bool_if:NTF \l_@@_final_open_bool

If we are outside the matrix, we have found the extremity of the dotted line and it’s an open extremity.

\int_compare:nNnTF \l_@@_final_j_int < \l_@@_col_min_int
{
  \int_compare:nNt { #4 } = {-1}
  { \bool_set_true:N \l_@@_final_open_bool }
  \int_compare:nNnT \l_@@_final_j_int > \l_@@_col_max_int
  { \bool_set_true:N \l_@@_final_open_bool }
}
\bool_if:NTF \l_@@_final_open_bool

We do a step backwards.

\int_sub:Nn \l_@@_final_i_int { #3 }
\int_sub:Nn \l_@@_final_j_int { #4 }
\bool_set_true:N \l_@@_stop_loop_bool

If we are in the matrix, we test whether the cell is empty. If it’s not the case, we stop the loop because we have found the correct values for \l_@@_final_i_int and \l_@@_final_j_int.

\cs_if_exist:cTF
{
  \l_@_dotted_
  \int_use:N \l_@@_final_i_int -
  \int_use:N \l_@@_final_j_int
}
\cs_if_exist:cTF
{
  \pgf @ sh @ ns @ \@@_env:
  - \int_use:N \l_@@_final_i_int
  - \int_use:N \l_@@_final_j_int
  \bool_set_true:N \l_@@_stop_loop_bool}

If the case is empty, we declare that the cell as non-empty. Indeed, we will draw a dotted line and the cell will be on that dotted line. All the cells of a dotted line have to be marked as “dotted” because we don’t want intersections between dotted lines. We recall that the research of the extremities of the lines are all done in the same TeX group (the group of the environment), even though, when the extremities are found, each line is drawn in a TeX group that we will open for the options of the line.
For $l_{\text{initial}_i}$ and $l_{\text{initial}_j}$ the programmation is similar to the previous one.

```latex
\begin{verbatim}
\textbf{bool_set_false:N} $l_{\text{stop loop bool}}$
\textbf{bool_do_until:Nn} $l_{\text{stop loop bool}}$
{ 
  \textbf{int_sub:Nn} $l_{\text{initial}_i}$ \textbf{n} \textbf{3} 
  \textbf{int_sub:Nn} $l_{\text{initial}_j}$ \textbf{n} \textbf{4} 
  \textbf{bool_set_false:N} $l_{\text{initial open bool}}$
  \textbf{int_compare:nNnTF} $l_{\text{initial}_i} < l_{\text{row min int}}$
  { { \textbf{int_compare:nNnTF} \textbf{n} \textbf{1} } 
    { \textbf{int_compare:nNnTF} l_{\text{col min int}} = \{ l_{\text{row min int}} \textbf{- 1} \} 
      { \textbf{bool_set_true:N} l_{\text{initial open bool}} } 
    } 
  } 
  \textbf{bool_if:NTF} l_{\text{initial open bool}}$
  { { \textbf{int_add:Nn} l_{\text{initial}_i} \textbf{n} \textbf{3} } 
    { \textbf{int_add:Nn} l_{\text{initial}_j} \textbf{n} \textbf{4} 
      { \textbf{bool_set_true:N} l_{\text{stop loop bool}} } 
    } 
  } 
  \textbf{cs_if_exist:cTF}
  { { \textbf{dotted} } 
    \textbf{int_use:N} l_{\text{initial}_i} \textbf{-} 
    \textbf{int_use:N} l_{\text{initial}_j} \textbf{-} 
  } 
  { { \textbf{int_add:Nn} l_{\text{initial}_i} \textbf{n} \textbf{3} } 
    { \textbf{int_add:Nn} l_{\text{initial}_j} \textbf{n} \textbf{4} 
      { \textbf{bool_set_true:N} l_{\text{initial open bool}} 
        \textbf{bool_set_true:N} l_{\text{stop loop bool}} } 
    } 
  }
\end{verbatim}
```
We remind the rectangle described by all the dotted lines in order to respect the corresponding virtual “block” when drawing the horizontal and vertical rules.

\seq_gput_right:Nx \g_@@_pos_of_xdots_seq
{ \int_use:N \l_@@_initial_i_int }

Be careful: with \ldots, \l_@@_final_j_int is inferior to \l_@@_initial_j_int. That’s why we use \int_min:nn and \int_max:nn.

\seq_map_inline:Nn \g_@@_submatrix_seq
{ \@@_adjust_to_submatrix:nnnnnn { #1 } { #2 } ##1 }

#1 and #2 are the numbers of row and columns of the cell where the command of dotted line (ex.: \Vdots) has been issued. #3, #4, #5 and #6 are the specification (in \i and \j) of the submatrix where are analysing.

\seq_map_inline:Nn \g_@@_submatrix_seq
{ \@@_adjust_to_submatrix:nnnnnn { #1 } { #2 } ##1 }

#1 and #2 are the numbers of row and columns of the cell where the command of dotted line (ex.: \Vdots) has been issued. #3, #4, #5 and #6 are the specification (in \i and \j) of the submatrix where are analysing.
If, in fact, all the cells of the columns are empty (no PGF/Tikz nodes in those cells).

If, in fact, all the cells of the columns are empty (no PGF/Tikz nodes in those cells).

\dim_compare:nNnT \l_@@_x_initial_dim = \c_max_dim
{ \@@_qpoint:n { col - \int_use:N \l_@@_initial_j_int }
\dim_compare:nNnT \l_@@_x_initial_dim = \c_max_dim
{ \@@_qpoint:n { col - \int_use:N \l_@@_initial_j_int }
\dim_set_eq:NN \l_@@_x_initial_dim \pgf@x
\int_compare_p:n { \l_@@_row_min_int \leq \l_@@_row_max_int }
\int_compare_p:n { \l_@@_col_min_int \leq \l_@@_col_max_int }
{ \int_set:Nn \l_@@_row_min_int { \int_max:nn \l_@@_row_min_int { \l_@@_row_min_int } }
\int_set:Nn \l_@@_col_min_int { \int_max:nn \l_@@_col_min_int { \l_@@_col_min_int } }
\int_set:Nn \l_@@_row_max_int { \int_min:nn \l_@@_row_max_int { \l_@@_row_max_int } }
\int_set:Nn \l_@@_col_max_int { \int_min:nn \l_@@_col_max_int { \l_@@_col_max_int } }
}
If, in fact, all the cells of the columns are empty (no PGF/Tikz nodes in those cells).

\dim_compare:nNnT \l_@@_x_final_dim = \{- \c_max_dim \}
\@@_qpoint:n \{ col - \int_eval:n \{ \l_@@_final_j_int + 1 \} \}
\dim_set_eq:NN \l_@@_x_final_dim \pgf@x
\dim_sub:Nn \l_@@_x_final_dim \col@sep

The first and the second arguments are the coordinates of the cell where the command has been issued. The third argument is the list of the options.

\cs_new_protected:Npn \@@_draw_Ldots:nnn #1 #2 #3
\@@_adjust_to_submatrix:nn { #1 } { #2 }
\cs_if_free:cT { @@_dotted _#1 - #2 }
\@@_find_extremities_of_line:nnnn { #1 } { #2 } 0 1

We remind that, when there is a “last row” \l_@@_last_row_int will always be (after the construction of the array) the number of that “last row” even if the option last-row has been used without value.

\int_compare:nNnTF \{ #1 \} = \l_@@_last_row_int
{ \color { nicematrix-first-row } }
{ }

The command \@@_actually_draw_Ldots: has the following implicit arguments:

- \l_@@_initial_i_int
- \l_@@_initial_j_int
- \l_@@_initial_open_bool
The following function is also used by \Hdotsfor.
\cs_new_protected:Npn \@@_actually_draw_Ldots:
\bool_if:NTF \l_@@_initial_open_bool
\begin{itemize}
\item \l_@@_final_i_int
\item \l_@@_final_j_int
\item \l_@@_final_open_bool.
\end{itemize}
We raise the line of a quantity equal to the radius of the dots because we want the dots really “on”
the line of texte. Of course, maybe we should not do that when the option line-style is used (?)..
\begin{itemize}
\item \dim_add:Nn \l_@@_y_initial_dim \l_@@_radius_dim
\item \dim_add:Nn \l_@@_y_final_dim \l_@@_radius_dim
\item \@@_draw_line:
\end{itemize}

The first and the second arguments are the coordinates of the cell where the command has been
issued. The third argument is the list of the options.
\cs_new_protected:Npn \@@_draw_Cdots:nnn #1 #2 #3
\begin{itemize}
\item \int_compare:nNnTF { #1 } = 0
\{ \color { nicematrix-first-row } \}
\item \int_compare:nNnT { #1 } = \l_@@_last_row_int
\{ \color { nicematrix-last-row } \}
\item \keys_set:nn { NiceMatrix / xdots } { #3 }
\end{itemize}

The command \@@_actually_draw_Cdots: has the following implicit arguments:
\begin{itemize}
\item \l_@@_initial_i_int
\item \l_@@_initial_j_int
\end{itemize}
The first and the second arguments are the coordinates of the cell where the command has been issued. The third argument is the list of the options.

\cs_new_protected:Npn \@@_draw_Vdots:nnn #1 #2 #3
{ \@@_adjust_to_submatrix:nn { #1 } { #2 } \cs_if_free:cT { @@_dotted _ #1 - #2 } { \@@_find_extremities_of_line:nnnn { #1 } { #2 } 1 0 }
\keys_set:nn { NiceMatrix / xdots } { #3 } \tl_if_empty:VF \l_@@_xdots_color_tl \color { \l_@@_xdots_color_tl } \@@_actually_draw_Vdots: \group_end: }

The previous command may have changed the current environment by marking some cells as “dotted”, but, fortunately, it is outside the group for the options of the line.

\cs_new_protected:Npn \@@_actually_draw_Vdots: \group_begin: \int_compare:nNnTF { #2 } = 0 { \color { nicematrix-first-col } } { \int_compare:nNnT { #2 } = \l_@@_last_col_int { \color { nicematrix-last-col } } } \keys_set:nn { NiceMatrix / xdots } { #3 } \tl_if_empty:VF \l_@@_xdots_color_tl { \color { \l_@@_xdots_color_tl } \@@_actually_draw_Vdots: } \group_end: }

The command \@@_actually_draw_Vdots: has the following implicit arguments:

\ \l_@@_initial_i_int
\ \l_@@_initial_j_int
\ \l_@@_initial_open_bool
\ \l_@@_final_i_int
\ \l_@@_final_j_int
\ \l_@@_final_open_bool.

The following function is also used by \Vdotsfor.

\cs_new_protected:Npn \@@_actually_draw_Vdots: \group_begin: \int_compare:nNnTF { #2 } = 0 { \color { nicematrix-first-col } } { \int_compare:nNnT { #2 } = \l_@@_last_col_int } { \color { nicematrix-last-col } } \keys_set:nn { NiceMatrix / xdots } { #3 } \tl_if_empty:VF \l_@@_xdots_color_tl \color { \l_@@_xdots_color_tl } \@@_actually_draw_Vdots: \group_end: }

The boolean \l_@@_initial_open_bool indicates whether the column is of type l or may be considered as if.

\bool_set_false:N \l_@@_initial_open_bool

First the case when the line is closed on both ends.

\bool_lazy_or:nnF \l_@@_initial_open_bool \l_@@_final_open_bool
{ \l_@@_set_initial_coords_from_anchor:n \l_@@_set_final_coords_from_anchor:n \bool_set:Nn \l_@@_final_open_bool
{ \dim_compare_p:nNn \l_@@_x_initial_dim = \l_@@_x_final_dim } }
Now, we try to determine whether the column is of type $c$ or may be considered as if.

We may think that the final user won’t use a “last column” which contains only a command $\Vdots$. However, if the $\Vdots$ is in fact used to draw, not a dotted line, but an arrow (to indicate the number of rows of the matrix), it may be really encountered.

Now the case where both extremities are closed. The first conditional tests whether the column is of type $c$ or may be considered as if.

For the diagonal lines, the situation is a bit more complicated because, by default, we parallelize the diagonals lines. The first diagonal line is drawn and then, all the other diagonal lines are drawn parallel to the first one.

The first and the second arguments are the coordinates of the cell where the command has been issued. The third argument is the list of the options.
The previous command may have changed the current environment by marking some cells as “dotted”, but, fortunately, it is outside the group for the options of the line.

\begin{NiceMatrix}
\resetkeys{\NiceMatrix / xdots} \color{\l_@@_xdots_color_tl}
\end{NiceMatrix}

The command \texttt{\@@\_actually\_draw\_Ddots} has the following implicit arguments:

- \texttt{\l_@@\_initial\_i\_int}
- \texttt{\l_@@\_initial\_j\_int}
- \texttt{\l_@@\_initial\_open\_bool}
- \texttt{\l_@@\_final\_i\_int}
- \texttt{\l_@@\_final\_j\_int}
- \texttt{\l_@@\_final\_open\_bool}.

\begin{Verbatim}
\cs_new_protected:Npn \@@\_actually\_draw\_Ddots:
{
  \bool_if:NTF \l_@@\_initial\_open\_bool
  {
    \@@\_open\_y\_initial\_dim:
    \@@\_open\_x\_initial\_dim:
  }
  { \@@\_set\_initial\_coords\_from\_anchor:n { south\_east } }
  \bool_if:NTF \l_@@\_final\_open\_bool
  {
    \@@\_open\_x\_final\_dim:
    \dim_set_eq:NN \l_@@\_x\_final\_dim \pgf@x
  }
  { \@@\_set\_final\_coords\_from\_anchor:n { north\_west } }
}
\end{Verbatim}
If the diagonal line is not the first one, we have to adjust the second extremity of the line by modifying the coordinate \l_{\text{initial\_dim}}.

\begin{verbatim}
  \dim_set:Nn \l_{\text{final\_dim}}
  \l_{\text{initial\_dim}} +
  ( \l_{\text{final\_dim}} - \l_{\text{initial\_dim}} ) *
  \dim_ratio:nn \g_{\text{delta\_y\_one\_dim}} \g_{\text{delta\_x\_one\_dim}}
\end{verbatim}

We draw the \texttt{\textbackslash Iddots} diagonals in the same way.
The first and the second arguments are the coordinates of the cell where the command has been issued. The third argument is the list of the options.

\begin{verbatim}
\cs_new_protected:Npn \@@_draw_Iddots:nnn #1 #2 #3
  \@@_adjust_to_submatrix:nn { #1 } { #2 }
  \cs_if_free:cT { \_dotted _#1 _#2 } {
    \@@_find_extremities_of_line:nnnn { #1 } { #2 } 1 -1
  }
\end{verbatim}

The previous command may have changed the current environment by marking some cells as “dotted”, but, fortunately, it is outside the group for the options of the line.

\begin{verbatim}
\keys_set:nn \texttt{NiceMatrix / xdots} \#3
\tl_if_empty:VF \l_{\text{xdots\_color\_tl}} \color { \l_{\text{xdots\_color\_tl}} }
\@@_actually_draw_Iddots:
\end{verbatim}

The command \texttt{\@@_actually_draw_Iddots:} has the following implicit arguments:

- \l_{\text{initial\_i\_int}}
- \l_{\text{initial\_j\_int}}
- \l_{\text{initial\_open\_bool}}
- \l_{\text{final\_i\_int}}
- \l_{\text{final\_j\_int}}
- \l_{\text{final\_open\_bool}}.
\int_gincr:N \g_@@_iddots_int
\int_compare:nNnTF \g_@@_iddots_int = 1
{
    \dim_gset:Nn \g_@@_delta_x_two_dim
    { \l_@@_x_final_dim - \l_@@_x_initial_dim }
    \dim_gset:Nn \g_@@_delta_y_two_dim
    { \l_@@_y_final_dim - \l_@@_y_initial_dim }
}
\@@_draw_line:

The actual instructions for drawing the dotted lines with Tikz

The command \@@_draw_line: should be used in a \{pgfpicture\}. It has six implicit arguments:

- \l_@@_x_initial_dim
- \l_@@_y_initial_dim
- \l_@@_x_final_dim
- \l_@@_y_final_dim
- \l_@@_initial_open_bool
- \l_@@_final_open_bool

\cs_new_protected:Npn \@@_draw_line:
{
    \pgfrememberpicturepositiononpagetrue
    \pgf@relevantforpicturesizefalse
    \bool_lazy_or:nnTF
        { \tl_if_eq_p:NN \l_@@_xdots_line_style_tl \c_@@_standard_tl }
        \l_@@_dotted_bool
    \@@_draw_standard_dotted_line:
    \@@_draw_unstandard_dotted_line:
}

\exp_args:NV to be able to put in the list of options in the correct place in the Tikz instruction.
We have used the fact that, in PGF, a color name can be put directly in a list of options (that’s why we have put directly $\color{xdots_color_tl}$).

The argument of $\@@_draw_unstandard_dotted_line:n$ is, in fact, the list of options.

\cs_new_protected:Npn \@@_draw_unstandard_dotted_line:n #1
\{ #1 \}
\l_@@_xdots_color_tl
\l_@@_xdots_up_tl
\l_@@_xdots_down_tl
\}
\cs_new_protected:Npn \@@_draw_unstandard_dotted_line:nnn #1 #2 #3
\{ \draw [#1 , shorten-> = \l_@@_xdots_shorten_dim , shorten<- = \l_@@_xdots_shorten_dim , ]
( \l_@@_x_initial_dim , \l_@@_y_initial_dim )
-- node [ sloped , above ] { $\scriptstyle #2$ }
node [ sloped , below ] { $\scriptstyle #3$ }
( \l_@@_x_final_dim , \l_@@_y_final_dim ) ; \end{scope}
\}
\cs_generate_variant:Nn \@@_draw_unstandard_dotted_line:nnn { n V V }

Be careful: We can’t put $\c_math_toggle_token$ instead of $\$ in the following lines because we are in the contents of Tikz nodes (and they will be rescanned if the Tikz library babel is loaded).
\-- node [ sloped , above ] { $\scriptstyle #2$ }
node [ sloped , below ] { $\scriptstyle #3$ }
( \l_@@_x_final_dim , \l_@@_y_final_dim ) ; \end{scope}
\}
\cs_generate_variant:Nn \@@_draw_unstandard_dotted_line:nnn { n V V }

The command $\@@_draw_standard_dotted_line:$ draws the line with our system of dots (which gives a dotted line with real round dots).
\cs_new_protected:Npn \@@_draw_standard_dotted_line:
\{ \bool_lazy_and:nnF { \tl_if_empty_p:N \l_@@_xdots_up_tl }
\tl_if_empty_p:N \l_@@_xdots_down_tl }
\{ \pgfscope
\pgftransformshift
{ \pgfpointlineattime { 0.5 } 
\pgfpoint { \l_@@_x_initial_dim \l_@@_y_initial_dim } 
\pgfpoint { \l_@@_x_final_dim \l_@@_y_final_dim } }
\pgftransformrotate
{ \fp_eval:n 
\atand 
( \l_@@_y_final_dim - \l_@@_y_initial_dim , 
\l_@@_x_final_dim - \l_@@_x_initial_dim ) }
\pgfnode

\c_math_toggle_token
\scriptstyle \l_@@_xdots_up_tl
\c_math_toggle_token
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The dimension $\l_\text{l}\_\text{dim}$ is the length $\ell$ of the line to draw. We use the floating point reals of the L3 programming layer to compute this length.

\begin{verbatim}
\dim_zero_new:N \l_\text{l}_\text{dim}
\dim_set:Nn \l_\text{l}_\text{dim}
{ \fp_to_dim:n }
{ sqrt } 
{ ( \l_\text{final}_\text{dim} - \l_\text{initial}_\text{dim} ) ^ 2 } 
{ + } 
{ ( \l_\text{final}_\text{dim} - \l_\text{initial}_\text{dim} ) ^ 2 } 
\end{verbatim}

It seems that, during the first compilations, the value of $\l_\text{dim}$ may be erroneous (equal to zero or very large). We must detect these cases because they would cause errors during the drawing of the dotted line. Maybe we should also write something in the aux file to say that one more compilation should be done.

\begin{verbatim}
\bool_lazy_or:nnF \{ \dim_compare_p:nNn { \dim_abs:n \l_\text{dim} } > \l_\text{max}_\text{dim} \} 
{ \dim_compare_p:nNn \l_\text{dim} = \l_\text{zero}_\text{dim} } 
\@@\text{draw_standard_dotted_line_i:}
\end{verbatim}

The number of dots will be $\l_{\text{tmpa}} + 1$.

\begin{verbatim}
\bool_if:NTF \l_\text{initial}_\text{open}_\text{bool} 
{ \bool_if:NTF \l_\text{final}_\text{open}_\text{bool} 
{ \int_set:Nn \l_\text{tmpa} } 
{ \dim_ratio:nn \l_\text{dim} \l_\text{inter_dots_dim} } 
} 
\int_set:Nn \l_\text{tmpa} 
{ \dim_ratio:nn 
{ \l_\text{dim} - \l_\text{xdots_shorten_dim} } 
\l_\text{inter_dots_dim} } 
\end{verbatim}
\bool_if:NTF \l_@@_final_open_bool
  \int_set:Nn \l_tmpa_int
  \dim_ratio:nn
  \l_@@_l_dim - \l_@@_xdots_shorten_dim
  \l_@@_inter_dots_dim
\}
\int_set:Nn \l_tmpb_int
  \dim_ratio:nn
  \l_@@_l_dim - 2 \l_@@_xdots_shorten_dim
  \l_@@_inter_dots_dim
\}
\}

The dimensions \l_tmpa_dim and \l_tmpb_dim are the coordinates of the vector between two dots in the dotted line.
\dim_set:Nn \l_tmpa_dim
  \l_@@_x_final_dim - \l_@@_x_initial_dim \times
  \dim_ratio:nn \l_@@_inter_dots_dim \l_@@_l_dim
\dim_set:Nn \l_tmpb_dim
  \l_@@_y_final_dim - \l_@@_y_initial_dim \times
  \dim_ratio:nn \l_@@_inter_dots_dim \l_@@_l_dim
\}

The length \( \ell \) is the length of the dotted line. We note \( \Delta \) the length between two dots and \( n \) the number of intervals between dots. We note \( \delta = \frac{1}{2}(\ell - n\Delta) \). The distance between the initial extremity of the line and the first dot will be equal to \( k \cdot \delta \) where \( k = 0, 1 \) or \( 2 \). We first compute this number \( k \) in \l_tmpb_int.

\int_set:Nn \l_tmpb_int
  \bool_if:NTF \l_@@_initial_open_bool
  \bool_if:NTF \l_@@_final_open_bool 1 0
  \bool_if:NTF \l_@@_final_open_bool 2 1
\}

In the loop over the dots, the dimensions \l_@@_x_initial_dim and \l_@@_y_initial_dim will be used for the coordinates of the dots. But, before the loop, we must move until the first dot.
\dim_gadd:Nn \l_@@_x_initial_dim
  \l_@@_x_final_dim - \l_@@_x_initial_dim \times
  \dim_ratio:nn \l_@@_inter_dots_dim \l_@@_l_dim
* \l_tmpa_int
\}
\dim_gadd:Nn \l_@@_y_initial_dim
  \l_@@_y_final_dim - \l_@@_y_initial_dim \times
  \dim_ratio:nn \l_@@_inter_dots_dim \l_@@_l_dim
* \l_tmpb_int
\}
\pgf@relevantforpicturesizefalse
User commands available in the new environments

The commands \@@_Ldots, \@@_Cdots, \@@_Vdots, \@@_Ddots and \@@_Iddots will be linked to \Ldots, \Cdots, \Vdots, \Ddots and \Iddots in the environments \{NiceArray\} (the other environments of nicematrix rely upon \{NiceArray\}).

The syntax of these commands uses the character _ as embellishment and thats’ why we have to insert a character _ in the arg spec of these commands. However, we don’t know the future catcode of _ in the main document (maybe the user will use underscore, and, in that case, the catcode is 13 because underscore activates _). That’s why these commands will be defined in a \hook_gput_code:nnn { begindocument } { . } and the arg spec will be rescanned.
\begin{verbatim}
{ \phantom { \ensuremath { \@@_old_iddots } } }
\bool_gset_true:N \g_@@_empty_cell_bool
}

End of the \AddToHook.

Despite its name, the following set of keys will be used for \Ddots but also for \Iddots.
\keys_define:nn { NiceMatrix / Ddots } { draw-first .bool_set:N = \l_@@_draw_first_bool , draw-first .default:n = true , draw-first .value_forbidden:n = true }

The command \@@_Hspace: will be linked to \hspace in \{NiceArray\}.
\cs_new_protected:Npn \@@_Hspace: { \bool_gset_true:N \g_@@_empty_cell_bool \hspace }

In the environments of nicematrix, the command \multicolumn is redefined. We will patch the environment \{tabular\} to go back to the previous value of \multicolumn.
\cs_set_eq:NN \@@_old_multicolumn \multicolumn

The command \@@_Hdotsfor will be linked to \Hdotsfor in \{NiceArrayWithDelims\}. Tikz nodes are created also in the implicit cells of the \Hdotsfor (maybe we should modify that point).

This command must not be protected since it begins with \multicolumn.
\cs_new:Npn \@@_Hdotsfor: { \bool_lazy_and:nnTF { \int_compare_p:nNn \c@jCol = 0 } { \int_compare_p:nNn \l_@@_first_col_int = 0 } { \bool_if:NTF \g_@@_after_col_zero_bool { \multicolumn { 1 } { c } { } \@@_Hdotsfor_i } { \@@_fatal:n { Hdotsfor~in~col~0 } } } { \@@_fatal:n { Hdotsfor-in-col-0 } } { \multicolumn { 1 } { c } { } \@@_Hdotsfor_i } }

The command \@@_Hdotsfor_i is defined with \NewDocumentCommand because it has an optional argument. Note that such a command defined by \NewDocumentCommand is protected and that’s why we have put the \multicolumn before (in the definition of \@@_Hdotsfor:).
\hook_gput_code:nnn { begindocument } { . }
\exp_args:NNV \NewDocumentCommand \@@_Hdotsfor_i \l_@@_argspec_tl

We don’t put ! before the last optional argument for homogeneity with \Cdots, etc. which have only one optional argument.
\exp_args:NNV \NewDocumentCommand \@@_Hdotsfor_i \l_@@_argspec_tl
\tl_gput_right:Nx \g_@@_HVdotsfor_lines_tl
\end{verbatim}
\begin{verbatim}
\end{verbatim}
We declare all the cells concerned by the \Hdotsfor as “dotted” (for the dotted lines created by \Cdots, \Ldots, etc., this job is done by \@@_find_extremities_of_line:nnnn). This declaration is done by defining a special control sequence (to nil).

For the column, it’s easy.

For the row, it’s a bit more complicated.
We declare all the cells concerned by the \Vdotsfor as “dotted” (for the dotted lines created by \Cdots, \Ldots, etc., this job is done by \@@_find_extremities_of_line:nnnn). This declaration is done by defining a special control sequence (to nil).

\int_step_inline:nnn { #1 } { #1 + #3 - 1 } { \cs_set:cpn { @@ _ dotted _ ##1 - #2 } { } }

The command \@@_rotate: will be linked to \rotate in \NiceArrayWithDelims.
\cs_new_protected:Npn \@@_rotate: { \bool_gset_true:N \g_@@_rotate_bool }

The command \line accessible in code-after

In the \CodeAfter, the command \@@_line:nn will be linked to \line. This command takes two arguments which are the specifications of two cells in the array (in the format i\text{-}j) and draws a dotted line between these cells.

First, we write a command with an argument of the format i\text{-}j and applies the command \int_eval:n to i and j; this must not be protected (and is, of course fully expandable).\footnote{Indeed, we want that the user may use the command \line in \CodeAfter with \LaTeX{} counters in the arguments — with the command \value.}
\cs_new:Npn \@@_double_int_eval:n #1-#2 \q_stop { \int_eval:n { #1 } - \int_eval:n { #2 } }

\begin{thebibliography}{99}
\bibitem{158}
\end{thebibliography}
With the following construction, the command \@@_double_int_eval:n is applied to both arguments before the application of \@@_line_i:nn (the construction uses the fact the \@@_line_i:nn is protected and that \@@_double_int_eval:n is fully expandable).

We recall that, when externalization is used, \tikzpicture and \endtikzpicture (or \pgfpicture and \endpgfpicture) must be directly “visible” and that why we do this static construction of the command \@@_draw_line_ii:.

The following command must be protected (it’s used in the construction of \@@_draw_line_ii:nn).
The commands $\ldots$, $\cdots$, $\vdots$, $\ddots$, and $\iddots$ don't use this command because they have to do other settings (for example, the diagonal lines must be parallelized).

The command $\RowStyle$

\keys_define:nn { NiceMatrix / RowStyle }

\NewDocumentCommand \@@_RowStyle:n { O { } m }
\keys_set:nn { NiceMatrix / RowStyle } { #1 }

If the key rowcolor has been used.
\tl_if_empty:NF \l_@@_tmpc_tl

First, the end of the current row (we remind that $\RowStyle$ applies to the end of the current row).
\tl_gput_right:Nx \g_nicematrix_code_before_tl
\@@_rectanglecolor
{ \l_@@_tmpc_tl }
{ \int_use:N \c@iRow - \int_use:N \c@jCol }
{ \int_use:N \c@iRow - * }

Then, the other rows (if there is several rows).
\int_compare:nNnT \l_@@_key_nb_rows_int > 1
\tl_gput_right:Nx \g_nicematrix_code_before_tl
\@@_rowcolor
{ \l_@@_tmpc_tl }
{ \int_eval:n { \c@iRow + 1 } - \int_eval:n { \c@iRow + \l_@@_key_nb_rows_int - 1 } }

\l_tmpa_dim is the value of the key cell-space-top-limit of RowStyle.
\dim_compare:nNnT \l_tmpa_dim > \c_zero_dim
{\tl_gput_right:Nx \g_@@_row_style_tl
{\tl_gput_right:Nn \exp_not:N \g_@@_post_action_cell_tl
{\dim_set:Nn \l_@@_cell_space_top_limit_dim
{\dim_use:N \l_tmpa_dim}
}
}
}
\l_tmpb_dim is the value of the key cell-space-bottom-limit of RowStyle.
\dim_compare:nNnT \l_tmpb_dim > \c_zero_dim
{\tl_gput_right:Nx \g_@@_row_style_tl
{\tl_gput_right:Nn \exp_not:N \g_@@_post_action_cell_tl
{\dim_set:Nn \l_@@_cell_space_bottom_limit_dim
{\dim_use:N \l_tmpb_dim}
}
}
}
\l_tmpa_tl is the value of the key color of RowStyle.
\tl_if_empty:NF \l_tmpa_tl
{\tl_gput_right:Nx \g_@@_row_style_tl
{\mode_leave_vertical: \exp_not:N \color \{ \l_tmpa_tl \}
}
}
\l_tmpa_bool is the value of the key bold.
\bool_if:NT \l_tmpa_bool
{\tl_gput_right:Nx \g_@@_row_style_tl
{\if_mode_math:
{\c_math_toggle_token \bfseries \boldmath \c_math_toggle_token}
{\bfseries \boldmath}
\fi:
}
}
\tl_gput_right:Nn \g_@@_row_style_tl { \fi }
\g_@@_row_style_tl \ignorespaces
}

Colors of cells, rows and columns

We want to avoid the thin white lines that are shown in some PDF viewers (eg: with the engine MuPDF used by SumatraPDF). That’s why we try to draw rectangles of the same color in the same instruction \pgfusepath { fill } (and they will be in the same instruction fill—coded f—in the resulting PDF).
The commands \texttt{\@\_rowcolor}, \texttt{\@\_columncolor}, \texttt{\@\_rectanglecolor} and \texttt{\@\_rowlistcolors} don’t directly draw the corresponding rectangles. Instead, they store their instructions color by color:

- A sequence \texttt{\_\_\_colors\_seq} will be built containing all the colors used by at least one of these instructions. Each color may be prefixed by its color model (eg: \texttt{[gray](0.5)}).
- For the color whose index in \texttt{\_\_\_colors\_seq} is equal to \texttt{i}, a list of instructions which use that color will be constructed in the token list \texttt{\_\_\_color\_i\_tl}. In that token list, the instructions will be written using \texttt{\_\_\_cartesian\_color:nn} and \texttt{\_\_\_rectanglecolor:nn}.

\#1 is the color and \#2 is an instruction using that color. Despite its name, the command \texttt{\_\_\_add\_to\_colors\_seq:nn} doesn’t only add a color to \texttt{\_\_\_colors\_seq}; it also updates the corresponding token list \texttt{\_\_\_color\_i\_tl}. We add in a global way because the final user may use the instructions such as \texttt{\cellcolor} in a loop of \texttt{pgffor} in the \texttt{\CodeBefore} (and we recall that a loop of \texttt{pgffor} is encapsulated in a group).

```latex
\cs_new_protected:Npn \_\_\_add\_to\_colors\_seq:nn #1 #2
\begin{pgfpicture}
\pgf@relevantforpicturesizefalse
\seq_map_indexed_inline:Nn \_\_\_colors\_seq
\{ \tl_if_eq:nnT { #1 } { ##2 } { \int_set:Nn \l_tmpa_int { ##1 } } \}
\int_compare:nNnTF \l_tmpa_int = \c_zero_int
\begin{CodeBefore}
\seq_gput_right:Nn \_\_\_colors\_seq { #1 }
\tl_gset:cx { \_\_\_color \seq_count:N \_\_\_colors\_seq _tl } { #2 }
\end{CodeBefore}
\endpgfpicture
```

First, we look for the number of the color and, if it’s found, we store it in \texttt{\_\_\_tmpa\_int}. If the color is not present in \texttt{\_\_\_colors\_seq}, \texttt{\_\_\_tmpa\_int} will remain equal to 0.

The macro \texttt{\_\_\_actually\_color:} will actually fill all the rectangles, color by color (using the sequence \texttt{\_\_\_colors\_seq} and all the token lists of the form \texttt{\_\_\_color\_i\_tl}).

```latex
\cs_new_protected:Npn \_\_\_actually\_color:
\pgfpicture
\seq_map_indexed_inline:Nn \_\_\_colors\_seq
\{ \color ##2
\use:c { \_\_\_color ##1 _tl }
\tl_gclear:c { \_\_\_color ##1 _tl }
\pgfusepath { fill }
\}
\endpgfpicture
```
Here is an example: `\%\_rowcolor {red!15} {1,3,5-7,10-}`

\NewDocumentCommand \%\_rowcolor { O { } m m }
{\tl_if_blank:nF { #2 }
  { \@@_add_to_colors_seq:xn
    { \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } }
    { \@@_cartesian_color:nn { #3 } { - } }
  }
}

Here an example: `\%\_columncolor:nn {red!15} {1,3,5-7,10-}`

\NewDocumentCommand \%\_columncolor { O { } m m }
{\tl_if_blank:nF { #2 }
  { \@@_add_to_colors_seq:xn
    { \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } }
    { \@@_cartesian_color:nn { - } { #3 } }
  }
}

Here is an example: `\%\_rectanglecolor{red!15}{2-3}{5-6}`

\NewDocumentCommand \%\_rectanglecolor { O { } m m m }
{\tl_if_blank:nF { #2 }
  { \@@_add_to_colors_seq:xn
    { \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } }
    { \@@_rectanglecolor:nnn { #3 } { #4 } { 0 pt } }
  }
}

The last argument is the radius of the corners of the rectangle.

\NewDocumentCommand \%\_roundedrectanglecolor { O { } m m m m }
{\tl_if_blank:nF { #2 }
  { \@@_add_to_colors_seq:xn
    { \tl_if_blank:nF { #1 } { [ #1 ] } { #2 } }
    { \@@_rectanglecolor:nnn { #3 } { #4 } { #5 } }
  }
}

The last argument is the radius of the corners of the rectangle.

\cs_new_protected:Npn \%\_rectanglecolor:nnn #1 #2 #3
{\@@_cut_on_hyphen:w #1 \q_stop
 \tl_clear_new:N \l_@@_tmpc_tl
 \tl_clear_new:N \l_@@_tmpd_tl
 \tl_set_eq:NN \l_@@_tmpc_tl \l_tmpa_tl
 \tl_set_eq:NN \l_@@_tmpd_tl \l_tmpb_tl
 \@@_cut_on_hyphen:w #2 \q_stop
 \tl_set:Nx \l_@@_rows_tl { \l_@@_tmpc_tl - \l_tmpa_tl }
 \tl_set:Nx \l_@@_cols_tl { \l_@@_tmpd_tl - \l_tmpb_tl }
 \@@_cartesian_path:n takes in two implicit arguments: \l_@@_cols_tl and \l_@@_rows_tl.
 \%\_cartesian_path:n { #3 }
}

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Here is an example: \@@_cellcolor[rgb]{0.5,0.5,0}{2-3,4-5,5-6}
\NewDocumentCommand \@@_cellcolor { O { } m m }
{ \clist_map_inline:nn { #3 } { \@@_rectanglecolor [ #1 ] { #2 } { ##1 } { ##1 } } }
\NewDocumentCommand \@@_chessboardcolors { O { } m m }
{ \int_step_inline:nn { \int_use:N \c@iRow } { \int_step_inline:nn { \int_use:N \c@jCol } { \int_if_even:nTF { ####1 + ##1 } { \@@_cellcolor [ #1 ] { #2 } } { \@@_cellcolor [ #1 ] { #3 } } { ##1 - ####1 } } } }
The command \@@_arraycolor (linked to \arraycolor at the beginning of the \CodeBefore) will color the whole table (excepted the potential exterior rows and columns) and the cells in the “corners”.
\NewDocumentCommand \@@_arraycolor { O { } m }
{ \@@_rectanglecolor [ #1 ] { #2 } { 1 - 1 } { \int_use:N \c@iRow - \int_use:N \c@jCol } }
\keys_define:nn { NiceMatrix / rowcolors }
{ respect-blocks .bool_set:N = \l_@@_respect_blocks_bool ,
  respect-blocks .default:n = true ,
  cols .tl_set:N = \l_@@_cols_tl ,
  restart .bool_set:N = \l_@@_rowcolors_restart_bool ,
  restart .default:n = true ,
  unknown .code:n = \@@_error:n { Unknown-key-for-rowcolors } }
The command \rowcolors (accessible in the code-before) is inspired by the command \rowcolors of the package xcolor (with the option table). However, the command \rowcolors of nicematrix has not the optional argument of the command \rowcolors of xcolor. Here is an example: \rowcolors{1}{blue!10}{[respect-blocks].
#1 (optional) is the color space; #2 is a list of intervals of rows; #3 is the list of colors; #4 is for the optional list of pairs key=value.
\NewDocumentCommand \@@_rowlistcolors { O { } m m O { } }
{ The group is for the options. \l_@@_colors_seq will be the list of colors.
\group_begin:
\seq_clear_new:N \l_@@_colors_seq
\seq_set_split:Nnn \l_@@_colors_seq { , } { #3 }
\tl_clear_new:N \l_@@_cols_tl
\tl_clear_new:N \l_@@_cols_tl
\keys_set:nn { NiceMatrix / rowcolors } { #4 }
The counter \texttt{\_@@\_color\_int} will be the rank of the current color in the list of colors (modulo the length of the list).

We don't want to take into account a block which is completely in the "first column" of (number 0) or in the "last column" and that's why we filter the sequence of the blocks (in a the sequence \texttt{\_tmpa\_seq}).

Now, \texttt{\_tmpa\_till} and \texttt{\_tmpb\_till} are the first row and the last row of the interval of rows that we have to treat. The counter \texttt{\_tmpa\_int} will be the index of the loop over the rows.

We will compute in \texttt{\_tmpb\_int} the last row of the "block".

If the key \texttt{\_@@\_respect\_blocks} is in force, we have to adjust that value (of course).

Now, the last row of the block is computed in \texttt{\_tmpb\_int}.

\texttt{\_@@\_tmcpc\_till} will be the color that we will use.
The command \@@_color_index:n peeks in \l_@@_colors_seq the color at the index #1. However, if that color is the symbol =, the previous one is poken. This macro is recursive.

\cs_new:Npn \@@_color_index:n #1
\{\str_if_eq:eeTF { \seq_item:Nn \l_@@_colors_seq { #1 } } { = } \{ \@@_color_index:n { #1 - 1 } \} \{ \seq_item:Nn \l_@@_colors_seq { #1 } \} \}

The command \rowcolors (available in the \CodeBefore) is a specialisation of the most general command \rowlistcolors.

\NewDocumentCommand \@@_rowcolors { O { } m m m O { } } \{ \@@_rowlistcolors \[ #1 \] { #2 } { { #3 } , { #4 } } \[ #5 \] \}

\cs_new_protected:Npn \@@_rowcolors_i:nnnnn #1 #2 #3 #4 #5
\{\int_compare:nNnT { #3 } > \l_tmpb_int \{ \int_set:Nn \l_tmpb_int { #3 } \} \}

\prg_new_conditional:Nnn \@@_not_in_exterior:nnnnn p \{ \bool_lazy_or:nnTF \{ \int_compare_p:nNn { #4 } = \c_zero_int \} \{ \int_compare_p:nNn { #2 } = \{ \int_eval:n { \c@jCol + 1 } \} \} \prg_return_false: \prg_return_true: \}

The following command return true when the block intersects the row \l_tmpa_int.

\prg_new_conditional:Nnn \@@_intersect_our_row:nnnnn p \{ \bool_if:nTF \{ \int_compare_p:nNn { #1 } <= \l_tmpa_int \} \& \& \int_compare_p:nNn { \l_tmpa_int <= #3 } \} \prg_return_true: \prg_return_false: \}

The following command uses two implicit arguments: \l_@@_rows_tl and \l_@@_cols_tl which are specifications for a set of rows and a set of columns. It creates a path but does not fill it. It must be filled by another command after. The argument is the radius of the corners. We define below a command \@@_cartesian_path: which corresponds to a value 0 pt for the radius of the corners. This command is in particular used in \@@_rectanglecolor:nnn (used in \@@_rectanglecolor, itself used in \@@_cellcolor).
We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
s_new_protected:Npn \@@_cartesian_path:n #1
\begin{align*}
\bool_lazy_and:nnT & ! \seq_if_empty_p:N \l_@@_corners_cells_seq \\
\dim_compare_p:nNn { #1 } & = \c_zero_dim \\
\end{align*}
\begin{align*}
\@@_expand_clist:NN \l_@@_cols_tl \c@jCol \\
\@@_expand_clist:NN \l_@@_rows_tl \c@iRow \\
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_tmpa_tl \{ #1 \}
\tl_if_in:NT \l_tmpa_tl \{ - \}
\bool_lazy_or:nnT \bool_lazy_and:nnT \\
\str_if_eq_p:V \l_tmpa_tl \{ * \}
\bool_lazy_or:nnT \tl_if_blank_p:V \l_tmpa_tl \\
\int_compare:nNnT \l_tmpb_tl \c@jCol \\
\tl_set:Nn \l_@@_tmpc_tl \l_tmpa_tl \\
\tl_set_eq:NN \l_@@_tmpc_tl \l_tmpa_tl \\
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_rows_tl
\begin{align*}
\tl_set:Nn \l_tmpa_tl \{ ####1 \}
\tl_if_in:NT \l_tmpa_tl \{ - \}
\tl_if_empty:NT \l_tmpa_tl \{ 1 \}
\tl_if_empty:NT \l_tmpb_tl \{ \int_use:N \c@jCol \}
\int_compare:nNnT \l_tmpb_tl \c@jCol \\
\tl_set:Nn \l_@@_tmpc_tl \l_tmpa_tl \\
\end{align*}
\end{lstlisting}

We begin the loop over the rows.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_rows_tl
\begin{align*}
\tl_set:Nn \l_tmpa_tl \{ ####1 \}
\tl_if_in:NT \l_tmpa_tl \{ - \}
\tl_if_empty:NT \l_tmpa_tl \{ 1 \}
\tl_set:Nn \l_@@_tmpc_tl \l_tmpa_tl \\
\end{align*}
\end{lstlisting}

We begin the loop over the rows.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_rows_tl
\begin{align*}
\dim_set:Nn \l_@@_tmpc_dim \{ \pgf@x - 0.5 \arrayrulewidth \}
\dim_set:Nn \l_@@_tmpc_dim \{ \pgf@x + 0.5 \arrayrulewidth \}
\end{align*}
\end{lstlisting}

We begin the loop over the rows.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_rows_tl
\begin{align*}
\int_compare:nNnT \l_@@_first_col_int \l_@@_tmpc_tl \\
\tl_set:Nn \l_@@_tmpc_tl \{ \pgf@x - 0.5 \arrayrulewidth \}
\tl_set:Nn \l_@@_tmpc_tl \{ \pgf@x + 0.5 \arrayrulewidth \}
\end{align*}
\end{lstlisting}

Now, the numbers of both rows are in \l_@@_tmpc_tl and \l_@@_tmpc_tl.
\begin{lstlisting}[language=TeX]
\seq_if_empty_p:NF \l_@@_corners_cells_seq \\
\tl_set:Nn \l_@@_tmpc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tmpc_tl \l_@@_tmpc_tl + 1
\tl_set:Nn \l_@@_tmpc_tl \l_@@_tmpc_tl
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_cols_tl \{ #1 \}
\tl_if_in:NT \l_@@_cols_tl \{ - \}
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
\begin{lstlisting}[language=TeX]
\clist_map_inline:Nn \l_@@_cols_tl
\begin{align*}
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\tl_set:Nn \l_@@_tempc_tl \l_@@_tmpc_tl
\end{align*}
\end{lstlisting}

We begin the loop over the columns.
The following command corresponds to a radius of the corners equal to 0 pt. This command is used by the commands \@@_rowcolors, \@@_columncolor and \@@_rowcolor:n (used in \@@_rowcolor).
\cs_new_protected:Npn \@@_cartesian_path: { \@@_cartesian_path:n { 0 pt } }

The following command will be used only with \l_@@_cols_tl and \c@jCol (first case) or with \l_@@_rows_tl and \c@iRow (second case). For instance, with \l_@@_cols_tl equal to 2,4-6,8-* and \c@jCol equal to 10, the clist \l_@@_cols_tl will be replaced by 2,4,5,6,8,9,10.
\cs_new_protected:Npn \@@_expand_clist:NN #1 #2
\clist_set_eq:NN \l_tmpa_clist #1
\clist_clear:N #1
\clist_map_inline:Nn \l_tmpa_clist
\tl_set:Nn \l_tmpa_tl { ##1 }
\tl_if_in:NnTF \l_tmpa_tl { - } { \@@_cut_on_hyphen:w ##1 \q_stop } { \@@_cut_on_hyphen:w ##1 - ##1 \q_stop }
\bool_lazy_or:nnT \tl_if_blank_p:V \l_tmpa_tl \str_if_eq_p:Vn \l_tmpa_tl { * } \tl_set:Nn \l_tmpa_tl { 1 }
\bool_lazy_or:nnT \tl_if_blank_p:V \l_tmpb_tl \str_if_eq_p:Vn \l_tmpb_tl { * } \tl_set:Nx \l_tmpb_tl { \int_use:N #2 }
\int_compare:nNnT \l_tmpb_tl > #2 \int_step_inline:nnn \l_tmpa_tl \l_tmpb_tl { \clist_put_right:Nn #1 { ####1 } }

When the user uses the key colortbl-like, the following command will be linked to \cellcolor in the tabular.
\NewDocumentCommand \@@_cellcolor_tabular { O { } m }
\peek_remove_spaces:n
\tl_gput_right:Nx \g_nicematrix_code_before_tl { \@@_cellcolor \[ #1 \] \exp_not:n { #2 } \int_use:N \c@iRow - \int_use:N \c@jCol }

We must not expand the color (#2) because the color may contain the token ! which may be activated by some packages (ex.: babel with the option french on latex and pdflatex).
\@@_cellcolor [ #1 ] \exp_not:n { #2 } \int_use:N \c@iRow - \int_use:N \c@jCol

When the user uses the key colortbl-like, the following command will be linked to \rowcolor in the tabular.
\NewDocumentCommand \@@_rowcolor_tabular { O { } m }
\peek_remove_spaces:n
\tl_gput_right:Nx \g_nicematrix_code_before_tl
{
  \@@_rectanglecolor [ #1 ] { \exp_not:n { #2 } }
  { \int_use:N \c@iRow - \int_use:N \c@jCol }
  { \int_use:N \c@iRow - \exp_not:n { \int_use:N \c@jCol } }
}

\NewDocumentCommand \@@_columncolor_preamble { O { } m }
{
With the following line, we test whether the cell is the first one we encounter in its column (don’t forget that some rows may be incomplete).
{ \int_compare:nNnT \c@jCol > \g_@@_col_total_int }
{ You use gput_left because we want the specification of colors for the columns drawn before the specifications of color for the rows (and the cells). Be careful: maybe this is not effective since we have an analyze of the instructions in the \CodeBefore in order to fill color by color (to avoid the thin white lines).
{ \tl_gput_left:Nx \g_nicematrix_code_before_tl
  { \exp_not:N \columncolor [ #1 ]
  { \exp_not:n { #2 } } { \int_use:N \c@jCol }
}
}
}

The vertical and horizontal rules

\OnlyMainNiceMatrix

We give to the user the possibility to define new types of columns (with newcolumntype of array) for special vertical rules (e.g., rules thicker than the standard ones) which will not extend in the potential exterior rows of the array.
We provide the command \OnlyMainNiceMatrix in that goal. However, that command must be no-op outside the environments of nicematrix (and so the user will be allowed to use the same new type of column in the environments of nicematrix and in the standard environments of array).
That’s why we provide first a global definition of \OnlyMainNiceMatrix.
\cs_set_eq:NN \OnlyMainNiceMatrix \use:n
Another definition of \OnlyMainNiceMatrix will be linked to the command in the environments of nicematrix. Here is that definition, called \@@_OnlyMainNiceMatrix:n.
\cs_new_protected:Npn \@@_OnlyMainNiceMatrix:n #1
{
  \int_compare:nNnTF \l_@@_first_col_int = 0
  { \@@_OnlyMainNiceMatrix_i:n { #1 } }
  { \int_compare:nNnTF \c@jCol = 0
    { \exp_not:N \columncolor [ #1 ]
      { \exp_not:n { #2 } } { \int_use:N \c@jCol }
    }
  }
}

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This definition may seem complicated but we must remind that the number of row \c@iRow is incremented in the first cell of the row, after a potential vertical rule on the left side of the first cell.

The command \@@_OnlyMainNiceMatrix_i:n is only a short-cut which is used twice in the above command. This command must not be protected.

\begin{verbatim}
\cs_new_protected:Npn \@@_OnlyMainNiceMatrix_i:n #1
{ \int_compare:nNnF \c@iRow = 0
  { \int_compare:nNnF \c@iRow = \l_@@_last_row_int { #1 } } }
\end{verbatim}

Remember that \c@iRow is not always inferior to \l_@@_last_row_int because \l_@@_last_row_int may be equal to $-2$ or $-1$ (we can't write \int_compare:nNnT \c@iRow < \l_@@_last_row_int).

General system for drawing rules

When a command, environment or "subsystem" of nicematrix wants to draw a rule, it will write in the internal \CodeAfter a command \@@_vline:n or \@@_hline:n. Both commands take in as argument a list of key=value pairs. That list will first be analyzed with the following set of keys. However, unknown keys will be analyzed further with another set of keys.

\begin{verbatim}
\keys_define:nn { NiceMatrix / Rules }
{ position .int_set:N = \l_@@_position_int ,
  position .value_required:n = true ,
  start .int_set:N = \l_@@_start_int ,
  start .initial:n = 1 ,
  end .int_set:N = \l_@@_end_int ,
}
\end{verbatim}

The following keys are no-op because there are keys which may be inherited from a list of pairs key=value of a definition of a customized rule (with the key custom-line of \NiceMatrixOptions).

\begin{verbatim}
letter .code:n = \prg_do_nothing: ,
command .code:n = \prg_do_nothing: }
\end{verbatim}

It’s possible that the rule won’t be drawn continuously from start ot end because of the blocks (created with the command \Block), the virtual blocks (created by \Cdots, etc.), etc. That’s why an analyse is done and the rule is cut in small rules which will actually be drawn. The small continuous rules will be drawn by \@@_vline_ii: and \@@_hline_ii:. Those commands use the following set of keys.

\begin{verbatim}
\keys_define:nn { NiceMatrix / RulesBis }
{ multiplicity .int_set:N = \l_@@_multiplicity_int ,
  multiplicity .initial:n = 1 ,
  dotted .bool_set:N = \l_@@_dotted_bool ,
  dotted .initial:n = false ,
  dotted .default:n = true ,
  color .code:n = \@@_set_CT@arc@: #1 \q_stop ,
  color .value_required:n = true ,
  sep-color .code:n = \@@_set_CT@drsc@: #1 \q_stop ,
  sep-color .value_required:n = true ,
}
\end{verbatim}

If the user uses the key tikz, the rule (or more precisely: the different sub-rules since a rule may be broken by blocks or others) will be drawn with Tikz.

\begin{verbatim}
tikz .tl_set:N = \l_@@_tikz_rule_tl ,
tikz .value_required:n = true ,
tikz .initial:n = ,
width .dim_set:N = \l_@@_rule_width_dim ,
width .value_required:n = true }
\end{verbatim}
The vertical rules

The following command will be executed in the internal \CodeAfter. The argument \#1 is a list of key=value pairs.

\cs_new_protected:Npn \@@_vline:n #1
{

The group is for the options.

\group_begin:
\int_zero_new:N \l_@@_end_int
\int_set_eq:NN \l_@@_end_int \c@iRow
\keys_set_known:nN { NiceMatrix / Rules } { #1 } \l_@@_other_keys_tl

The following test is for the case where the user does not use all the columns specified in the preamble of the environment (for instance, a preamble of \texttt{|c|c|c|} but only two columns used).

\int_compare:nNnT \l_@@_position_int < { \c@jCol + 2 }
\@@_vline_i:
\group_end:
\cs_new_protected:Npn \@@_vline_i:
{
\int_zero_new:N \l_@@_local_start_int
\int_zero_new:N \l_@@_local_end_int

\l_tmpa_tl is the number of row and \l_tmpb_tl the number of column. When we have found a row corresponding to a rule to draw, we note its number in \l_@@_corners_clist.

\int_compare:nNnT \l_@@_position_int < \c@jCol + 2
\@@_vline_i:
\group_end:
\cs_new_protected:Npn \@@_vline_i:
{
\int_zero_new:N \l_@@_local_start_int
\int_zero_new:N \l_@@_local_end_int
\l_tmpa_tl

The boolean \g_tmpa_bool indicates whether the small vertical rule will be drawn. If we find that it is in a block (a real block, created by \Block or a virtual block corresponding to a dotted line, created by \Cdots, \Vdots, etc.), we will set \g_tmpa_bool to false and the small vertical rule won’t be drawn.

\bool_gset_true:N \g_tmpa_bool
\seq_map_inline:Nn \g_@@_pos_of_blocks_seq
{ \@@_test_vline_in_block:nnnnn ##1 }
\seq_map_inline:Nn \g_@@_pos_of_xdots_seq
{ \@@_test_vline_in_block:nnnnn ##1 }
\seq_map_inline:Nn \g_@@_pos_of_stroken_blocks_seq
{ \@@_test_vline_in_stroken_block:nnnn ##1 }
\clist_if_empty:NF \l_@@_corners_clist \@@_test_in_corner_v:
\bool_if:NTF \g_tmpa_bool
{ \int_compare:nNnT \l_@@_local_start_int = 0 }

We keep in memory that we have a rule to draw. \l_@@_local_start_int will be the starting row of the rule that we will have to draw.

\bool_gset_true:N \g_tmpa_bool
\seq_map_inline:Nn \g_@@_pos_of_blocks_seq
{ \@@_test_vline_in_block:nmmnnn \#1 }
\seq_map_inline:Nn \g_@@_pos_of_xdots_seq
{ \@@_test_vline_in_block:nmmnnn \#1 }
\seq_map_inline:Nn \g_@@_pos_of_stroken_blocks_seq
{ \@@_test_vline_in_stroken_block:nmmnnn \#1 }
\clist_if_empty:NF \l_@@_corners_clist \@@_test_in_corner_v:
\bool_if:NTF \g_tmpa_bool
{ \int_compare:nNnT \l_@@_local_start_int = 0 }

{ \int_compare:nNnT \l_@@_local_start_int > 0 }
{ \int_compare:nNnT \l_@@_local_start_int > 0 }
{ \int_compare:nNnT \l_@@_local_start_int > 0 }

\int_compare:nNnT \l_@@_local_start_int > 0
\@@_vline_i:
\@@_vline_i:

First the case of a standard rule, that is to say a rule which is not dotted (and the user has not used the key \texttt{tikz}).
The following code is for the case of a dotted rule (with our system of rounded dots).

\cs_new_protected:Npn \@@_vline_iv:
\begin{tikzpicture}
\pgfsetlinewidth{1.1 \arrayrulewidth}
\pgfsetrectcap
\pgfusepathqstroke
\endpgfpicture

The following code is for the case when the user uses the key tikz (in the definition of a customized rule by using the key custom-line).

\cs_new_protected:Npn \@@_vline_v:
\begin{tikzpicture}
\pgfsetlinewidth{1.1 \arrayrulewidth}
\pgfsetrectcap
\pgfusepathqstroke
\endpgfpicture
The command \@@_draw_vlines: draws all the vertical rules excepted in the blocks, in the virtual blocks (determined by a command such as \Cdots) and in the corners (if the key corners is used).

\cs_new_protected:Npn \@@_draw_vlines:
{
\int_step_inline:nnn
{
\bool_if:nTF { \l_@@_NiceArray_bool && ! \l_@@_except_borders_bool }
1 2
}{\bool_if:nTF { \l_@@_NiceArray_bool && ! \l_@@_except_borders_bool }
{\int_eval:n { \c@jCol + 1 } }
\c@jCol
}{\tl_if_eq:NnF \l_@@_vlines_clist { all }
{\clist_if_in:NnT \l_@@_vlines_clist { ##1 }
{ \@@_vline:n { position = ##1 } }
}}
}

The horizontal rules

The following command will be executed in the internal \CodeAfter. The argument #1 is a list of key=value pairs of the form \{NiceMatrix/Rules\}.

\cs_new_protected:Npn \@@_hline:n #1
{
\group_begin:
\int_zero_new:N \l_@@_end_int
\int_set_eq:NN \l_@@_end_int \c@jCol
\keys_set_known:nnN { NiceMatrix / Rules } { #1 } \l_@@_other_keys_tl
\@@_hline_i:
\group_end:
\cs_new_protected:Npn \@@_hline_i:
{
\int_zero_new:N \l_@@_local_start_int
\int_zero_new:N \l_@@_local_end_int
\l_tmpa_tl is the number of row and \l_tmpb_tl the number of column. When we have found a column corresponding to a rule to draw, we note its number in \l_@@_tmpc_tl.
\tl_set:Nx \l_ttmpa_tl { \int_use:N \l_@@_position_int }
\int_step_variable:nnNn \l_@@_start_int \l_@@_end_int \l_tmpb_tl
\l_@@_tmpc_tl
{
The boolean \g_tmpa_bool indicates whether the small horizontal rule will be drawn. If we find that it is in a block (a real block, created by \Block or a virtual block corresponding to a dotted line, created by \Cdots, \Vdots, etc.), we will set \g_tmpa_bool to false and the small horizontal rule won't be drawn.
\bool_gset_true:N \g_tmpa_bool
\seq_map_inline:Nn \g_@@_pos_of_blocks_seq
We keep in memory that we have a rule to draw. \l_@@_local_start_int will be the starting row of the rule that we will have to draw.

\begin{verbatim}
\int_compare:nNnT \l_@@_local_start_int = 0
\{ \int_set:Nn \l_@@_local_start_int \l_tmpb_tl \}
\}
\int_compare:nNnT \l_@@_local_start_int > 0
\{ \int_set:Nn \l_@@_local_end_int { \l_tmpb_tl - 1 } \@@_hline_ii: \int_zero:N \l_@@_local_start_int \}
\}
\int_compare:nNnT \l_@@_local_start_int > 0
\{ \int_set_eq:NN \l_@@_local_end_int \l_@@_end_int \@@_hline_ii: \}
\end{verbatim}

\begin{verbatim}
\cs_new_protected:Npn \@@_test_in_corner_h:
\{ \int_compare:nNnTF \l_tmpa_tl = { \int_eval:n { \c@iRow + 1 } } \{
\int_set:Nn \l_@@_local_start_int \l_tmpb_tl \}
\}
\bool_set_false:N \l_@@_dotted_bool
\keys_set:nV { NiceMatrix / RulesBis } \l_@@_other_keys_tl
\bool_if:NTF \l_@@_dotted_bool \@@_hline_iv:
\end{verbatim}
First the case of a standard rule, that is to say a rule which is not dotted.

The following code is for the case of a dotted rule (with our system of rounded dots). The aim is that, by standard the dotted line fits between square brackets (\hline doesn’t).
\begin{bNiceMatrix}
1 & 2 & 3 & 4 \\
\hline
1 & 2 & 3 & 4 \\
\hdottedline
1 & 2 & 3 & 4
\end{bNiceMatrix}

\begin{bNiceMatrix}[margin]
1 & 2 & 3 & 4 \\
\hline
1 & 2 & 3 & 4 \\
\hdottedline
1 & 2 & 3 & 4
\end{bNiceMatrix}

But, if the user uses margin, the dotted line extends to have the same width as a \hline.

\begin{bNiceMatrix}
1 & 2 & 3 & 4 \\
\hline
1 & 2 & 3 & 4 \\
\hdottedline
1 & 2 & 3 & 4
\end{bNiceMatrix}

For reasons purely aesthetic, we do an adjustment in the case of a rounded bracket. The correction by $0.5 \ \text{l_00_inter_dots_dim}$ is ad hoc for a better result.

\begin{tikzpicture}
\pgfrememberpicturepositiononpagetrue
\pgf@relevantforpicturesizefalse
\@@_qpoint:n { row - \int_use:N \l_@@_position_int }
\dim_set_eq:NN \l_@@_y_initial_dim \pgf@y
\dim_set_eq:NN \l_@@_y_final_dim \pgf@y
\@@_qpoint:n { col - \int_use:N \l_@@_local_start_int }
\dim_set_eq:NN \l_@@_x_initial_dim \pgf@x
\dim_set_eq:NN \l_@@_x_final_dim \pgf@x
\int_compare:nNnT \l_@@_local_start_int = 1
\{ 
\dim_sub:Nn \l_@@_x_initial_dim \l_00_left_margin_dim 
\bool_if:NT \l_@@_NiceArray_bool
\{ \dim_sub:Nn \l_@@_x_initial_dim \arraycolsep \}
\}
\@@_qpoint:n { col - \int_eval:n { \l_00_local_end_int + 1 } }
\dim_set_eq:NN \l_@@_x_final_dim \pgf@x
\int_compare:nNnT \l_@@_local_end_int = \c@jCol
\{ 
\dim_add:Nn \l_@@_x_final_dim \l_00_right_margin_dim 
\bool_if:NT \l_@@_NiceArray_bool
\{ \dim_add:Nn \l_@@_x_final_dim \arraycolsep \}
\}
\} 
\CT@arc@ 
\@@_draw_line: 
\endpgfpicture

The following code is for the case when the user uses the key \texttt{tikz} (in the definition of a customized rule by using the key \texttt{custom-line}).

\begin{tikzpicture}
\pgfrememberpicturepositiononpagetrue
\pgf@relevantforpicturesizefalse
\@@_qpoint:n { col - \int_use:N \l_@@_local_start_int }
\dim_set_eq:NN \l_@@_x_final_dim \pgf@x
\@@_qpoint:n { row - \int_use:N \l_@@_position_int }
\dim_set:Nn \l_tmpb_dim { \pgf@y - 0.5 \l_00_rule_width_dim }

\begin{Verbatim}
\begin{tikzpicture}
\pgfrememberpicturepositiononpagetrue
\pgf@relevantforpicturesizefalse
\@@_qpoint:n { row - \int_use:N \l_@@_position_int }
\dim_set_eq:NN \l_@@_y_initial_dim \pgf@y
\dim_set_eq:NN \l_@@_y_final_dim \pgf@y
\@@_qpoint:n { col - \int_use:N \l_@@_local_start_int }
\dim_set_eq:NN \l_@@_x_initial_dim \pgf@x
\dim_set_eq:NN \l_@@_x_final_dim \pgf@x
\int_compare:nNnT \l_@@_local_start_int = 1
\{ 
\dim_sub:Nn \l_@@_x_initial_dim \l_00_left_margin_dim 
\bool_if:NT \l_@@_NiceArray_bool
\{ \dim_sub:Nn \l_@@_x_initial_dim \arraycolsep \}
\}
\@@_qpoint:n { col - \int_eval:n { \l_00_local_end_int + 1 } }
\dim_set_eq:NN \l_@@_x_final_dim \pgf@x
\int_compare:nNnT \l_@@_local_end_int = \c@jCol
\{ 
\dim_add:Nn \l_@@_x_final_dim \l_00_right_margin_dim 
\bool_if:NT \l_@@_NiceArray_bool
\{ \dim_add:Nn \l_@@_x_final_dim \arraycolsep \}
\}
\} 
\CT@arc@ 
\@@_draw_line: 
\endpgfpicture

\end{Verbatim}

\end{tikzpicture}
The command \@@_draw_hlines: draws all the horizontal rules excepted in the blocks (even the virtual blocks determined by commands such as \Cdots and in the corners (if the key corners is used)).

\cs_new_protected:Npn \@@_draw_hlines: 
\int_step_inline:nnn 
{ \bool_if:nTF { \l_@@_NiceArray_bool && ! \l_@@_except_borders_bool } 1 2 
} 
\bool_if:nTF { \l_@@_NiceArray_bool && ! \l_@@_except_borders_bool } { \int_eval:n { \c@iRow + 1 } } \c@iRow 
\tl_if_eq:NnF \l_@@_hlines_clist { all } { \clist_if_in:NnT \l_@@_hlines_clist { ##1 } } { \@@_hline:n { position = ##1 } } 
\ifnum 0 = `{ \fi }

The command \@@_Hline: will be linked to \Hline in the environments of nicematrix.

\cs_set:Npn \@@_Hline: { \noalign { \ifnum 0 = `} \fi \@@_Hline_i:n { 1 } }

The argument of the command \@@_Hline_i:n is the number of successive \Hline found.

\cs_set:Npn \@@_Hline_i:n #1 
\peek_meaning_ignore_spaces:NTF \Hline { \@@_Hline_ii:nn { #1 + 1 } } { \@@_Hline_iii:n { #1 } }
\ifnum 0 = `{ \fi }

The argument of the command \@@_Hline_iii:n is the number of successive \Hline found.
Customized rules defined by the final user

The final user can define a customized rule by using the key `custom-line` in `\NiceMatrixOptions`. That key takes in as value a list of `key=value` pairs.

Among the keys available in that list, there is the key `letter` to specify a letter that the final user will use in the preamble of the array. All the letters defined by this way by the final user for such customized rules are added in the set of keys `{NiceMatrix/ColumnTypes}`. That set of keys is used to store the characteristics of those types of rules for convenience: the keys of that set of keys won’t never be used as keys by the final user (he will use, instead, letters in the preamble of its array).

```latex
\keys_define:nn { NiceMatrix / ColumnTypes } { }
```

The following command will create the customized rule (it is executed when the final user uses the key `custom-line` in `\NiceMatrixOptions`).

```latex
\cs_new_protected:Npn \@@_custom_line:n #1
\str_clear_new:N \l_@@_command_str
\str_clear_new:N \l_@@_letter_str
\dim_zero_new:N \l_@@_rule_width_dim
\tl_clear:N \l_tmpa_tl
\bool_set_false:N \l_tmpa_bool
\bool_set_false:N \l_tmpb_bool
\keys_set_known:nn { NiceMatrix / Custom-Line } { #1 }
\bool_if:NT \l_tmpa_bool
{ We can’t use \c_@@_tikz_loaded_bool to test whether tikz is loaded because \NiceMatrixOptions may be used in the preamble of the document.
\\cs_if_exist:NF \tikzpicture
{ \@@_error:n { tikz~in~custom-line~without~tikz } }
\tl_if_empty:NF \l_tmpa_tl
{ \@@_error:n { color~in~custom-line~with~tikz } }
}
\bool_if:NT \l_tmpb_bool
{ \bool_if:NF \l_tmpa_bool
{ \@@_error:n { key~width~without~key~tikz } }
}
\bool_lazy_and:nnTF
{ \str_if_empty_p:N \l_@@_letter_str }
{ \str_if_empty_p:N \l_@@_command_str }
{ \@@_error:n { No~letter~and~no~command } }
{ \str_if_empty:NF \l_@@_letter_str
\int_compare:nNnTF { \str_count:N \l_@@_letter_str } = 1
{ \exp_args:NnV \tl_if_in:NnTF \c_@@_forbidden_letters_str \l_@@_letter_str
\@@_error:n { Forbidden~letter } }
{ \exp_args:Nnx \keys_define:nn { NiceMatrix / ColumnTypes }
\keys_define:nn { NiceMatrix / ColumnTypes } { }
} }
```

If the final user only wants to draw horizontal rules, he does not need to specify a letter (for the vertical rules in the preamble of the array). On the other hand, if he only wants to draw vertical rules, he does not need to define a command (which is the tool to draw horizontal rules in the array). Of course, a definition of custom lines with no letter and no command would be point-less.

```latex
\bool_lazy_and:nnTF
{ \str_if_empty_p:N \l_@@_letter_str }
{ \str_if_empty_p:N \l_@@_command_str }
{ \@@_error:n { No-letter-and-no-command } }
{ 
\str_if_empty:NF \l_@@_letter_str
\int_compare:nNnTF { \str_count:N \l_@@_letter_str } = 1
{ \exp_args:Nn \tl_if_in:NnTF \c_@@_forbidden_letters_str \l_@@_letter_str
\@@_error:n { Forbidden~letter } }
{ \exp_args:Nnx \keys_define:nn { NiceMatrix / ColumnTypes }
\keys_define:nn { NiceMatrix / ColumnTypes } { }
} }
```
The flag \texttt{l_tampa_bool} means that the key 'tikz' have been used. When the key 'tikz' has not been used, the width of the rule is computed with the multiplicity of the rule.

The previous command \texttt{\@\_custom\_line:n} uses the following set of keys. However, the whole definition of the customized lines (as provided by the final user as argument of \texttt{custom-line}) will also be used further with other sets of keys (for instance \texttt{NiceMatrix/Rules}). That's why the following set of keys has only entries for a few keys.

When the key tikz is used, the rule will be drawn with Tikz by using the set of keys specified in the value of that key tikz.

The key width must be used only when the key tikz is used. When used, the key width specifies the width of the rule: it will be used to reserve space (in the preamble of the array or in the command for the horizontal rules).

The following command will create the command that the final user will use in its array to draw a horizontal rule (hence the 'h' in the name). \texttt{#1} is the whole set of keys to pass to \texttt{\@\_line:n} and \texttt{#2} is the width of the whole rule.
We use \cs_set:cpn and not \cs_new:cpn because we want a local definition. Moreover, the command must not be protected since it begins with \noalign.

\begin{verbatim}
\cs_set:cpn \l_@@_command_str
\{
  \noalign
\{ \skip_vertical:n { #2 }
  \tl_gput_right:Nx \g_@@_internal_code_after_tl
  { \@@_hline:n { #1 , position = \int_eval:n { \c@iRow + 1 } } }
\}

The flag $\l_tmpa_bool$ means that the key 'tikz' have been used. When the key 'tikz' has not been used, the width of the rule is computed with the multiplicity of the rule.

\begin{verbatim}
\cs_new_protected:Npn \@@_custom_line_i:n #1
\{
  \bool_if:NF \l_tmpa_bool
  { \dim_set:Nn \l_@@_rule_width_dim
    { \arrayrulewidth * \l_@@_tmpc_int
      + \doublerulesep * ( \l_@@_tmpc_int - 1) }
  }
\tl_gput_right:Nx \g_@@_preamble_tl
  { \exp_not:N !
    \{ \skip_horizontal:n { \dim_use:N \l_@@_rule_width_dim } }
  }
\tl_gput_right:Nx \g_@@_internal_code_after_tl
  { \@@_vline:n { #1 , position = \int_eval:n { \c@jCol + 1 } } }

The key hvlines
\end{verbatim}

The following command tests whether the current position in the array (given by $\l_tmpa_tl$ for the row and $\l_tmpb_tl$ for the column) would provide an horizontal rule towards the right in the block delimited by the four arguments #1, #2, #3 and #4. If this rule would be in the block (it must not be drawn), the boolean $\l_tmpa_bool$ is set to false.

\begin{verbatim}
\cs_new_protected:Npn \@@_test_hline_in_block:nnnnn #1 #2 #3 #4
\{
  \bool_lazy_all:nT
  { \int_compare_p:nNn \l_tmpa_tl > { #1 } 
    { \int_compare_p:nNn \l_tmpa_tl < { #3 + 1 } 
      { \int_compare_p:nNn \l_tmpb_tl > { #2 - 1 } 
        { \int_compare_p:nNn \l_tmpb_tl < { #4 + 1 } 
          { \bool_gset_false:N \g_tmpa_bool }
        }
      }
    }
  
  \}
\}

The same for vertical rules.

\begin{verbatim}
\cs_new_protected:Npn \@@_test_vline_in_block:nnnnn #1 #2 #3 #4
\{
  \bool_lazy_all:nT
  { \int_compare_p:nNn \l_tmpa_tl > { #1 - 1 } 
    { \int_compare_p:nNn \l_tmpa_tl < { #3 + 1 } 
      { \int_compare_p:nNn \l_tmpb_tl > { #2 } 
        { \int_compare_p:nNn \l_tmpb_tl < { #4 + 1 } 
          { \bool_gset_false:N \g_tmpa_bool }
        }
      }
    }
  
  \}
\}
\end{verbatim}

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The key corners

When the key corners is raised, the rules are not drawn in the corners. Of course, we have to compute the corners before we begin to draw the rules.

Even if the user has used the key corners the list of cells in the corners may be empty.

You write on the aux file the list of the cells which are in the (empty) corners because you need that information in the \CodeBefore since the commands which color the rows, columns and cells must not color the cells in the corners.
"Computing a corner" is determining all the empty cells (which are not in a block) that belong to that corner. These cells will be added to the sequence \_@@\_corners\_cells\_seq.

The six arguments of \_@@\_compute\_a\_corner:nnnnnn are as follow:

- #1 and #2 are the number of row and column of the cell which is actually in the corner;
- #3 and #4 are the steps in rows and the step in columns when moving from the corner;
- #5 is the number of the final row when scanning the rows from the corner;
- #6 is the number of the final column when scanning the columns from the corner.

For the explanations and the name of the variables, we consider that we are computing the left-upper corner.

First, we try to determine which is the last empty cell (and not in a block: we won’t add that precision any longer) in the column of number 1. The flag \_l\_tmpa\_bool will be raised when a non-empty cell is found.

Now, you determine the last empty cell in the row of number 1.

Now, we loop over the rows.
We treat the row number \#1 with another loop.

\begin{verbatim}
\bool_set_false:N \l_tmpa_bool
\int_step_inline:nnnn { #2 } { #4 } \l_@@_last_empty_column_int
{ \@@_test_if_cell_in_a_block:nn { ##1 } { ####1 }
\bool_lazy_or:nnTF
\l_tmpb_bool
{ \cs_if_exist_p:c
{ pgf @ sh @ ns @ \@@_env: - ##1 - ####1 }
}
{ \bool_set_true:N \l_tmpa_bool }
{ \bool_if:NF \l_tmpa_bool
{ \int_set:Nn \l_@@_last_empty_column_int { ####1 }
\seq_put_right:Nn \l_@@_corners_cells_seq { ##1 - ####1 }
}
}
}
\end{verbatim}

The following macro tests whether a cell is in (at least) one of the blocks of the array (or in a cell with a \diagbox).

The flag \l_tmpb_bool will be raised if the cell \#1-\#2 is in a block (or in a cell with a \diagbox).

\begin{verbatim}
\cs_new_protected:Npn \@@_test_if_cell_in_a_block:nn { \l_@@_test_if_cell_in_a_block:nn { #1 } \l_tmpa_int
{ \int_set:Nn \l_tmpa_int { #1 }
\int_set:Nn \l_tmpb_int { #2 }
\bool_set_false:N \l_tmpb_bool
\seq_map_inline:Nn \g_@@_pos_of_blocks_seq
{ \@@_test_if_cell_in_block:nnnnnnn \l_tmpa_int \l_tmpb_int ##1 }
}
}
\cs_new_protected:Npn \@@_test_if_cell_in_block:nnnnnnn #1 #2 #3 #4 #5 #6 #7
{ \int_compare:nNnT { #3 } < { \int_eval:n { #1 + 1 } }
{ \int_compare:nNnT { #1 } < { \int_eval:n { #5 + 1 } }
{ \int_compare:nNnT { #4 } < { \int_eval:n { #2 + 1 } }
{ \bool_set_true:N \l_tmpb_bool }
}
}
}
\end{verbatim}

The commands to draw dotted lines to separate columns and rows

These commands don’t use the normal nodes, the medium nor the large nodes. They only use the col nodes and the row nodes.

**Horizontal dotted lines**

The following command must *not* be protected because it’s meant to be expanded in a \noalign.

\begin{verbatim}
\cs_new:Npn \@@_hdottedline:
{ }
\end{verbatim}

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On the other side, the following command should be protected.
\cs_new_protected:Npn \@@_hdottedline_i:\{
\tl_gput_right:Nx \g_@@_internal_code_after_tl { \@@_hdottedline:n { \int_use:N \c@iRow } }
\}

We write in the internal \CodeAfter the instruction that will actually draw the dotted line. It’s not possible to draw this dotted line now because we don’t know the length of the line (we don’t even know the number of columns).
\tl_gput_right:Nx \g_@@_internal_code_after_tl { \@@_hdottedline:n \int_use:N \c@iRow }

The command \@@_hdottedline:n is the command written in the internal \CodeAfter that will actually draw the dotted line. Its argument is the number of the row before which we will draw the row.
\cs_new_protected:Npn \@@_hdottedline:n #1 { \@@_hline:n { position = #1 , end = \int_use:N \c@jCol , dotted } }

Vertical dotted lines
\cs_new_protected:Npn \@@_vdottedline:n #1 { \@@_vline:n { position = \int_eval:n { #1 + 1 } , dotted } }

The environment \{NiceMatrixBlock\}

The following flag will be raised when all the columns of the environments of the block must have the same width in “auto” mode.
\bool_new:N \l_@@_block_auto_columns_width_bool

Up to now, there is only one option available for the environment \{NiceMatrixBlock\}.
\keys_define:nn { NiceMatrix / NiceMatrixBlock } { auto-columns-width .code:n = \bool_set_true:N \l_@@_block_auto_columns_width_bool , \dim_gzero_new:N \g_@@_max_cell_width_dim , \bool_set_true:N \l_@@_auto_columns_width_bool }

\NewDocumentEnvironment { NiceMatrixBlock } { ! O { } } { \int_gincr:N \g_@@_NiceMatrixBlock_int , \dim_zero:N \l_@@_columns_width_dim , \keys_set:nn { NiceMatrix / NiceMatrixBlock } { #1 } , \bool_if:NT \l_@@_block_auto_columns_width_bool { \cs_if_exist:cT { @@_max_cell_width_ \int_use:N \g_@@_NiceMatrixBlock_int } { \exp_args:NNc \dim_set:Nn \l_@@_columns_width_dim \@@_max_cell_width_{ \int_use:N \g_@@_NiceMatrixBlock_int } } , \bool_if:NT \l_@@_auto_columns_width_bool { \cs_if_exist:cT \@@_max_cell_width_{ \int_use:N \g_@@_NiceMatrixBlock_int } { \exp_args:NNc \dim_set:Nn \l_@@_columns_width_dim \@@_max_cell_width_{ \int_use:N \g_@@_NiceMatrixBlock_int } } } , \}
At the end of the environment \{NiceMatrixBlock\}, we write in the main aux file instructions for the column width of all the environments of the block (that’s why we have stored the number of the first environment of the block in the counter \l_@@_first_env_block_int).}

\bool_if:NT \l_@@_block_auto_columns_width_bool
\{
\iow_shipout:Nn \@mainaux \ExplSyntaxOn
\iow_shipout:Nx \@mainaux
\{
\cs_gset:cpn \@@_max_cell_width \int_use:N \g_@@_NiceMatrixBlock_int
\}
\iow_shipout:Nn \@mainaux \ExplSyntaxOff
\}
\}
\For technical reasons, we have to include the width of a potential rule on the right side of the cells.
\{
\dim_eval:n \{ \g_@@_max_cell_width_dim + \arrayrulewidth \}
\}
\iow_shipout:Nn \@mainaux \ExplSyntaxOff
\}
\}

The extra nodes

First, two variants of the functions \dim_min:nn and \dim_max:nn.
\cs_generate_variant:Nn \dim_min:nn { v n }\cs_generate_variant:Nn \dim_max:nn { v n }

The following command is called in \@@_use_arraybox_with_notes_c: just before the construction of the blocks (if the creation of medium nodes is required, medium nodes are also created for the blocks and that construction uses the standard medium nodes).
\cs_new_protected:Npn \@@_create_extra_nodes:
\{
\bool_if:nTF \l_@@_medium_nodes_bool
\{
\bool_if:NTF \l_@@_large_nodes_bool
\@@_create_medium_and_large_nodes:
\@@_create_medium_nodes:
\}
\{ \bool_if:NT \l_@@_large_nodes_bool \@@_create_large_nodes: \}
\}
\We have three macros of creation of nodes: \@@_create_medium_nodes:, \@@_create_large_nodes: and \@@_create_medium_and_large_nodes:.

We have to compute the mathematical coordinates of the “medium nodes”. These mathematical coordinates are also used to compute the mathematical coordinates of the “large nodes”. That’s why we write a command \@@_computations_for_medium_nodes: to do these computations.

The command \@@_computations_for_medium_nodes: must be used in a \{pgfpicture\}.

For each row \(i\), we compute two dimensions \l_@@_row_i_min_dim and \l_@@_row_i_max_dim. The dimension \l_@@_row_i_min_dim is the minimal \(y\)-value of all the cells of the row \(i\). The dimension \l_@@_row_i_max_dim is the maximal \(y\)-value of all the cells of the row \(i\).

Similarly, for each column \(j\), we compute two dimensions \l_@@_column_j_min_dim and \l_@@_column_j_max_dim. The dimension \l_@@_column_j_min_dim is the minimal \(x\)-value of all the cells of the column \(j\). The dimension \l_@@_column_j_max_dim is the maximal \(x\)-value of all the cells of the column \(j\).

Since these dimensions will be computed as maximum or minimum, we initialize them to \c_max_dim or \~c_max_dim.
\cs_new_protected:Npn \@@_computations_for_medium_nodes:
\{
\int_step_variable:nnNn \l_@@_first_row_int \g_@@_row_total_int \l_@@_i:
We begin the two nested loops over the rows and the columns of the array.

If the cell \((i, j)\) is empty or an implicit cell (that is to say a cell after implicit ampersands & ) we don’t update the dimensions we want to compute.

Now, we have to deal with empty rows or empty columns since we don’t have created nodes in such rows and columns.

\[
\begin{align*}
\text{\texttt{\textbackslash int\_step\_variable:nnNn \_l\_0\_first\_row\_int \_g\_0\_row\_total\_int \_0\_j:}} \\
\text{\texttt{| \dim\_zero\_new:c \{ l\_0\_row\_0\_i: \_min\_dim \}}} \\
\dim\_set\_eq:cN \{ l\_0\_row\_0\_i: \_min\_dim \} \c\_max\_dim \\
\text{\texttt{| \dim\_zero\_new:c \{ l\_0\_row\_0\_i: \_max\_dim \}}} \\
\dim\_set\_cn \{ l\_0\_row\_0\_i: \_max\_dim \} \{- \c\_max\_dim \}
\end{align*}
\]

\[
\begin{align*}
\text{\texttt{| \int\_step\_variable:nnNn \_l\_0\_first\_col\_int \_g\_0\_col\_total\_int \_0\_i:}} \\
\text{\texttt{| \dim\_zero\_new:c \{ l\_0\_column\_0\_j: \_min\_dim \}}} \\
\dim\_set\_eq:cN \{ l\_0\_column\_0\_j: \_min\_dim \} \c\_max\_dim \\
\text{\texttt{| \dim\_zero\_new:c \{ l\_0\_column\_0\_j: \_max\_dim \}}} \\
\dim\_set\_cn \{ l\_0\_column\_0\_j: \_max\_dim \} \{- \c\_max\_dim \}
\end{align*}
\]
Here is the command \@@_create_medium_nodes:. When this command is used, the “medium nodes” are created.

\cs_new_protected:Npn \@@_create_medium_nodes: \@@_create_medium_node:
\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgf@relevantforpicturesizefalse
\@@_computations_for_medium_nodes:
\@@_create_nodes:
\endpgfpicture

Now, we can create the “medium nodes”. We use a command \@@_create_nodes: because this command will also be used for the creation of the “large nodes”.

\tl_set:Nn \l_@@_suffix_tl { -medium }
\@@_create_nodes:
\@@_computations_for_large_nodes:
\tl_set:Nn \l_@@_suffix_tl { - large }
\@@_create_nodes:
\endpgfpicture

The command \@@_create_large_nodes: must be used when we want to create only the “large nodes” and not the medium ones\footnote{If we want to create both, we have to use \@@_create_medium_and_large_nodes:}. However, the computation of the mathematical coordinates of the “large nodes” needs the computation of the mathematical coordinates of the “medium nodes”. Hence, we use first \@@_computations_for_medium_nodes: and then the command \@@_computations_for_large_nodes:.

\cs_new_protected:Npn \@@_create_medium_and_large_nodes: \@@_create_medium_and_large_nodes:
\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgf@relevantforpicturesizefalse
\@@_computations_for_medium_nodes:
\@@_create_nodes:
\endpgfpicture

Now, we can create the “medium nodes”. We use a command \@@_create_nodes: because this command will also be used for the creation of the “large nodes”.

\tl_set:Nn \l_@@_suffix_tl { -medium }
\@@_create_nodes:
\@@_computations_for_large_nodes:
\tl_set:Nn \l_@@_suffix_tl { - large }
\@@_create_nodes:
\endpgfpicture
For “large nodes”, the exterior rows and columns don’t interfere. That’s why the loop over the columns will start at 1 and stop at \c@jCol (and not \g_@@_col_total_int). Idem for the rows.

\cs_new_protected:Npn \@@_computations_for_large_nodes:
\begin{verbatim}
{ \int_set:Nn \l_@@_first_row_int 1
  \int_set:Nn \l_@@_first_col_int 1

  We have to change the values of all the dimensions \l_@@_row_i_min_dim, \l_@@_row_i_max_dim, \l_@@_column_j_min_dim and \l_@@_column_j_max_dim.

  \int_step_variable:nnNn \c@iRow - 1 \@@_i:
  \{ \int_step_variable:nnNn \c@jCol - 1 \@@_j:
    \{ \dim_set:cn { \l_@@_row_\@@_i: _min _ dim } {
      \dim_use:c { \l_@@_row_\@@_i: _min _ dim } +
      \dim_use:c { \l_@@_row_\int_eval:n { \@@_i: + 1 } _max _ dim }
    } / 2
    \dim_set_eq:cc { \l_@@_row_{\int_eval:n { \@@_i: + 1 } } _max _ dim } { \l_@@_row_\@@_i: _min_dim }
  \}

  \dim_set_eq:cc { \l_@@_column_{\int_eval:n { \@@_j: + 1 } } _min _ dim } { \l_@@_column_\@@_j: _max_dim }

  \int_step_variable:nnNn \c@jCol - 1 \@@_j:
  \{ \int_step_variable:nnNn \c@iRow - 1 \@@_i:
    \{ \dim_set:cn { \l_@@_column_\@@_j: _max _ dim } {
      \dim_use:c { \l_@@_column_\@@_j: _max _ dim } +
      \dim_use:c { \l_@@_column_\int_eval:n { \@@_j: + 1 } _min _ dim }
    } / 2
    \dim_set_eq:cc { \l_@@_column_{\int_eval:n { \@@_j: + 1 } } _min _ dim } { \l_@@_column_\@@_j: _max_dim }
  \}

\end{verbatim}

Here, we have to use \dim_sub:cn because of the number 1 in the name.

\begin{verbatim}
\dim_sub:cn { \l_@@_column_1 _min _ dim } \l_@@_left_margin_dim
\dim_add:cn { \l_@@_column_\int_use:N \c@jCol _max_dim } \l_@@_right_margin_dim
\end{verbatim}

The command \l_@@_create_nodes: is used twice: for the construction of the “medium nodes” and for the construction of the “large nodes”. The nodes are constructed with the value of all the dimensions \l_@@_row_i_min_dim, \l_@@_row_i_max_dim, \l_@@_column_j_min_dim and \l_@@_column_j_max_dim. Between the construction of the “medium nodes” and the “large nodes”, the values of these dimensions are changed.

The function also uses \l_@@_suffix_tl (-medium or -large).

\begin{verbatim}
\cs_new_protected:Npn \@@_create_nodes:
\begin{verbatim}
{ \int_step_variable:nnNn \l_@@_first_row_int \g_@@_row_total_int \@@_i:
  \{ \int_step_variable:nnNn \l_@@_first_col_int \g_@@_col_total_int \@@_j:
    \{ \@@_pgf_rect_node:nnnnn
      \{ \l_@@_suffix_tl - \l_@@_i: - \l_@@_j: \l_@@_suffix_tl \}
      \{ \dim_use:c { \l_@@_column_ \l_@@_j: _min_dim } \}
  \}

\end{verbatim}
\end{verbatim}

\end{verbatim}
Now, we create the nodes for the cells of the \multicolumn. We recall that we have stored in \g_@@_multicolumn_cells_seq the list of the cells where a \multicolumn{\textit{n}}{...}{...} with \textit{n}>1 was issued and in \g_@@_multicolumn_sizes_seq the correspondant values of \textit{n}.

\seq_mapthread_function:NNN \g_@@_multicolumn_cells_seq \g_@@_multicolumn_sizes_seq \@@_node_for_multicolumn:nn

The command \@@_node_for_multicolumn:nn takes two arguments. The first is the position of the cell where the command \multicolumn{\textit{n}}{...}{...} was issued in the format \textit{i-j} and the second is the value of \textit{n} (the length of the “multi-cell”).

The blocks

The code deals with the command \Block. This command has no direct link with the environment \{NiceMatrixBlock\}.

The options of the command \Block will be analyzed first in the cell of the array (and once again when the block will be put in the array). Here is the set of keys for the first pass.

\keys_define:nn \{ NiceMatrix / Block / FirstPass \}
\{ l .code:n = \str_set:Nn \l_@@_hpos_block_str l , l .value_forbidden:n = true , r .code:n = \str_set:Nn \l_@@_hpos_block_str r , r .value_forbidden:n = true ,

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The following command `\@@_Block:` will be linked to `\Block` in the environments of `nicematrix`. We define it with `\NewExpandableDocumentCommand` because it has an optional argument between `<` and `>`. It’s mandatory to use an expandable command.

\NewExpandableDocumentCommand \@@_Block: { O { } m D < > { } +m }

If the first mandatory argument of the command (which is the size of the block with the syntax $i-j$) has not been provided by the user, you use $1-1$ (that is to say a block of only one cell).

\peek_remove_spaces:n
\tl_if_blank:nTF { #2 }
{ \@@_Block_i 1-1 \q_stop }
{ \@@_Block_i #2 \q_stop }
{ #1 } { #3 } { #4 }
\}

With the following construction, we extract the values of $i$ and $j$ in the first mandatory argument of the command.

\cs_new:Npn \@@_Block_i #1-#2 \q_stop { \@@_Block_ii:nnnnn { #1 } { #2 } { #3 } { #4 } { #5 } }

Now, the arguments have been extracted: #1 is $i$ (the number of rows of the block), #2 is $j$ (the number of columns of the block), #3 is the list of key=values pairs, #4 are the tokens to put before the math mode and the beginning of the small array of the block and #5 is the label of the block.

\cs_new_protected:Npn \@@_Block_ii:nnnnn #1 #2 #3 #4 #5
{

We recall that #1 and #2 have been extracted from the first mandatory argument of `\Block` (which is of the syntax $i-j$). However, the user is allowed to omit $i$ or $j$ (or both). We detect that situation by replacing a missing value by 100 (it’s a convention: when the block will actually be drawn these values will be detected and interpreted as maximal possible value according to the actual size of the array).

\bool_lazy_or:nnTF
{ \tl_if_blank:p:n { #1 } }
{ \str_if_eq_p:nn { #1 } { * } }
{ \int_set:Nn \l_tmpa_int { 100 } }
{ \int_set:Nn \l_tmpa_int { #1 } }
\bool_lazy_or:nnTF
{ \tl_if_blank:p:n { #2 } }
{ \str_if_eq_p:nn { #2 } { * } }
{ \int_set:Nn \l_tmpb_int { 100 } }
{ \int_set:Nn \l_tmpb_int { #2 } }

If the block is mono-column.
\int_compare:nNnTF \l_tmpb_int = 1
{
\str_if_empty:NTF \l_@@_hpos_cell_str
{ \str_set:Nn \l_@@_hpos_block_str c }
{ \str_set_eq:NN \l_@@_hpos_block_str \l_@@_hpos_cell_str }
}
l_@@_hpos_block_str may be modified by the keys of the command \Block that we will analyze now.
\keys_set_known:nn { NiceMatrix / Block / FirstPass } { #3 }
\tl_set:Nx \l_tmpa_tl
{ \int_use:N \c@iRow }
{ \int_use:N \c@jCol }
{ \int_eval:n { \c@iRow + \l_tmpa_int - 1 } }
{ \int_eval:n { \c@jCol + \l_tmpb_int - 1 } }

Now, \l_tmpa_tl contains an “object” corresponding to the position of the block with four components, each of them surrounded by curly brackets: \{imin\} \{jmin\} \{imax\} \{jmax\}.

If the block is mono-column or mono-row, we have a special treatment. That’s why we have two macros: \@@_Block_iv:nnnnn and \@@_Block_v:nnnnn (the five arguments of those macros are provided by curryfication).
\bool_if:nTF
{ \int_compare_p:nNn { \l_tmpa_int } = 1 || \int_compare_p:nNn { \l_tmpb_int } = 1 }
&& ! \tl_if_empty_p:n { #5 }
{ \exp_args:Nxx \@@_Block_iv:nnnnn }
{ \exp_args:Nxx \@@_Block_v:nnnnn }
{ \l_tmpa_int } { \l_tmpb_int } { #3 } { #4 } { #5 }

For the blocks mono-column, we will compose right now in a box in order to compute its width and take that width into account for the width of the column. However, if the column is a X column, we should not do that since the width is determined by another way. This should be the same for the p, m and b columns and we should modify that point. However, for the X column, it’s imperative. Otherwise, the process for the determination of the widths of the columns will be wrong.

The following macro is for the case of a \Block which is mono-row or mono-column (or both). In that case, the content of the block is composed right now in a box (because we have to take into account the dimensions of that box for the width of the current column or the height and the depth of the current row). However, that box will be put in the array after the construction of the array (by using PGF).
\cs_new_protected:Npn \@@_Block_iv:nnnnn #1 #2 #3 #4 #5
{ \int_gincr:N \g_@@_block_box_int
\cs_set_protected_nopar:Npn \diagbox ##1 ##2
{ \tl_gput_right:Nx \g_@@_internal_code_after_tl
{ \@@_actually_diagbox:nnnnn
{ \int_use:N \c@iRow } }
{ \int_compare:nNnTF \l_tmpb_int = 1
{ \str_if_empty:NTF \l_@@_hpos_cell_str
{ \str_set:Nn \l_@@_hpos_block_str c }
{ \str_set_eq:NN \l_@@_hpos_block_str \l_@@_hpos_cell_str }
}
{ \str_set:Nn \l_@@_hpos_block_str c }
}
For a mono-column block, if the user has specified a color for the column in the preamble of the array, we want to fix that color in the box we construct. We do that with \set@color and not \color_ensure_current: (in order to use \color_ensure_current: safely, you should load \l3backend before the \documentclass with \RequirePackage{expl3}).

If the block is mono-row, we use \g_@@_row_style_tl even if it has yet been used in the beginning of the cell where the command \Block has been issued because we want to be able to take into account a potential instruction of color of the font in \g_@@_row_style_tl.

If the box is rotated (the key \rotate may be in the previous \#4), the tabular used for the content of the cell will be constructed with a format c. In the other cases, the tabular will be constructed with a format equal to the key of position of the box. In other words: the alignment internal to the tabular is the same as the external alignment of the tabular (that is to say the position of the block in its zone of merged cells).

When the block is mono-column in a column with a fixed width (eg p{3cm}).
If we are in a mono-column block, we take into account the width of that block for the width of the column.

\int_compare:nNnT { #2 } = 1
\dim_gset:Nn \g_@@_blocks_wd_dim
\dim_max:nn \g_@@_blocks_wd_dim
\box_wd:c \g_@@_block_box_int \int_use:N \g_@@_block_box_int \box_grotate:cn
\bool_gset_false:N \g_@@_rotate_bool

If we are in a mono-row block, we take into account the height and the depth of that block for the height and the depth of the row.

\int_compare:nNnT { #1 } = 1
\dim_gset:Nn \g_@@_blocks_ht_dim
\dim_max:nn \g_@@_blocks_ht_dim
\box_ht:c \g_@@_block_box_int \int_use:N \g_@@_block_box_int
\dim_gset:Nn \g_@@_blocks_dp_dim
\dim_max:nn \g_@@_blocks_dp_dim
\box_dp:c \g_@@_block_box_int \int_use:N \g_@@_block_box_int
\seq_gput_right:Nx \g_@@_blocks_seq

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In the list of options #3, maybe there is a key for the horizontal alignment (l, r or c). In that case, that key has been read and stored in \l_@@_hpos_block_str. However, maybe there were no key of the horizontal alignment and that’s why we put a key corresponding to the value of \l_@@_hpos_block_str, which is fixed by the type of current column.

The following macro is for the standard case, where the block is not mono-row and not mono-column. In that case, the content of the block is not composed right now in a box. The composition in a box will be done further, just after the construction of the array.

If the box is rotated (the key \rotate may be in the previous #4), the tabular used for the content of the cell will be constructed with a format c. In the other cases, the tabular will be constructed with a format equal to the key of position of the box. In other words: the alignment internal to the tabular is the same as the external alignment of the tabular (that is to say the position of the block in its zone of merged cells).
We recall that the options of the command \Block are analyzed twice: first in the cell of the array and once again when the block will be put in the array after the construction of the array (by using PGF).

\keys_define:nn { NiceMatrix / Block / SecondPass }
{\tikz .code:n = \bool_if:NTF \c_@@_tikz_loaded_bool {
\seq_put_right:Nn \l_@@_tikz_seq { \{ \#1 \} }
\{ \%0_error:n { tikz-key-without-tikz } \},
\tikz .value_required:n = true,
\fill .tl_set:N = \l_@@_fill_tl,
\fill .value_required:n = true,
\draw .tl_set:N = \l_@@_draw_tl,
\draw .default:n = default,
\rounded-corners .dim_set:N = \l_@@_rounded_corners_dim,
\rounded-corners .default:n = 4 pt,
\color .code:n = {color { \#1 } \tl_set:Nn \l_@@_draw_tl { \#1 }},
\color .value_required:n = true,
\borders .clist_set:N = \l_@@_borders_clist,
\borders .value_required:n = true,
\hvlines .meta:n = { vlines , hlines },
\vlines .bool_set:N = \l_@@_vlines_block_bool,
\vlines .default:n = true,
\hlines .bool_set:N = \l_@@_hlines_block_bool,
\hlines .default:n = true,
\line-width .dim_set:N = \l_@@_line_width_dim,
\line-width .value_required:n = true,
\l .code:n = { \str_set:Nn \l_@@_hpos_block_str l,
\l .value_forbidden:n = true,
\r .code:n = { \str_set:Nn \l_@@_hpos_block_str r,
\r .value_forbidden:n = true,
\c .code:n = { \str_set:Nn \l_@@_hpos_block_str c,
\c .value_forbidden:n = true,
\L .code:n = { \str_set:Nn \l_@@_vpos_of_block_tl t,
\L .value_forbidden:n = true,
\R .code:n = { \str_set:Nn \l_@@_vpos_of_block_tl b,
\R .value_forbidden:n = true,
\name .tl_set:N = \l_@@_block_name_str,
\name .value_required:n = true,
\name .initial:n = ,
\respect-arraystretch .bool_set:N = \l_@@_respect_arraystretch_bool,
The command \@@_draw_blocks: will draw all the blocks. This command is used after the construction of the array. We have to revert to a clean version of \ialign because there may be tabulars in the \Block instructions that will be composed now.

The integer \l_@@_last_row_int will be the last row of the block and \l_@@_last_col_int its last column.

We remind that the first mandatory argument of the command \Block is the size of the block with the special format \(i-j\). However, the user is allowed to omit \(i\) or \(j\) (or both). This will be interpreted as: the last row (resp. column) of the block will be the last row (resp. column) of the block (without the potential exterior row—resp. column—of the array). By convention, this is stored in \g_@@_blocks_seq as a number of rows (resp. columns) for the block equal to 100. That’s what we detect now.

The group is for the keys.
We restrict the use of the key \texttt{v-center} to the case of a mono-row block.

\begin{verbatim}
\bool_if:NT \l_@@_v_center_bool
{\int_compare:nNnF { #1 } = { #3 }
{\@@_error:n { Wrong use of v-center }
\bool_set_false:N \l_@@_v_center_bool
}
}
\bool_if:NT \l_@@_vlines_block_bool
{\tl_gput_right:Nx \g_nicematrix_code_after_tl
{\@@_vlines_block:nnn
{\exp_not:n { #5 }}
{ #1 - #2 }
{ \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int }
}
}
\bool_if:NT \l_@@_hlines_block_bool
{\tl_gput_right:Nx \g_nicematrix_code_after_tl
{\@@_hlines_block:nnn
{\exp_not:n { #5 }}
{ #1 - #2 }
{ \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int }
}
}
\bool_if:nT
{ ! \l_@@_vlines_block_bool && ! \l_@@_hlines_block_bool }
{The sequence of the positions of the blocks (excepted the blocks with the key \texttt{hvlines}) will be used when drawing the rules (in fact, there is also the \texttt{\multicolumn} and the \texttt{\diagbox} in that sequence).

\seq_gput_left:Nx \g_@@_pos_of_blocks_seq
{ { #1 } { #2 } { #3 } { #4 } { \l_@@_block_name_str } }
}
\tl_if_empty:NF \l_@@_draw_tl
{\tl_gput_right:Nx \g_nicematrix_code_after_tl
{\@@_stroke_block:nnn
{\exp_not:n { #5 }}
{ #1 - #2 }
{ \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int }
}
\seq_gput_right:Nn \g_@@_pos_of_stroken_blocks_seq
{ { #1 } { #2 } { #3 } { #4 } }
}
\clist_if_empty:NF \l_@@_borders_clist
{\tl_gput_right:Nx \g_nicematrix_code_after_tl
{\@@_stroke_borders_block:nnn
{\exp_not:n { #5 }}
{ #1 - #2 }
{ \int_use:N \l_@@_last_row_int - \int_use:N \l_@@_last_col_int }
}
}
\tl_if_empty:NF \l_@@_fill_tl
{ }
\end{verbatim}

The command \texttt{\@\@\_extract\_brackets} will extract the potential specification of color space at the beginning of \texttt{\_\_fill\_tl} and store it in \texttt{\_tmpa\_tl} and store the color itself in \texttt{\_tmpb\_tl}.

Let’s consider the following \texttt{NiceTabular}. Because of the instruction !{\hspace{1cm}} in the preamble which increases the space between the columns (by adding, in fact, that space to the previous column, that is to say the second column of the tabular), we will create two nodes relative to the block: the node 1-1-block and the node 1-1-block-short.

\begin{NiceTabular}{cc!{\hspace{1cm}}c}
\Block{2-2}{our block} & & one \\ 
 & & two \\ 
three & four & five \\ 
six & seven & eight \\
\end{NiceTabular}

We highlight the node 1-1-block. We highlight the node 1-1-block-short.

\begin{tabular}{|c|c|c|}
\hline
\textbf{our block} & \textbf{one} & \textbf{two} \\
\textbf{three} & \textbf{four} & \textbf{five} \\
\textbf{six} & \textbf{seven} & \textbf{eight} \\
\hline
\end{tabular}
The construction of the node corresponding to the merged cells.

We construct the node for the block with the name (#1-#2-block).
The function \@@_pgf_rect_node:nnnnn takes in as arguments the name of the node and the four coordinates of two opposite corner points of the rectangle.

Now, we create the “short node” which, in general, will be used to put the label (that is to say the content of the node). However, if one of the keys L, C or R is used (that information is provided by the boolean \l_@@_hpos_of_block_cap_bool), we don’t need to create that node since the normal node is used to put the label.

The short node is constructed by taking into account the contents of the columns involved in at least one cell of the block. That’s why we have to do a loop over the rows of the array.

We recall that, when a cell is empty, no (normal) node is created in that cell. That’s why we test the existence of the node before using it.

If all the cells of the column were empty, \l_tmpb_dim has still the same value \c_max_dim. In that case, you use for \l_tmpb_dim the value of the position of the vertical rule.
If the creation of the “medium nodes” is required, we create a “medium node” for the block. The function \@@_pgf_rect_node:nnn takes in as arguments the name of the node and two PGF points.

Now, we will put the label of the block beginning with the case of a \Block of one row. We take into account the case of a block of one row in the “first row” or the “last row”. If the block has only one row, we want the label of the block perfectly aligned on the baseline of the row. That’s why we have constructed a \pgfcoordinate on the baseline of the row, in the first column of the array. Now, we retrieve the y-value of that node and we store it in \l_tampa_dim. We retrieve (in \pgf@x) the x-value of the center of the block.
We put the label of the block which has been composed in \l_@@_cell_box.

If the number of rows is different of 1, we will put the label of the block by using the short node (the label of the block has been composed in \l_@@_cell_box).

If we are in the first column, we must put the block as if it was with the key r.

\int_compare:nNnT { #2 } = 0
{ \str_set:Nn \l_@@_hpos_block_str r }
\bool_if:nT \g_@@_last_col_found_bool
{ \int_compare:nNnT { #2 } = \g_@@_col_total_int
{ \str_set:Nn \l_@@_cell_box } { } } }
The first argument of \@@_stroke_block:nnn is a list of options for the rectangle that you will stroke. The second argument is the upper-left cell of the block (with, as usual, the syntax \(i-j\)) and the third is the last cell of the block (with the same syntax).

If the user has used the key color of the command \Block without value, the color fixed by \arrayrulecolor is used.

If the user has used the key color of the command \Block without value, the color fixed by \arrayrulecolor is used.
We can't use `\pgfusepathqstroke` because of the key `rounded-corners`.

Here is the set of keys for the command `\@@_stroke_block:nnn`.

The first argument of `\@@_vlines_block:nnn` is a list of options for the rules that we will draw. The second argument is the upper-left cell of the block (with, as usual, the syntax `i-j`) and the third is the last cell of the block (with the same syntax).
The first argument of \@@_stroke_borders_block:nnn is a list of options for the borders that you will stroke. The second argument is the upper-left cell of the block (with, as usual, the syntax i-j) and the third is the last cell of the block (with the same syntax).

\cs_new_protected:Npn \@@_stroke_borders_block:nnn #1 #2 #3
{
    \dim_set_eq:NN \l_@@_line_width_dim \arrayrulewidth
    \keys_set_known:nN { NiceMatrix / BlockBorders } { #1 }
    \dim_compare:nNnTF \l_@@_rounded_corners_dim > \c_zero_dim
    { \@@_error:n { borders~forbidden } }
    { 
        \tl_clear_new:N \l_@@_borders_tikz_tl
        \keys_set:nV { NiceMatrix / OnlyForTikzInBorders }
        \l_@@_borders_clist
        \@@_cut_on_hyphen:w #2 \q_stop
        \tl_set_eq:NN \l_@@_tmpc_tl \l_tmpa_tl
        \tl_set_eq:NN \l_@@_tmpd_tl \l_tmpb_tl
        \@@_cut_on_hyphen:w #3 \q_stop
        \tl_set:Nx \l_tmpa_tl { \int_eval:n { \l_tmpa_tl + 1 } }
        \tl_set:Nx \l_tmpb_tl { \int_eval:n { \l_tmpb_tl + 1 } }
        \@@_stroke_borders_block_i:
    }
}
\hook_gput_code:nnn { begindocument } { . }
\cs_new_protected:Npx \@@_stroke_borders_block_i:
{
    \c_@@_pgfortikzpicture_tl
    \@@_stroke_borders_block_ii:
    \c_@@_endpgfortikzpicture_tl
}
\cs_new_protected:Npn \@@_stroke_borders_block_ii:
{
    \pgfrememberpicturepositiononpagetrue
    \pgf@relevantforpicturesizefalse
    \CT@arc@
    \pgfsetlinewidth { 1.1 \l_@@_line_width_dim }
    \clist_if_in:NnT \l_@@_borders_clist { right }
    { \@@_stroke_vertical:n \l_tmpb_tl }
    \clist_if_in:NnT \l_@@_borders_clist { left }
    { \@@_stroke_vertical:n \l_@@_tmpd_tl }
    \clist_if_in:NnT \l_@@_borders_clist { bottom }
    { \@@_stroke_horizontal:n \l_@@_tmpc_tl }
    \clist_if_in:NnT \l_@@_borders_clist { top }
    { \@@_stroke_horizontal:n \l_@@_tmpc_tl }
}
\keys_define:nn { NiceMatrix / OnlyForTikzInBorders }
{ tikz .code:n = \cs_if_exist:NTF \tikzpicture
    { \tl_set:Nn \l_@@_borders_tikz_tl { #1 } }
    { \@@_error:n { tikz-in-borders-without-tikz } },}
The following command is used to stroke the left border and the right border. The argument #1 is the number of column (in the sense of the col node).

\cs_new_protected:Npn \@@_stroke_vertical:n #1
\{\l_@@_tmpc_tl \dim_set:Nn \l_tmpb_dim { \pgf@y + 0.5 \l_@@_line_width_dim } \l_@@_tmpc_tl \dim_set:Nn \l_@@_tmpc_dim { \pgf@y + 0.5 \l_@@_line_width_dim } \l_@@_tmpc_tl \tl_if_empty:NTF \l_@@_borders_tikz_tl \{ \pgfpathmoveto { \pgfpoint \pgf@x \l_tmpb_dim } \pgfpathlineto { \pgfpoint \pgf@x \l_@@_tmpc_dim } \pgfusepathqstroke \} \\use:x { \exp_not:N \draw \[ \l_@@_borders_tikz_tl \] ( \pgf@x , \l_tmpb_dim ) -- ( \pgf@x , \l_@@_tmpc_dim ); \} \}

The following command is used to stroke the top border and the bottom border. The argument #1 is the number of row (in the sense of the row node).

\cs_new_protected:Npn \@@_stroke_horizontal:n #1
\{\l_@@_tmpd_tl \clist_if_in:NnTF \l_@@_borders_clist { left } { \dim_set:Nn \l_tmpa_dim { \pgf@x - 0.5 \l_@@_line_width_dim } } { \dim_set:Nn \l_tmpa_dim { \pgf@x + 0.5 \l_@@_line_width_dim } } \l_@@_tmpd_tl \dim_set:Nn \l_@@_tmpd_dim { \pgf@x + 0.5 \l_@@_line_width_dim } \l_@@_tmpd_tl \tl_if_empty:NTF \l_@@_borders_tikz_tl \{ \pgfpathmoveto { \pgfpoint \l_tmpa_dim \pgf@y } \pgfpathlineto { \pgfpoint \l_@@_tmpd_dim \pgf@y } \pgfusepathqstroke \} \\use:x { \exp_not:N \draw \[ \l_@@_borders_tikz_tl \] ( \l_tmpa_dim , \pgf@y ) -- ( \l_@@_tmpd_dim , \pgf@y ); \} \}

Here is the set of keys for the command \@@_strokeBorders_block:nnn.

\keys_define:nn { NiceMatrix / BlockBorders } {\l_@@_borders_clist , \l_@@_rounded_corners_dim , \l_@@_line_width_dim , \l_@@_rounded_corners_dim , \l_@@_line_width_dim ,}
The following command will be used if the key \texttt{tikz} has been used for the command \texttt{Block}. The arguments \texttt{#1} and \texttt{#2} are the coordinates of the first cell and \texttt{#3} and \texttt{#4} the coordinates of the last cell of the block. \texttt{#5} is a comma-separated list of the Tikz keys used with the path.

\begin{verbatim}
\cs_new_protected:Npn \@@_block_tikz:nnnnn #1 #2 #3 #4 #5
\begin {tikzpicture}
\clist_map_inline:nn { #5 }
\path [ ##1 ]
( #1 -| #2 )
rectangle
( \int_eval:n { #3 + 1 } -| \int_eval:n { #4 + 1 } ) ;
\end {tikzpicture}
\end{verbatim}

How to draw the dotted lines transparently

\begin{verbatim}
\cs_set_protected:Npn \@@_renew_matrix:
{ \RenewDocumentEnvironment { pmatrix } { } { \pNiceMatrix }
{ \endpNiceMatrix }
{ \RenewDocumentEnvironment { vmatrix } { } { \vNiceMatrix }
{ \endvNiceMatrix }
{ \RenewDocumentEnvironment { Vmatrix } { } { \VNiceMatrix }
{ \endVNiceMatrix }
{ \RenewDocumentEnvironment { bmatrix } { } { \bNiceMatrix }
{ \endbNiceMatrix }
{ \RenewDocumentEnvironment { Bmatrix } { } { \BNiceMatrix }
{ \endBNiceMatrix }
};
\end{verbatim}

Automatic arrays

\begin{verbatim}
\cs_new_protected:Npn \@@_set_size:n #1-#2 \q_stop
{ \int_set:Nn \l_@@_nb_rows_int { #1 }
\int_set:Nn \l_@@_nb_cols_int { #2 }
}
\keys_define:nn { NiceMatrix / Auto }
{ l .code:n = \tl_set:Nn \l_@@_type_of_col_tl l ,
  r .code:n = \tl_set:Nn \l_@@_type_of_col_tl r ,
  c .code:n = \tl_set:Nn \l_@@_type_of_col_tl c }
\NewDocumentCommand \AutoNiceMatrixWithDelims { m m O { } m O { } m ! O { } }
{ \int_zero_new:N \l_@@_nb_rows_int
\int_set:Nn \l_@@_nb_cols_int { #1 }
\int_zero_new:N \l_@@_nb_rows_int
\int_zero_new:N \l_@@_nb_cols_int
\@@_set_size:n \l_@@_nb_rows_int \l_@@_nb_cols_int
\group_begin:
\end{verbatim}

We will extract the potential keys \texttt{l}, \texttt{r} and \texttt{c} and pass the other keys to the environment \texttt{NiceArrayWithDelims}.

\begin{verbatim}
\keys_define:nn { NiceMatrix / Auto }
{ l .code:n = \tl_set:Nn \l_@@_type_of_col_tl l ,
  r .code:n = \tl_set:Nn \l_@@_type_of_col_tl r ,
  c .code:n = \tl_set:Nn \l_@@_type_of_col_tl c }
\NewDocumentCommand \AutoNiceMatrixWithDelims { m m O { } m O { } m ! O { } }
{ \int_zero_new:N \l_@@_nb_rows_int
\int_set:Nn \l_@@_nb_cols_int { #1 }
\int_zero_new:N \l_@@_nb_rows_int
\int_zero_new:N \l_@@_nb_cols_int
\@@_set_size:n \l_@@_nb_rows_int \l_@@_nb_cols_int
\group_begin:
\end{verbatim}

The group is for the protection of \texttt{l_@@_type_of_col_tl}.
We put \{ \} before \#6 to avoid a hasty expansion of a potential \arabic{iRow} at the beginning of the row which would result in an incorrect value of that iRow (since iRow is incremented in the first cell of the row of the \halign).

We define also a command \AutoNiceMatrix similar to the environment \{NiceMatrix\}.

The redefinition of the command \dotfill
First, we insert \@@_dotfill (which is the saved version of \dotfill) in case of use of \dotfill “internally” in the cell (e.g. \hbox to 1cm {\dotfill}).

\@@_old_dotfill
\bool_if:NT \l_@@_NiceTabular_bool
{ \group_insert_after:N \@@_dotfill_ii: }
{ \group_insert_after:N \@@_dotfill_i: }
\cs_new_protected:Npn \@@_dotfill_i: { \group_insert_after:N \@@_dotfill_ii: }
\cs_new_protected:Npn \@@_dotfill_ii: { \group_insert_after:N \@@_dotfill_iii: }
\cs_new_protected:Npn \@@_dotfill_iii: { \dim_compare:nNnT { \box_wd:N \l_@@_cell_box } = \c_zero_dim \@@_old_dotfill }

Now, if the box if not empty (unfortunately, we can’t actually test whether the box is empty and that’s why we only consider it’s width), we insert \@@_dotfill (which is the saved version of \dotfill) in the cell of the array, and it will extend, since it is no longer in \l_@@_cell_box.

\cs_new_protected:Npn \@@_dotfill_ii: { \group_insert_after:N \@@_dotfill_iii: }
\cs_new_protected:Npn \@@_dotfill_iii: { \dim_compare:nNnT { \box_wd:N \l_@@_cell_box } = \c_zero_dim \@@_old_dotfill }

The command \diagbox

The command \diagbox will be linked to \diagbox:nn in the environments of nicematrix. However, there are also redefinitions of \diagbox in other circumstances.

\cs_new_protected:Npn \@@_diagbox:nn #1 #2
\tl_gput_right:Nx \g_@@_internal_code_after_tl
\@@_actually_diagbox:nnnnnn
\int_use:N \c@iRow
\int_use:N \c@jCol
\int_use:N \c@iRow
\int_use:N \c@jCol
\exp_not:n { #1 }
\exp_not:n { #2 }
\endpgfmatrixcode
\endpgfmatrix

We put the cell with \diagbox in the sequence \g_@@_pos_of_blocks_seq because a cell with \diagbox must be considered as non empty by the key corners.

\seq_gput_right:Nx \g_@@_pos_of_blocks_seq
\int_use:N \c@iRow
\int_use:N \c@jCol
\int_use:N \c@iRow
\int_use:N \c@jCol
\exp_not:n { #1 }
\exp_not:n { #2 }
\endpgfmatrixcode
\endpgfmatrix

The last argument is for the name of the block.

\seq_gput_right:Nx \g_@@_pos_of_blocks_seq
\int_use:N \c@iRow
\int_use:N \c@jCol
\int_use:N \c@iRow
\int_use:N \c@jCol
\exp_not:n { #1 }
\exp_not:n { #2 }
\endpgfmatrixcode
\endpgfmatrix

The command \diagbox is also redefined locally when we draw a block.

The first four arguments of \@@_actually_diagbox:nnnnnn correspond to the rectangle (=block) to slash (we recall that it’s possible to use \diagbox in a \Block). The other two are the elements to draw below and above the diagonal line.

\cs_new_protected:Npn \@@_actually_diagbox:nnnnnn #1 #2 #3 #4 #5 #6
\pgfpicture
\pgf@relevantforpicturesizefalse
\pgfrememberpicturepositiononpagetrue
\@@_qpoint:n \row - #1
\dim_set_eq:NN \l_tmpa_dim \pgf@y
\@@_qpoint:n \col - #2
\dim_set_eq:NN \l_tmpb_dim \pgf@x
\pgfpathmoveto \pgfpoint \l_tmpb_dim \l_tmpa_dim
\@@_qpoint:n \row - \int_eval:n { #3 + 1 }
\dim_set_eq:NN \l_@@_tmpc_dim \pgf@y
\pgfpathmoveto \pgfpoint \l_@@_tmpc_dim \l_@@_tmpb_dim
\pgfpathmoveto \pgfpoint \l_@@_tmpc_dim \l_@@_tmpa_dim
\pgfpathmoveto \pgfpoint \l_@@_tmpb_dim \l_@@_tmpa_dim
\pgfpathmoveto \pgfpoint \l_@@_tmpc_dim \l_@@_tmpb_dim
\pgf@y
The command \CT@arc is a command of colorbl which sets the color of the rules in the array. The package nicematrix uses it even if colorbl is not loaded.

\CT@arc\pgfsetroundcap\pgfusepathqstroke

\pgfset { inner~sep = 1 pt }
\pgfscope\pgftransformshift { \pgfpoint \l_tmpb_dim \l_@@_tmpc_dim }
\pgfnode { rectangle } { south-west }
{ \begin { minipage } { 20 cm } \@@_math_toggle_token: #5 \@@_math_toggle_token: \end { minipage } }
{ }{ }
\endpgfscope\pgftransformshift { \pgfpoint \l_@@_tmpd_dim \l_tmpa_dim }
\pgfnode { rectangle } { north-east }
{ \begin { minipage } { 20 cm } \raggedleft \@@_math_toggle_token: #6 \@@_math_toggle_token: \end { minipage } }
{ }{ }
\endpgfpicture

The keyword \CodeAfter

The \CodeAfter (inserted with the key code-after or after the keyword \CodeAfter) may always begin with a list of pairs key=value between square brackets. Here is the corresponding set of keys.

\keys_define:nn { NiceMatrix / CodeAfter } { sub-matrix .code:n = \keys_set:nn { NiceMatrix / sub-matrix } { #1 } , sub-matrix .value_required:n = true , delimiters / color .tl_set:N = \l_@@_delimiters_color_tl , delimiters / color .value_required:n = true , rules .code:n = \keys_set:nn { NiceMatrix / rules } { #1 } , rules .value_required:n = true , unknown .code:n = \@@_error:n { Unknown-key-for-CodeAfter } }

In fact, in this subsection, we define the user command \CodeAfter for the case of the “normal syntax”. For the case of “light-syntax”, see the definition of the environment \{@@-light-syntax\} on p. 122.

In the environments of nicematrix, \CodeAfter will be linked to \@@_CodeAfter:. That macro must not be protected since it begins with \omit.
However, in each cell of the environment, the command \CodeAfter will be linked to the following command \@@_CodeAfter_ii:n which begins with \\.

We have to catch everything until the end of the current environment (of nicematrix). First, we go until the next command \end.

We catch the argument of the command \end (in \#1).

If this is really the end of the current environment (of nicematrix), we put back the command \end and its argument in the TeX flow.

If this is not the \end we are looking for, we put those tokens in \g_nicematrix_code_after_tl and we go on searching for the next command \end with a recursive call to the command \@@_CodeAfter:n.

The delimiters in the preamble

The command \@@_delimiter:nnn will be used to draw delimiters inside the matrix when delimiters are specified in the preamble of the array. It does not concern the exterior delimiters added by \{NiceArrayWithDelims\} (and \{pNiceArray\}, \{pNiceMatrix\}, etc.).

A delimiter in the preamble of the array will write an instruction \@@_delimiter:nnn in the \g@@_internal_code_after_tl (and also potentially add instructions in the preamble provided to \array in order to add space between columns).

The first argument is the type of delimiter (\(, [\), \{ or \}). The second argument is the number of columns. The third argument is a boolean equal to \c_true_bool (resp. \c_false_true) when the delimiter must be put on the left (resp. right) side.

\cs_new_protected:Npn \@@_delimiter:nnn #1 #2 #3

\pgfpicture
\pgfrememberpicturepositiononpagetrue
\pgf@relevantforpicturesizefalse
\l@@y_initial_dim
\@@qpoint:n {row - 1}
\dim_set_eq:NN \l@@y_initial_dim \pgf@y
\@@qpoint:n {row - \int_eval:n {\c@iRow + 1}}
\dim_set_eq:NN \l@@y_final_dim \pgf@y
\bool_if:nTF {#3}
{\dim_set_eq:NN \l_tmpa_dim \c_max_dim}
{\dim_set:Nn \l_tmpa_dim { - \c_max_dim}}
\int_step_inline:nnn \l@@first_row_int \g@@row_total_int
\l@@y_initial_dim and \l@@y_final_dim will be the \(y\)-values of the extremities of the delimiter we have to construct.

We will compute in \l_tmpa_dim the \(x\)-value where we will have to put our delimiter (on the left side or on the right side).

\bool_if:nTF {#3}
{\dim_set_eq:NN \l_tmpa_dim \c_max_dim}
{\dim_set:Nn \l_tmpa_dim { - \c_max_dim}}
\int_step_inline:nnn \l@@first_row_int \g@@row_total_int
Now we can put the delimiter with a node of \texttt{pgf}.

\begin{pgfpicture}
\pgfset { inner~sep = \c_zero_dim }
\dim_zero:N \nulldelimiterspace
\pgftransformshift
\pgfpoint
{ \l_tmpa_dim }
{ ( \l_@@_y_initial_dim + \l_@@_y_final_dim + \arrayrulewidth ) / 2 }
\pgfnode
{ rectangle }
{ \bool_if:nTF { #3 } { east } { west } }
\endpgfpicture

Here is the content of the \texttt{PGF} node, that is to say the delimiter, constructed with its right size.

\begin{center}
\nullfont
\c_math_toggle_token
\tl_if_empty:NF \l_@@_delimiters_color_tl
{ \color { \l_@@_delimiters_color_tl } }
\bool_if:nTF { #3 } { \left \#1 } { \left . }
\vcenter
{ \nullfont
\hrule \@height
\dim_eval:n { \l_@@_y_initial_dim - \l_@@_y_final_dim }
\@depth \c_zero_dim
\@width \c_zero_dim
}
\bool_if:nTF { #3 } { \right . } { \right \#1 }
\c_math_toggle_token
\end{center}

The command $\texttt{\SubMatrix}$

\begin{keys_define:nn}{NiceMatrix / sub-matrix}
\extra-height .dim_set:N = \l_@@_submatrix_extra_height_dim ,
\extra-height .value_required:n = true ,
\left-xshift .dim_set:N = \l_@@_submatrix_left_xshift_dim ,
\left-xshift .value_required:n = true ,
\right-xshift .dim_set:N = \l_@@_submatrix_right_xshift_dim ,
\right-xshift .value_required:n = true ,
\xshift .meta:n = { \left-xshift = \#1, \right-xshift = \#1 },
\xshift .value_required:n = true ,
\delimiters / color .tl_set:N = \l_@@_delimiters_color_tl ,
\delimiters / color .value_required:n = true ,
\slim .bool_set:N = \l_@@_submatrix_slim_bool ,
\slim .default:n = true ,
\end{keys_define:nn}
The following keys set is for the command \SubMatrix itself (not the tuning of \SubMatrix that can be done elsewhere).

\keys_define:nn { NiceMatrix / SubMatrix }
{
  \SubMatrix .inherit:n = NiceMatrix / sub-matrix ,
  CodeAfter / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
  NiceMatrix / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
  NiceArray / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
  pNiceArray / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
  NiceMatrixOptions / sub-matrix .inherit:n = NiceMatrix / sub-matrix ,
}

\NewDocumentCommand \@@_SubMatrix_in_code_before { m m m m ! O { } }
{
  \peek_remove_spaces:n
  { \@@_cut_on_hyphen:w #3 \q_stop
    \tl_clear_new:N \l_@@_tmpc_tl
    \tl_clear_new:N \l_@@_tmpd_tl
    \tl_set_eq:NN \l_@@_tmpc_tl \l_tmpa_tl
    \tl_set_eq:NN \l_@@_tmpd_tl \l_tmpb_tl
    \@@_cut_on_hyphen:w #2 \q_stop
    \seq_gput_right:Nx \g_@@_submatrix_seq

In the internal code-after and in the \CodeAfter the following command \@@_SubMatrix will be linked to \SubMatrix.
• #1 is the left delimiter;
• #2 is the upper-left cell of the matrix with the format $i$-$j$;
• #3 is the lower-right cell of the matrix with the format $i$-$j$;
• #4 is the right delimiter;
• #5 is the list of options of the command;
• #6 is the potential subscript;
• #7 is the potential superscript.

For explanations about the construction with rescanning of the preamble, see the documentation for the user command \Cdots.

The following macro will compute \l_@@_first_i_tl, \l_@@_first_j_tl, \l_@@_last_i_tl and \l_@@_last_j_tl from the arguments of the command as provided by the user (for example 2-3 and 5-last).
The four following token lists correspond to the position of the \SubMatrix.

The last value of \int_step_inline:nnn is provided by currification.

#1 is the left delimiter, #2 is the right one, #3 is the subscript and #4 is the superscript.
We will draw the rules in the \SubMatrix.

\begin{Verbatim}
\pgfsetlinewidth{1.1\arrayrulewidth}
\tl_if_empty:NF \l_@@_rules_color_tl
{ \exp_after:wN \@@_set_CT@arc@: \l_@@_rules_color_tl \q_stop }
\CT@arc@
\end{Verbatim}

Now, we draw the potential vertical rules specified in the preamble of the environments with the letter fixed with the key vlines-in-sub-matrix. The list of the columns where there is such rule to draw is in \g_@@_cols_vlism_seq.

\begin{Verbatim}
\seq_map_inline:Nn \g_@@_cols_vlism_seq
\int_compare:nNnT \l_@@_first_j_tl < { ##1 }
\int_compare:nNnT { ##1 } < { \int_eval:n { \l_@@_last_j_tl + 1 } }
\@@_qpoint:n { col - ##1 }
\pgfpathmoveto { \pgfpoint \pgf@x \l_@@_y_initial_dim }
\pgfpathlineto { \pgfpoint \pgf@x \l_@@_y_final_dim }
\pgfusepathqstroke

\end{Verbatim}

Now, we draw the vertical rules specified in the key vlines of \SubMatrix. The last argument of \int_step_inline:nn or \clist_map_inline:Nn is given by curryfication.

\begin{Verbatim}
\tl_if_eq:NnTF \l_@@_submatrix_vlines_clist { all }
{ \int_step_inline:nn { \l_@@_last_j_tl - \l_@@_first_j_tl } }
{ \clist_map_inline:Nn \l_@@_submatrix_vlines_clist }
\bool_lazy_and:nnTF
{ \int_compare:nNn { ##1 } > 0 }
{ \int_compare:nNn { \l_@@_last_j_tl + 1 } }
\@@_qpoint:n { col - \int_eval:n { ##1 + \l_@@_first_j_tl } }
\pgfpathmoveto { \pgfpoint \pgf@x \l_@@_y_initial_dim }
\pgfpathlineto { \pgfpoint \pgf@x \l_@@_y_final_dim }
\pgfusepathqstroke

\end{Verbatim}

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Now, we draw the horizontal rules specified in the key `hlines` of \SubMatrix. The last argument of \int_step_inline:nn or \clist_map_inline:Nn is given by curryfication.

\tl_if_eq:NnTF \l_@@_submatrix_hlines_clist { all }{ \int_step_inline:nn { \l_@@_last_i_tl - \l_@@_first_i_tl } }{ \clist_map_inline:Nn \l_@@_submatrix_hlines_clist }\
\bool_lazy_and:nnTF { \int_compare_p:nNn { ##1 } > 0 } { \int_compare_p:nNn { ##1 } < { \l_@@_last_i_tl - \l_@@_first_i_tl + 1 } } { \@@_qpoint:n { row - \int_eval:n { ##1 + \l_@@_first_i_tl } } }

We use a group to protect \l_tmpa_dim and \l_tmpb_dim.

\begin { pgfscope }\pgftransformshift { \dim_sub:Nn \l_tmpa_dim { 0.9 mm } } \pgfpathmoveto { \pgfpoint \l_tmpa_dim \pgf@y }\end { pgfscope }

We compute in \l_tmpa_dim the x-value of the left end of the rule.

\dim_set:Nn \l_tmpa_dim { \l_@@_x_initial_dim - \l_@@_submatrix_left_xshift_dim }\str_case:nn { #1 }{ \dim_sub:Nn \l_tmpa_dim { 0.9 mm } }{ \dim_sub:Nn \l_tmpa_dim { 0.2 mm } }{ \dim_sub:Nn \l_tmpa_dim { 0.9 mm } }\pgfpathmoveto { \pgfpoint \l_tmpa_dim \pgf@y }\pgfusepathqstroke

We compute in \l_tmpb_dim the x-value of the right end of the rule.

\dim_set:Nn \l_tmpb_dim { \l_@@_x_final_dim + \l_@@_submatrix_right_xshift_dim }\str_case:nn { #2 }{ \dim_add:Nn \l_tmpb_dim { 0.9 mm } }{ \dim_add:Nn \l_tmpb_dim { 0.2 mm } }{ \dim_add:Nn \l_tmpb_dim { 0.9 mm } }\pgfpathlineto { \pgfpoint \l_tmpb_dim \pgf@y }\pgfusepathqstroke

If the key `name` has been used for the command \SubMatrix, we create a PGF node with that name for the submatrix (this node does not encompass the delimiters that we will put after).

\str_if_empty:NF \l_@@_submatrix_name_str{ \@@_pgf_rect_node:nnnnn \l_@@_submatrix_name_str \l_@@_x_initial_dim \l_@@_y_initial_dim \l_@@_x_final_dim \l_@@_y_final_dim}\pgfpathlineto { \pgfpoint \l_tmpb_dim \pgf@y }\pgfusepathqstroke\group_end:

The group was for \CT@arc@ (the color of the rules).

Now, we deal with the left delimiter. Of course, the environment \{pgfscope\} is for the \pgftransformshift.

\begin { pgfscope }\pgftransformshift{\end { pgfscope }\pgftransformshift
Now, we deal with the right delimiter.

\begin{verbatim}
\pgftransformshift
\pgfpoint
\pgfpoint
\str_if_empty:NTF \l_@@_submatrix_name_str
{ \@@_node_right:nnnn #2 { } { #3 } { #4 }
{ \@@_node_right:nnnn #2
{ \@@_env: - \l_@@_submatrix_name_str - right } { #3 } { #4 }
\cs_set_eq:NN \pgfpointanchor \@@_pgfpointanchor:n
\flag_clear_new:n { nicematrix }
\l_@@_code_tl
\end{verbatim}

In the key code of the command \SubMatrix there may be Tikz instructions. We want that, in these instructions, the $i$ and $j$ in specifications of nodes of the forms $i-j$, row-$i$, col-$j$ and $i-\mid j$ refer to the number of row and column relative of the current \SubMatrix. That’s why we will patch (locally in the \SubMatrix) the command \pgfpointanchor.

The following command will be linked to \pgfpointanchor just before the execution of the option code of the command \SubMatrix. In this command, we catch the argument #1 of \pgfpointanchor and we apply to it the command \@@_pgfpointanchor_i:nn before passing it to the original \pgfpointanchor. We have to act in an expandable way because the command \pgfpointanchor is used in names of Tikz nodes which are computed in an expandable way.

\begin{verbatim}
\cs_new_protected:Npn \@@_pgfpointanchor_i:nn #1 #2
{ #1 { \@@_pgfpointanchor_ii:w #2 - \q_stop } }
\tl_const:Nn \c_@@_integers_alist_tl
\end{verbatim}

In fact, the argument of \pgfpointanchor is always of the form \a_command { name_of_node } where “name_of_node” is the name of the Tikz node without the potential prefix and suffix. That’s why we catch two arguments and work only on the second by trying (first) to extract an hyphen -.

Since \seq_if_in:NnTF and \clist_if_in:NnTF are not expandable, we will use the following token list and \str_case:nVTF to test whether we have an integer or not.

\begin{verbatim}
\tl_const:Nn \c_@@_integers_alist_tl
\end{verbatim}
If there is no hyphen, that means that the node is of the form of a single number (ex.: 5 or 11). In that case, we are in an analysis which result from a specification of node of the form i-|j. In that case, the i of the number of row arrives first (and alone) in a \pgfpointanchor and, the, the j arrives (alone) in the following \pgfpointanchor. In order to know whether we have a number of row or a number of column, we keep track of the number of such treatments by the expandable flag called nicematrix.

\tl_if_empty:nTF { #2 }
{ \str_case:nVTF { #1 } \c_@@_integers_alist_tl
  { \flag_raise:n { nicematrix }
    \int_if_even:nTF { \flag_height:n { nicematrix } } { \int_eval:n { #1 + \l_@@_first_i_tl - 1 } } { \int_eval:n { #1 + \l_@@_first_j_tl - 1 } } } { #1 } }

If there is an hyphen, we have to see whether we have a node of the form i-j, row-i or col-j.
{ \@@_pgfpointanchor_iii:w { #1 } #2 }

There was an hyphen in the name of the node and that’s why we have to retrieve the extra hyphen we have put (cf. \@@_pgfpointanchor_i:nn).
\cs_new:Npn \@@_pgfpointanchor_iii:w #1 #2 -
{ \str_case:nnF { #1 } { row } { row - \int_eval:n { #2 + \l_@@_first_i_tl - 1 } } { col } { col - \int_eval:n { #2 + \l_@@_first_j_tl - 1 } } }

Now the case of a node of the form i-j.
{ \int_eval:n { #1 + \l_@@_first_i_tl - 1 } - \int_eval:n { #2 + \l_@@_first_j_tl - 1 } }

The command \@@_node_left:nn puts the left delimiter with the correct size. The argument #1 is the delimiter to put. The argument #2 is the name we will give to this PGF node (if the key name has been used in \SubMatrix).
\cs_new_protected:Npn \@@_node_left:nn #1 #2
{ \pgfnode
  { rectangle }
  { east }
  { \nullfont \c_math_toggle_token \tl_if_empty:nF \l_@@_delimiters_color_tl
    { \color { \l_@@_delimiters_color_tl } } \left #1 \vcenter
      { \nullfont \hrule \@height \l_tmpa_dim \@depth \c_zero_dim \@width \c_zero_dim } } }
The command \@@_node_right:nn puts the right delimiter with the correct size. The argument \#1 is the delimiter to put. The argument \#2 is the name we will give to this PGF node (if the key name has been used in \SubMatrix). The argument \#3 is the subscript and \#4 is the superscript.

\cs_new_protected:Npn \@@_node_right:nnnn #1 #2 #3 #4
{
\pgfnode
{ rectangle }
{ west }
{
  \nullfont
  \c_math_toggle_token
  \tl_if_empty:NF \l_@@_delimiters_color_tl
  { \color { \l_@@_delimiters_color_tl } }
  \left .
  \vcenter
  {
    \nullfont
    \hrule \@height \l_tmpa_dim
    \@depth \c_zero_dim
    \@width \c_zero_dim
  }
  \right #1
  \tl_if_empty:nF { #3 } { _ { \smash { #3 } } }
  ^ { \smash { #4 } }
  \c_math_toggle_token
}
{ #2 }
{ }
yshift .initial:n = \c_zero_dim ,
color .tl_set:N = \l_tmpa_tl ,
color .value_required:n = true ,
unknown .code:n = \@@_error:n { Unknown-key-for-Brace }
}

#1 is the first cell of the rectangle (with the syntax $i-|j$; #2 is the last cell of the rectangle; #3 is the label of the text; #4 is the optional argument (a list of key-value pairs); #5 is equal to under or over.

\cs_new_protected:Npn \@@_brace:nnnnn #1 #2 #3 #4 #5
{
  \group_begin:
The four following token lists correspond to the position of the sub-matrix to which a brace will be attached.

  \@@_compute_i_j:nn { #1 } { #2 }

  \bool_lazy_or:nnTF
  { \int_compare_p:nNn \l_@@_last_i_tl > \g_@@_row_total_int }
  { \int_compare_p:nNn \l_@@_last_j_tl > \g_@@_col_total_int }
  { \str_if_eq:nnTF { #5 } { under } }
  { \str_if_eq:nnTF { #5 } { over } }

  \tl_clear:N \l_tmpa_tl % added the 2022-02-25
  \keys_set:nn { NiceMatrix / Brace } { #4 }
  \pgfpicture
  \pgfrememberpicturepositiononpagetrue
  \pgf@relevantforpicturesizefalse
  \bool_if:NT \l_@@_brace_left_shorten_bool
  { \dim_set_eq:NN \l_@@_x_initial_dim \c_max_dim
    \int_step_inline:nnn \l_@@_first_i_tl \l_@@_last_i_tl
    { \cs_if_exist:cT
      { pgf @ sh @ ns @ \@@_env: - ##1 - \l_@@_first_j_tl }
      { \pgfpointanchor { \@@_env: - ##1 - \l_@@_first_j_tl } { west }
        \dim_set:Nn \l_@@_x_initial_dim
        { \dim_min:nn \l_@@_x_initial_dim \pgf@x } }
    } }
  \bool_lazy_or:nnT
  { \bool_not_p:n \l_@@_brace_left_shorten_bool }
  { \dim_compare_p:nNn \l_@@_x_initial_dim = \c_max_dim }

  \if_exist:cT
  { pgf @ sh @ ns @ \@@_env: - \l_@@_first_j_tl }
  { \pgfpointanchor { \@@_env: - \l_@@_first_j_tl } { west }
    \dim_set:Nn \l_@@_x_initial_dim \pgf@x }
  }

  \bool_if:NT \l_@@_brace_right_shorten_bool
  { \dim_set_eq:NN \l_@@_x_final_dim { - \c_max_dim }
    \int_step_inline:nnn \l_@@_first_i_tl \l_@@_last_i_tl
    { \cs_if_exist:cT
      { pgf @ sh @ ns @ \@@_env: - #1 - \l_@@_last_j_tl }
      { \pgfpointanchor { \@@_env: - #1 - \l_@@_last_j_tl } { east }
        \dim_set:Nn \l_@@_x_final_dim
        { \dim_max:nn \l_@@_x_final_dim \pgf@x } }
    } }

  \bool_lazy_or:nnT
  { \bool_not_p:n \l_@@_brace_right_shorten_bool }
  { \dim_compare_p:nNn \l_@@_x_final_dim = \c_max_dim }

  \if_exist:cT
  { pgf @ sh @ ns @ \@@_env: - #1 - \l_@@_last_j_tl }
  { \pgfpointanchor { \@@_env: - #1 - \l_@@_last_j_tl } { east }
    \dim_set:Nn \l_@@_x_final_dim \pgf@x }
  }
\group_end:
The argument is the text to put above the brace.
\cs_new_protected:Npn \@overbrace_i:n \_#1
\pgftransformshift
\pgfnode { rectangle } { south } {
\vbox_top:n {
\group_begin: 
\everycr { }
\halign {
\hfil #1 \hfil \cr}
\noalign { \skip_vertical:n { 4.5 pt } \nointerlineskip }
\box_to wd:nn { \l_@@_x_final_dim - \l_@@_x_initial_dim } \cr }
\group_end: }
}
\group_end:

The argument is the text to put under the brace.
\cs_new_protected:Npn \@underbrace_i:n \_#1
\pgftransformshift
\pgfnode { rectangle }
We process the options at package loading

We process the options when the package is loaded (with `\usepackage`) but we recommend to use `\NiceMatrixOptions` instead. We must process these options after the definition of the environment `{NiceMatrix}` because the option `renew-matrix` executes the code `\cs_set_eq:NN \env@matrix \NiceMatrix`. Of course, the command `\NiceMatrix` must be defined before such an instruction is executed.

The boolean `\g_@@_footnotehyper_bool` will indicate if the option `footnotehyper` is used.

```
\bool_new:N \c_@@_footnotehyper_bool
```

The boolean `\c_@@_footnote_bool` will indicate if the option `footnote` is used, but quickly, it will also be set to `true` if the option `footnotehyper` is used.

```
\bool_new:N \c_@@_footnotehyper_bool
\bool_new:n { Unknown-key-for-package }
\keys_define:nn { NiceMatrix / Package }
```

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```
```
You can’t use the option ‘footnote’ because the package footnotehyper has already been loaded.
If you want, you can use the option ‘footnotehyper’ and the footnotes within the environments of nicematrix will be extracted with the tools of the package footnotehyper.\\nIf you go on, the package footnote won’t be loaded.

You can’t use the option ‘footnotehyper’ because the package footnote has already been loaded.
If you want, you can use the option ‘footnote’ and the footnotes within the environments of nicematrix will be extracted with the tools of the package footnotehyper.\\nIf you go on, the package footnotehyper won’t be loaded.

The class beamer has its own system to extract footnotes and that’s why we have nothing to do if beamer is used.

The class beamer has its own system to extract footnotes and that’s why we have nothing to do if beamer is used.

The flag \c_@@_footnote_bool is raised and so, we will only have to test \c_@@_footnote_bool in order to know if we have to insert an environment \{savenotes\}.

Error messages of the package
If the user uses too much columns, the command `@@_error_too_much_cols:` is executed. This command raises an error but try to give the best information to the user in the error message. The command `\seq_if_in:NVTF` is not expandable and that’s why we can’t put it in the error message itself. We have to do the test before the `\@@_fatal:n`:

The following command must not be protected since it’s used in an error message.

For the following message, remind that the test is not done after the construction of the array but in each row. That’s why we have to put `\c@jCol-1` and not `\c@jCol`. 

For the following message, remind that the test is not done after the construction of the array but in each row. That’s why we have to put `\c@jCol-1` and not `\c@jCol`. 

keys-'hlines'-and-'corners'.\}

However, you can go on for this time. This message won't be shown anymore-
in-this-document.
}
\@@_msg_new:nn { last-col-not-used }
{ 
The-key-'last-col'-is-in-force-but-you-have-not-used-that-last-column-
in-your-\@@_full_name_env:. However, you can go on.
}
\@@_msg_new:nn { columns-not-used }
{ 
The-preamble-of-your-\@@_full_name_env:\ announces-\int_use:N \g_@@_static_num_of_col_int \ columns-but-you-use-only-\int_use:N \c@jCol.\ You-can-go-on-but-the-columns-you-did-not-used-won't-be-created.
}
\@@_msg_new:nn { in-first-col }
{ 
You-can't-use-the-command-#1 in-the-first-column-(number-0)-of-the-array.\ You-can't-use-the-command-#1 in-the-first-column-(number-0)-of-the-array.\} 
If-you-go-on,-this-command-will-be-ignored.
}
\@@_msg_new:nn { in-last-col }
{ 
You-can't-use-the-command-#1 in-the-last-column-(exterior)-of-the-array.\} 
If-you-go-on,-this-command-will-be-ignored.
}
\@@_msg_new:nn { in-first-row }
{ 
You-can't-use-the-command-#1 in-the-first-row-(number-0)-of-the-array.\} 
If-you-go-on,-this-command-will-be-ignored.
}
\@@_msg_new:nn { in-last-row }
{ 
You-can't-use-the-command-#1 in-the-last-row-(exterior)-of-the-array.\} 
If-you-go-on,-this-command-will-be-ignored.
}
\@@_msg_new:nn { double-closing-delimiter }
{ 
You-can't-put-a-second-closing-delimiter-"#1"-just-after-a-first-closing-
delimiter.-This-delimiter-will-be-ignored.
}
\@@_msg_new:nn { delimiter-after-opening }
{ 
You-can't-put-a-second-delimiter-"#1"-just-after-a-first-opening-
delimiter.-This-delimiter-will-be-ignored.
}
\@@_msg_new:nn { bad-option-for-line-style }
{ 
Since-you-haven't-loaded-Tikz,-the-only-value-you-can-give-to-'line-style'-is-'standard'.-If-you-go-on,-this-key-will-be-ignored.
}
\@@_msg_new:nn { Unknown-key-for-xdots }
{ 
As-for-now,-there-is-only-three-keys-available-here:-'color','-line-style'-
and-'shorten'-(and-you-try-to-use-\l_keys_key_str').-If-you-go-on,-
this-key-will-be-ignored.
}
\@@_msg_new:nn { Unknown-key-for-rowcolors }
{ 
As-for-now,-there-is-only-two-keys-available-here:-'cols'-and-'respect-blocks'-
(and-you-try-to-use-`\l_keys_key_str').-If-you-go-on,-this-key-will-be-ignored.

\@@_msg_new:nn { ampersand-in-light-syntax }
{ You-can't-use-an-ampersand-(\token_to_str:N &)-to-separate-columns-because-you-have-used-the-key-'light-syntax'.-This-error-is-fatal. }

\@@_msg_new:nn { Construct-too-large }
{ Your-command-\token_to_str:N #1 can't-be-drawn-because-your-matrix-is-too-small.\ If-you-go-on,-this-command-will-be-ignored. }

\@@_msg_new:nn { double-backslash-in-light-syntax }
{ You-can't-use-\token_to_str:N \-to-separate-rows-because-you-have-used-the-key-'light-syntax'.-You-must-use-the-character-`\l_@@_end_of_row_tl'- (set-by-the-key-'end-of-row').-This-error-is-fatal. }

\@@_msg_new:nn { standard-cline-in-document }
{ The-key-'standard-cline'-is-available-only-in-the-preamble.\ If-you-go-on-this-command-will-be-ignored. }

\@@_msg_new:nn { bad-value-for-baseline }
{ The-value-given-to-'baseline'-(\int_use:N \l_tmpa_int)-is-not-valid.\ The-value-must-be-between-\int_use:N \l_@@_first_row_int\ and-\int_use:N \g_@@_row_total_int\ or-equal-to-'t',-'c'-or-'b'.\ If-you-go-on,-a-value-of-1-will-be-used. }

\@@_msg_new:nn { Invalid-name-format }
{ You-can't-give-the-name-`\l_keys_value_tl'-to-a-\token_to_str:N \SubMatrix.\ A-name-must-be-accepted-by-the-regular-expression-^[A-Za-z][A-Za-z0-9]*.\ If-you-go-on,-this-key-will-be-ignored. }

\@@_msg_new:nn { Wrong-line-in-SubMatrix }
{ You-try-to-draw-a-#1-line-of-number-`#2'-in-a-\token_to_str:N \SubMatrix\ of-your-\@@_full_name_env:\ but-that-number-is-not-valid.-If-you-go-on,-it-will-be-ignored. }

\@@_msg_new:nn { impossible-delimiter }
{ It's-impossible-to-draw-the-#1-delimiter-of-your-\token_to_str:N \SubMatrix\ because-all-the-cells-are-empty-in-that-column. \bool_if:NT \l_@@_submatrix_slim_bool
  { \maybe-you-should-try-without-the-key-'slim'. } \}
  If-you-go-on,-this-\token_to_str:N \SubMatrix\ will-be-ignored. }

\@@_msg_new:nn { width-without-X-columns }
{ You-have-used-the-key-'width'-but-you-have-put-no-'X'-column.\ If-you-go-on,-that-key-will-be-ignored. }
\@_msg_new:nn { empty-environment }
{ Your-\@_full_name_env:\ is-empty.-This-error-is-fatal. }
\@_msg_new:nn { Wrong-use-of-v-center }
{ You-should-not-use-the-key-'v-center’-here-because-your-block-is-not-
mono-row.-However,-you-can-go-on. }
\@_msg_new:nn { No-letter-and-no-command }
{ Your-use-of-'custom-line’-is-no-op-since-you-don’t-have-used-the-
key-'letter’-(for-a-letter-for-vertical-rules)-nor-the-key-'command’-
to-draw-horizontal-rules).\}
However,-you-can-go-on. }
\@_msg_new:nn { Forbidden-letter }
{ You-can’t-use-the-letter-‘\l_@@_letter_str’-for-a-customized-line.\}
If-you-go-on,-it-will-be-ignored. }
\@_msg_new:nn { key-width-without-key-tikz }
{ In-‘custom-line’-you-have-used-‘width’-without-‘tikz’.-That’s-not-correct.-
If-you-go-on,-that-key-‘width’-will-be-discarded. }
\@_msg_new:nn { Several-letters }
{ You-must-use-only-one-letter-as-value-for-the-key-‘letter’-(and-
have-used-‘\l_@@_letter_str’).\}
If-you-go-on,-it-will-be-ignored. }
\@_msg_new:nn { Delimiter-with-small }
{ You-can’t-put-a-delimiter-in-the-preamble-of-your-\@_full_name_env:\
because-the-key-‘small’-is-in-force.\}
This-error-is-fatal. }
\@_msg_new:nn { unknown-cell-for-line-in-CodeAfter }
{ Your-command-\token_to_str:N\line\{#1\}\{#2\}-in-the-‘code-after’-
can’t-be-executed-because-a-cell-doesn’t-exist.\}
If-you-go-on-this-command-will-be-ignored. }
\@_msg_new:nn { Duplicate-name-for-SubMatrix }
{ The-name-‘#1’-is-already-used-for-a-\token_to_str:N \SubMatrix
in-this-\@_full_name_env:.\}
If-you-go-on,-this-key-will-be-ignored.\}
For-a-list-of-the-names-already-used,-type-H<return>.}
\seq_use:Nnnn \g_@@_submatrix_names_seq \{ -and- \} \{ , - \} \{ -and- \}. }
\@_msg_new:nn { r-or-l-with-preamble }
{ You-can’t-use-the-key-‘\l_keys_key_str’-in-your-\@_full_name_env:.-
You-must-specify-the-alignment-of-your-columns-with-the-preamble-of-
your-\@_full_name_env:.\}
If-you-go-on,-this-key-will-be-ignored. }
You can't use \texttt{Hdotsfor} in an exterior column of the array. This error is fatal.

#1 is an incorrect specification for a corner (in the keys 'corners' and 'except-corners'). The available values are: NW, SW, NE and SE. If you go on, this specification of corner will be ignored.

\l_keys_key_str space is an incorrect specification for a border (in the key 'borders' of the command \texttt{\Block}). The available values are: left, right, top and bottom (and you can also use the key 'tikz'). If you load the LaTeX package 'tikz', you can also use the key 'tikz'.

You can't use the key 'tikz' for the command \texttt{\Block} because you have not loaded Tikz. If you go on, this key will be ignored.

You try to draw a block in the cell #1-#2 of your matrix but the matrix is too small for that block. You should add some ampersands (&) at the end of the first row of your \texttt{\@@_full_name_env:}. If you go on, this block and maybe others will be ignored.

The column type '#1' in your \texttt{\@@_full_name_env:}
This error is fatal.

The column type ':' in your \@@_full_name_env: is unknown. If you want to use ':' of 'arydshln', you should load that package. If you want a dotted line of 'nicematrix', you should use '{\l_@@_letter_for_dotted_lines_str}'.

This error is fatal.

You can't use the command \token_to_str:N \tabularnote because you haven't loaded 'booktabs'. If you go on, this command will be ignored.

You can't use the key 'borders' of the command \token_to_str:N \Block because the option 'rounded-corners' is in force with a non-zero value. If you go on, this key will be ignored.

You can't use the key 'tabular/bottomrule' because you haven't loaded 'booktabs'. If you go on, this key will be ignored.

You can't use the command \token_to_str:N \tabularnote because you haven't loaded 'enumitem'. If you go on, this command will be ignored.

You have used the key 'tikz' in a key 'borders' (of a command \token_to_str:N \Block) but Tikz is not loaded. You can go on but you will have another error if you actually use that custom line.

You have used the key 'tikz' in the definition of a customized line (with 'custom-line') but Tikz is not loaded. You can go on but you will have another error if you actually use that custom line.

You have used the key 'tikz' in the definition of a customized line (with 'custom-line') but Tikz is not loaded. You can go on but you will have another error if you actually use that custom line.

In a 'custom-line', you have used both 'tikz' and 'color', which is forbidden (you should use 'color' inside the key 'tikz'). If you go on, the key 'color' will be discarded.

You have used 'last-row=\int_use:N \l_@@_last_row_int' but your \@@_full_name_env: seems to have \int_use:N \c@iRow rows. -
If you go on, the value of `\int_use:N \c@iRow \` will be used for last row. You can avoid this problem by using `last-row` without value (more compilations might be necessary).

```latex
\@@_msg_new:nn { Yet-in-env }
\{ Environments-of-nicematrix-can't-be-nested.\ This-error-is-fatal. }\n\@@_msg_new:nn { Outside-math-mode }
\{ The-\@@_full_name_env:\ can-be-used-only-in-math-mode-
(\and-not-in-``\operator@font token_to_str:N \vcenter).\ This-error-is-fatal. }\n\@@_msg_new:nn { One-letter-allowed }
\{ The-value-of-key-``\l_keys_key_str'\ must-be-of-length-1.\}
If-you-go-on,-it-will-be-ignored.
\}
\@@_msg_new:nn { varwidth-not-loaded }
\{ You-can't-use-the-column-type-'V'-because-'varwidth'-is-not-
loaded.\ If-you-go-on,-your-column-will-behave-like-'p'.
\}
\@@_msg_new:nn { Unknown-key-for-Block }
\{ The-key-``\l_keys_key_str'\-is-unknown-for-the-command-``token_to_str:N \Block.\ If-you-go-on,-it-will-be-ignored. \For-a-list-of-the-available-keys,-type-H<return>. \}
\{ The-available-keys-are-(in-alphabetic-order):-b,-borders,-c,-draw,-fill,-
hlines,-hvlines,-l,-line-width,-name,-rounded-corners,-r,-respect-arraysstretch,-
-t,-tikz-and-vlines. \}
\@@_msg_new:nn { Version-of-siunitx-too-old }
\{ You-can't-use-'S'-columns-because-your-version-of-'siunitx' -is-too-old.-You-need-at-least-v3.0.\}
This-error-is-fatal.
\}
\@@_msg_new:nn { Unknown-key-for-Brace }
\{ The-key-``\l_keys_key_str'\-is-unknown-for-the-commands-``\operator@font token_to_str:N \UnderBrace\ and-``\operator@font token_to_str:N \OverBrace.\ If-you-go-on,-it-will-be-ignored. \For-a-list-of-the-available-keys,-type-H<return>. \}
\{ The-available-keys-are-(in-alphabetic-order):-color,-left-shorten,-
right-shorten,-shorten-(which-fixes-both-left-shorten-and-
right-shorten)-and-yshift. \}
\@@_msg_new:nn { Unknown-key-for-CodeAfter }
\{ The-key-``\l_keys_key_str'\-is-unknown.\}
If-you-go-on,-it-will-be-ignored. \For-a-list-of-the-available-keys-in-``\operator@font token_to_str:N \CodeAfter,-type-H<return>. \}
\}
The available keys are (in alphabetic order):

delimiters/color, -
rules - (with the subkeys 'color' and 'width'), -
sub-matrix - (several subkeys) -
and-xdots - (several subkeys).

The latter is for the command \token_to_str:N \line.

\@@_msg_new:nnn { Unknown key for SubMatrix }
{
The key \l_keys_key_str is unknown.\"
If you go on, this key will be ignored. \"
For a list of the available keys in \token_to_str:N \SubMatrix, \type-H<return>.
}
{
The available keys are (in alphabetic order):
'delimiters/color', -
'extra-height', -
'hlines', -
'hvlines', -
'left-xshift', -
'name', -
'right-xshift', -
'rules' - (with the subkeys 'color' and 'width'), -
'slim', -
'vlines' and 'xshift' - (which sets both 'left-xshift' -
and 'right-xshift'). \"

\@@_msg_new:nnn { Unknown key for notes }
{
The key \l_keys_key_str is unknown.\"
If you go on, it will be ignored. \"
For a list of the available keys about notes, \type-H<return>.
}
{
The available keys are (in alphabetic order):
'bottomrule', -
'code-after', -
'code-before', -
enumitem-keys, -
enumitem-keys-para, -
'para', -
'label-in-list', -
'label-in-tabular- and-
'style.

\@@_msg_new:nnn { Unknown key for RowStyle }
{
The key \l_keys_key_str is unknown for the command\token_to_str:N \RowStyle. \"
If you go on, it will be ignored. \"
For a list of the available keys, \type-H<return>.
}
{
The available keys are (in alphabetic order):
'bold', -
'cell-space-top-limit', -
'cell-space-bottom-limit', -
'cell-space-limits', -
'color', -
'nb-rows' - and-
'rowcolor'.

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The key '\l_keys_key_str' is unknown for the command \token_to_str:N \NiceMatrixOptions. \If\you\go\on, it will be ignored. \For a list of the *principal* available keys, type H <return>.

The available keys are (in alphabetic order):
- allow-duplicate-names,
- cell-space-bottom-limit,
- cell-space-limits,
- cell-space-top-limit,
- code-for-first-col,
- code-for-first-row,
- code-for-last-col,
- code-for-last-row,
- corners,
- custom-key,
- create-extra-nodes,
- create-medium-nodes,
- create-large-nodes,
- delimiters-(several-subkeys),
- end-of-row,
- first-col,
- first-row,
- blines,
- hlines,
- last-col,
- last-row,
- left-margin,
- letter-for-dotted-lines,
- light-syntax,
- notes-(several-subkeys),
- nullify-dots,
- renew-dots,
- renew-matrix,
- respect-arraystretch,
- right-margin,
- rules-(with-the-subkeys-"color"-and-"width"),
- small,
- sub-matrix-(several-subkeys),
- vlines,
- xdots-(several-subkeys).

The key '\l_keys_key_str' is unknown for the environment \{NiceArray\}. \If\you\go\on, it will be ignored. \For a list of the *principal* available keys, type H <return>.

The available keys are (in alphabetic order):
- b,
- baseline,
- c,
- cell-space-bottom-limit,
- cell-space-limits,
- cell-space-top-limit,
- code-after,
- code-for-first-col,
- code-for-first-row,
This error message is used for the set of keys \texttt{NiceMatrix/NiceMatrix} and \texttt{NiceMatrix/pNiceArray} (but not by \texttt{NiceMatrix/NiceArray} because, for this set of keys, there is also the keys \texttt{t, c and b}).

\begin{verbatim}
\@@_msg_new:nnn { Unknown-key-for-NiceMatrix }
{
  The-key-\texttt{\l_keys_key_str}-is-unknown-for-the-
  \@@_full_name_env:. \"
  If-you-go-on,-it-will-be-ignored. \"
  For-a-list-of-the-\texttt{\textbf{principal}}-available-keys,-type-H<return>.
}
\end{verbatim}

\begin{verbatim}
{ The-available-keys-are-(in-alphabetic-order):-
  b,-
  baseline,-
  c,-
  cell-space-bottom-limit,-
  cell-space-limits,-
  cell-space-top-limit,-
  code-after,-
  code-for-first-col,-
  code-for-first-row,-
  code-for-last-col,-
  code-for-last-row,-
  colortbl-like,-
  columns-width,-
  corners,-
  create-extra-nodes,-
  create-medium-nodes,-
  create-large-nodes,-
  delimiters/color,-
  extra-left-margin,-
  extra-right-margin,-
  first-col,-
  first-row,-
  hlines,-
  hvlines,-
  last-col,-
  last-row,-
  left-margin,-
  light-syntax,-
  name,-
  notes/bottomrule,-
  notes/para,-
  nullify-dots,-
  renew-dots,-
  respect-arraystretch,-
  right-margin,-
  rules-(with-the-subkeys-'color'-and-'width'),-
  small,-
  t,-
  tabularnote,-
  vlines,-
  xdots/color,-
  xdots/shorten-and-
  xdots/line-style.
}\end{verbatim}
delimiters-(several-subkeys),-
extra-left-margin,-
extra-right-margin,-
first-col,-
first-row,-
hlines,-
hvlines,-
l,-
last-col,-
last-row,-
left-margin,-
light-syntax,-
name,-
nullify-dots,-
r,-
renew-dots,-
respect-arraystretch,-
right-margin,-
rules-(with-the-subkeys-‘color’-and-‘width’),-
small,-
t,-
vlines,-
xdots/color,-
xdots/shorten-and-
xdots/line-style.

\@_msg_new:nnn { Unknown-key-for-NiceTabular }
{
  The-key-‘\l_keys_key_str’-is-unknown-for-the-environment-
  \{NiceTabular\}. \}
  If-you-go-on,-it-will-be-ignored. \}
  For-a-list-of-the-\textbf{principal}-available-keys,-type-H<return>.
}

{ The-available-keys-are-(in-alphabetic-order):-
  b,-
  baseline,-
  c,-
  cell-space-bottom-limit,-
  cell-space-limits,-
  cell-space-top-limit,-
  code-after,-
  code-for-first-col,-
  code-for-first-row,-
  code-for-last-col,-
  code-for-last-row,-
  colortbl-like,-
  columns-width,-
  corners,-
  custom-line,-
  create-extra-nodes,-
  create-medium-nodes,-
  create-large-nodes,-
  extra-left-margin,-
  extra-right-margin,-
  first-col,-
  first-row,-
  hlines,-
  hvlines,-
  last-col,-
  last-row,-
  left-margin,-
  light-syntax,-
19  History

The successive versions of the file nicematrix.sty provided by TeXLive are available on the SVN server of TeXLive:
https://www.tug.org/svn/texlive/trunk/Master/texmf-dist/tex/latex/nicematrix/nicematrix.sty

Changes between versions 1.0 and 1.1

The dotted lines are no longer drawn with Tikz nodes but with Tikz circles (for efficiency).
Modification of the code which is now twice faster.

Changes between versions 1.1 and 1.2

New environment \{NiceArray\} with column types L, C and R.

Changes between version 1.2 and 1.3

New environment \{pNiceArrayC\} and its variants.
Correction of a bug in the definition of \{BNiceMatrix\}, \{vNiceMatrix\} and \{VNiceMatrix\} (in fact, it was a typo).
Options are now available locally in \{pNiceMatrix\} and its variants.
The names of the options are changed. The old names were names in “camel style”.

Changes between version 1.3 and 1.4

The column types \texttt{w} and \texttt{W} can now be used in the environments \{\texttt{NiceArray}\}, \{\texttt{pNiceArrayC}\} and its variants with the same meaning as in the package \texttt{array}.
New option \texttt{columns-width} to fix the same width for all the columns of the array.

Changes between version 1.4 and 2.0

The versions 1.0 to 1.4 of \texttt{nicematrix} were focused on the continuous dotted lines whereas the version 2.0 of \texttt{nicematrix} provides different features to improve the typesetting of mathematical matrices.

Changes between version 2.0 and 2.1

New implementation of the environment \{\texttt{pNiceArrayRC}\}. With this new implementation, there is no restriction on the width of the columns.
The package \texttt{nicematrix} no longer loads \texttt{mathtools} but only \texttt{amsmath}.
Creation of “medium nodes” and “large nodes”.

Changes between version 2.1 and 2.1.1

Small corrections: for example, the option \texttt{code-for-first-row} is now available in the command \texttt{\NiceMatrixOptions}.
Following a discussion on \TeX\ StackExchange\footnote{\url{tex.stackexchange.com/questions/450841/tikz-externalize-and-nicematrix-package}}, Tikz externalization is now deactivated in the environments of the package \texttt{nicematrix}.

Changes between version 2.1.2 and 2.1.3

When searching the end of a dotted line from a command like \texttt{\Cdots} issued in the “main matrix” (not in the exterior column), the cells in the exterior column are considered as outside the matrix.
That means that it’s possible to do the following matrix with only a \texttt{\Cdots} command (and a single \texttt{\Vdots}).

\[
C_j \begin{pmatrix}
0 & \vdots & 0 \\
0 & \ddots & \ddots \\
0 & 0 & L_i
\end{pmatrix}
\]

Changes between version 2.1.3 and 2.1.4

Replacement of some options \texttt{O \{ \}} in commands and environments defined with \texttt{xparse} by \texttt{! O \{ \}} (because a recent version of \texttt{xparse} introduced the specifier \texttt{!} and modified the default behaviour of the last optional arguments).
See \url{www.texdev.net/2018/04/21/xparse-optional-arguments-at-the-end}

Changes between version 2.1.4 and 2.1.5

Compatibility with the classes \texttt{revtex4-1} and \texttt{revtex4-2}.
Option \texttt{allow-duplicate-names}.

\footnotetext[72]{\texttt{tex.stackexchange.com/questions/450841/tikz-externalize-and-nicematrix-package}}

\footnotetext[73]{Before this version, there was an error when using \texttt{nicematrix} with Tikz externalization. In any case, it’s not possible to externalize the Tikz elements constructed by \texttt{nicematrix} because they use the options \texttt{overlay} and \texttt{remember picture}.}
Changes between version 2.1.5 and 2.2

Possibility to draw horizontal dotted lines to separate rows with the command \hdottedline (similar to the classical command \hline and the command \hdashline of arydshln).
Possibility to draw vertical dotted lines to separate columns with the specifier “;” in the preamble (similar to the classical specifier “|” and the specifier “;” of arydshln).

Changes between version 2.2 and 2.2.1

Improvement of the vertical dotted lines drawn by the specifier “;” in the preamble.
Modification of the position of the dotted lines drawn by \hdottedline.

Changes between version 2.2.1 and 2.3

Compatibility with the column type S of siunitx.
Option hlines.

Changes between version 2.3 and 3.0

Modification of \Hdotsfor. Now \Hdotsfor erases the \vlines (of “|”) as \hdotsfor does.
Composition of exterior rows and columns on the four sides of the matrix (and not only on two sides) with the options first-row, last-row, first-col and last-col.

Changes between version 3.0 and 3.1

Command \Block to draw block matrices.
Error message when the user gives an incorrect value for last-row.
A dotted line can no longer cross another dotted line (excepted the dotted lines drawn by \cdottedline, the symbol “;” (in the preamble of the array) and \line in code-after).
The starred versions of \Cdots, \Ldots, etc. are now deprecated because, with the new implementation, they become pointless. These starred versions are no longer documented.
The vertical rules in the matrices (drawn by “|”) are now compatible with the color fixed by colortbl.
Correction of a bug: it was not possible to use the colon “;” in the preamble of an array when pdflatex was used with french-babel (because french-babel activates the colon in the beginning of the document).

Changes between version 3.1 and 3.2 (and 3.2a)

Option small.

Changes between version 3.2 and 3.3

The options first-row, last-row, first-col and last-col are now available in the environments \NiceMatrix, \pNiceMatrix, \bNiceMatrix, etc.
The option columns-width=auto doesn’t need any more a second compilation.
The options renew-dots, renew-matrix and transparent are now available as package options (as said in the documentation).
The previous version of nicematrix was incompatible with a recent version of expl3 (released 2019/09/30). This version is compatible.
Changes between version 3.3 and 3.4

Following a discussion on TeX StackExchange\textsuperscript{74}, optimization of Tikz externalization is disabled in the environments of nicematrix when the class standalone or the package standalone is used.

Changes between version 3.4 and 3.5

Correction on a bug on the two previous versions where the code-after was not executed.

Changes between version 3.5 and 3.6

LaTeX counters iRow and jCol available in the cells of the array.

Addition of \normalbaselines before the construction of the array: in environments like \{align\} of amsmath the value of \baselineskip is changed and if the options first-row and last-row were used in an environment of nicematrix, the position of the delimiters was wrong.

A warning is written in the .log file if an obsolete environment is used.

There is no longer artificial errors Duplicate-name in the environments of amsmath.

Changes between version 3.6 and 3.7

The four “corners” of the matrix are correctly protected against the four codes: code-for-first-col, code-for-last-col, code-for-first-row and code-for-last-row.

New command \pAutoNiceMatrix and its variants (suggestion of Christophe Bal).

Changes between version 3.7 and 3.8

New programmation for the command \Block when the block has only one row. With this programmation, the vertical rules drawn by the specifier “|” at the end of the block is actually drawn. In previous versions, they were not because the block of one row was constructed with \multicolumn.

An error is raised when an obsolete environment is used.

Changes between version 3.8 and 3.9

New commands \NiceMatrixLastEnv and \OnlyMainNiceMatrix.

New options create-medium-nodes and create-large-nodes.

Changes between version 3.9 and 3.10

New option light-syntax (and end-of-row).

New option dotted-lines-margin for fine tuning of the dotted lines.

Changes between versions 3.10 and 3.11

Correction of a bug linked to first-row and last-row.

\textsuperscript{74}cf. tex.stackexchange.com/questions/510841/nicematrix-and-tikz-external-optimize
Changes between versions 3.11 and 3.12

Command \rotate in the cells of the array.
Options vlines, hlines and hvlines.
Option baseline pour \{NiceArray\} (not for the other environments).
The name of the Tikz nodes created by the command \Block has changed: when the command has been issued in the cell i-j, the name is i-j-block and, if the creation of the “medium nodes” is required, a node i-j-block-medium is created.
If the user tries to use more columns than allowed by its environment, an error is raised by nicematrix (instead of a low-level error).
The package must be loaded with the option obsolete-environments if we want to use the deprecated environments.

Changes between versions 3.12 and 3.13

The behaviour of the command \rotate is improved when used in the “last row”.
The option dotted-lines-margin has been renamed in xdots/shorten and the options xdots/color and xdots/line-style have been added for a complete customisation of the dotted lines.
In the environments without preamble (\{NiceMatrix\}, \{pNiceMatrix\}, etc.), it’s possible to use the options l (==L) or r (==R) to specify the type of the columns.
The starred versions of the commands \Cdots, \Ldots, \Vdots, \Ddots and \Iddots are deprecated since the version 3.1 of nicematrix. Now, one should load nicematrix with the option starred-commands to avoid an error at the compilation.
The code of nicematrix no longer uses Tikz but only PGF. By default, Tikz is not loaded by nicematrix.

Changes between versions 3.13 and 3.14

Correction of a bug (question 60761504 onstackoverflow).
Better error messages when the user uses & or \ when light-syntax is in force.

Changes between versions 3.14 and 3.15

It’s possible to put labels on the dotted lines drawn by \Ldots, \Cdots, \Vdots, \Ddots, \Iddots, \Hdots for and the command \line in the code-after with the tokens _ and ^.
The option baseline is now available in all the environments of nicematrix. Before, it was available only in \{NiceArray\}.
New keyword \CodeAfter (in the environments of nicematrix).

Changes between versions 3.15 and 4.0

New environment \{NiceTabular\}
Commands to color cells, rows and columns with a perfect result in the PDF.

Changes between versions 4.0 and 4.1

New keys cell-space-top-limit and cell-space-bottom-limit
New command \diagbox
The key hvline don’t draw rules in the blocks (commands \Block) and in the virtual blocks corresponding to the dotted lines.

Changes between versions 4.1 and 4.2

It’s now possible to write \begin{pNiceMatrix}a&b\\c&d\end{pNiceMatrix}^2 with the expected result.
Changes between versions 4.2 and 4.3

The horizontal centering of the content of a Block is correct even when an instruction such as \qquad is used in the preamble of the array. It’s now possible to use the command \Block in the “last row”.

Changes between versions 4.3 and 4.4

New key hvlines-except-corners.

Changes between versions 4.4 and 5.0

Use of the standard column types l, c and r instead of L, C and R. It’s now possible to use the command diagbox in a Block. Command \tabularnote

Changes between versions 5.0 and 5.1

The vertical rules specified by | in the preamble are not broken by \hline (and other). Environment \NiceTabular*
Command \Vdotsfor similar to \Hdotsfor
The variable \g_nicematrix_code_after_tl is now public.

Changes between versions 5.1 and 5.2

The vertical rules specified by | or || in the preamble respect the blocks. Key respect-blocks for \rowcolors (with a s) in the code-before.
The variable \g_nicematrix_code_before_tl is now public.
The key baseline may take in as value an expression of the form line-i to align the \hline in the row i.
The key hvlines-except-corners may take in as value a list of corners (eg: NW,SE).

Changes between versions 5.2 and 5.3

Keys c, r and l for the command Block. It’s possible to use the key draw-first with \Ddots and \Iddots to specify which dotted line will be drawn first (the other lines will be drawn parallel to that one if parallelization is activated).

Changes between versions 5.3 and 5.4

Key tabularnote.
Different behaviour for the mono-column blocks.

Changes between versions 5.4 and 5.5

The user must never put \omit before \CodeAfter.
Correction of a bug: the tabular notes \tabularnotes were not composed when present in a block (except a mono-column block).

Changes between versions 5.5 and 5.6

Different behaviour for the mono-row blocks.
New command \NotEmpty.
Changes between versions 5.6 and 5.7

New key delimiters-color
Keys fill, draw and line-width for the command \Block.

Changes between versions 5.7 and 5.8

Keys cols and restart of the command \rowcolors in the code-before.
Modification of the behaviour of \ in the columns of type p, m or b (for a behaviour similar to the environments of array).
Better error messages for the command \Block.

Changes between versions 5.8 and 5.9

Correction of a bug: in the previous versions, it was not possible to use the key line-style for the continuous dotted lines when the Tikz library babel was loaded.
New key cell-space-limits.

Changes between versions 5.9 and 5.10

New command \SubMatrix available in the \CodeAfter.
It’s possible to provide options (between brackets) to the keyword \CodeAfter.
A (non fatal) error is raised when the key transparent, which is deprecated, is used.

Changes between versions 5.10 and 5.11

It’s now possible, in the code-before and in the \CodeAfter, to use the syntax |(i-|j) for the Tikz node at the intersection of the (potential) horizontal rule number i and the (potential) vertical rule number j.

Changes between versions 5.11 and 5.12

Keywords \CodeBefore and \Body (alternative syntax to the key code-before).
New key delimiters/max-width.
New keys hlines, vlines and hvlines for the command \SubMatrix in the \CodeAfter.
New key rounded-corners for the command \Block.

Changes between versions 5.12 and 5.13

New command \arraycolor in the \CodeBefore (with its key except-corners).
New key borders for the command \Block.
New command \Hline (for horizontal rules not drawn in the blocks).
The keys vlines and hlines takes in as value a (comma-separated) list of numbers (for the rules to draw).

Changes between versions 5.13 and 5.14

Nodes of the form (1.5), (2.5), (3.5), etc.
Keys t and b for the command \Block.
Key corners.
Changes between versions 5.14 and 5.15

Key `hvlines` for the command `\Block`. The commands provided by `nicematrix` to color cells, rows and columns don’t color the cells which are in the “corners” (when the key `corner` is used). It’s now possible to specify delimiters for submatrices in the preamble of an environment. The version 5.15b is compatible with the version 3.0+ of `siunitx` (previous versions were not).

Changes between versions 5.15 and 5.16

It’s now possible to use the cells corresponding to the contents of the nodes (of the form `i-j`) in the `\CodeBefore` when the key `create-cell-nodes` of that `\CodeBefore` is used. The medium and the large nodes are also available if the corresponding keys are used.

Changes between versions 5.16 and 5.17

The key `define-L-C-R` (only available at load-time) now raises a (non fatal) error. Keys `L`, `C` and `R` for the command `\Block`. Key `hvlines-except-borders`. It’s now possible to use a key `l`, `r` or `c` with the command `pAutoNiceMatrix` (and the similar ones).

Changes between versions 5.17 and 5.18

New command `\RowStyle`

Changes between versions 5.18 and 5.19

New key `tikz` for the command `\Block`.

Changes between versions 5.19 and 6.0

Columns `X` and environment `{NiceTabularX}`. Command `\rowlistcolors` available in the `\CodeBefore`. In columns with fixed width, the blocks are composed as paragraphs (wrapping of the lines). The key `define-L-C-R` has been deleted.

Changes between versions 6.0 and 6.1

Better computation of the widths of the `X` columns. Key `\color` for the command `\RowStyle`.

Changes between versions 6.1 and 6.2

Better compatibility with the classes `revtex4-1` and `revtex4-2`. Key `vlines-in-sub-matrix`.

Changes between versions 6.2 and 6.3

Keys `nb-rows`, `rowcolor` and `bold` for the command `\RowStyle` Key `name` for the command `\Block`. Support for the columns `V` of `varwidth`. 

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Changes between versions 6.3 and 6.4

New commands \UnderBrace and \OverBrace in the \CodeAfter.
Correction of a bug of the key baseline (cf. question 623258 on TeX StackExchange).
Correction of a bug with the columns V of \varwidth.
Correction of a bug: the use of \dottedline and in the preamble of the array (of another letter specified by letter-for-dotted-lines) was incompatible with the key xdots/line-style.

Changes between versions 6.4 and 6.5

Key custom-line in \NiceMatrixOptions.
Key respect-arraystretch.

Changes between version 6.5 and 6.6

Keys tikz and width in custom-line.

Changes between version 6.6 and 6.7

Key color for \OverBrace and \UnderBrace in the \CodeAfter
Key tikz in the key borders of a command \Block

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The italic numbers denote the pages where the corresponding entry is described, numbers underlined point to the definition, all others indicate the places where it is used.

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