The package EASYMAT

Enrico Bertolazzi

Department of Mechanics and Structures Engineering
University of Trento
via Mesiano 77, I – 38050 Trento, Italy

enrico.bertolazzi@ing.unitn.it

November 13, 2017

Abstract

The EASYMAT package is a macro package for supporting block matrices having equal column widths or equal rows heights or both, and supporting various kinds of rules (lines) between rows and columns. The package is based on an array/tabular-like syntax.

Contents

1   Some examples with EASYMAT

The pachage is loaded by means the usual way:

```
\documentclass{article}
.
.
\usepackage[thinlines,thicklines]{easymat}
.
.
```

The options `thinlines` and `thicklines` are self explanatory. EASYMAT provides the MAT environment which is a simple re-implementation of the array/tabular environment, with some limitation and some additional features. The syntax is

```
\begin{MAT}'(eq)''[ex]''{cc...c}'
  a & b & ... & n \\
  ...
\end{MAT}
```

or

```
\begin{MAT}'(eq,mx,my)''[ex,MX,MY]''{cc...c}'
   a & b & ... & n \\
   ...
\end{MAT}
```

- **(eq)** or **(eq,mx,my)**. By **eq** you can balance the rows or the column or both, as shown in this table:

Table 1.

value of **eq**	effect
@	no balancing
r	equal rows heights
c	equal column widths
b	equal rows heights and equal column widths
e	equal rows heights and column widths

By **mx** and **my** you can modify the minimum size of the box in the MAT environment. This must be a valid measure e.g. **2pt**. This is useful in writing matrices an vectors.

- **[ex]** or **[ex,MX,MY]**. By **ex** you can specify the amount of extra space around the item in the MAT environment. The default is **2pt**. By **MX** and **MY** you can modify the minimum size of the whole table in the TAB environment. This must be a valid measure e.g. **10cm**.

- The `'{cc...c}'` is the definition of the columns and their alignment. The possible alignment for the columns are:

<div align="center">

Table 2.

c	centering
l	flush left
r	flush right

</div>

IMPORTANT: The package can manage matrices with a maximum of **30** rows by **30** columns.

It is possible to produce rules among columns or rows as this example shows:

```
\[ \begin{MAT}(b){|l:cr|}
    \first-
    \aligntop
    1 & 1 & 1 \\;
    1 & \frac{111}{222} & 1 \\
    \alignbottom
    1 & 1 & 1 \\-
  \end{MAT}
  \qquad
  \begin{MAT}(b){|r:cl|}
    \first-
    \alignbottom
    1 & 1 & 1 \\;
    1 & \frac{111}{222} & 1 \\
    \aligntop
    1 & 1 & 1 \\-
  \end{MAT}
\]
```

$$
\begin{array}{|l:cr|}
\hline
1 & 1 & 1 \\
\hdashline
1 & \dfrac{111}{222} & 1 \\
1 & 1 & 1 \\
\hline
\end{array}
\qquad
\begin{array}{|r:cl|}
\hline
1 & 1 & 1 \\
1 & \dfrac{111}{222} & 1 \\
1 & 1 & 1 \\
\hline
\end{array}
$$

The command \first is used to produce the first top rule. The various separation rules are defined by a character code immediately after the command ****. The available rules for the rows and columns are

Table 3.

nothing	no rule
|	solid line (or **–** for the rows)
:	dash line
;	dot-dash line
.	dotted line
0	solid line with size **1/5** of normal line
1	solid line with size **1/4** of normal line
2	solid line with size **1/3** of normal line
3	solid line with size **1/2** of normal line
4	equivalent to **|**
5	solid line with size **2** times of normal line
6	solid line with size **3** times of normal line
7	solid line with size **4** times of normal line
8	solid line with size **5** times of normal line
9	solid line with size **6** times of normal line

IMPORTANT: each row **must** end with **** otherwise an error is produced.

The main feature of the MAT environment is that it is reentrant as shown below:

```
\[ \begin{MAT}{0c.c9}
    \first-
    1 & 2 \\. 3 &
    \begin{MAT}{c:c}
        a & b \\.
        c & d \\
    \end{MAT} \\-
  \end{MAT}
\]
```


IMPORTANT: The package can manage maximum reentrance of **8** levels.

2   Some example with balancing

The effect of various balancing is seen below:

```
\[
   \begin{MAT}{|c|c|c|}
       \first-
       1 & 22 & 333 \\-
       \frac{1}{2} & 1 & 1 \\-
       \frac{1}{\frac{1}{2}} & 1 & 1 \\-
   \end{MAT}
   \quad
   \begin{MAT}(r){|c|c|c|}
       \first-
       1 & 22 & 333 \\-
       \frac{1}{2} & 1 & 1 \\-
       \frac{1}{\frac{1}{2}} & 1 & 1 \\-
   \end{MAT}
   \quad
   \begin{MAT}(c){|c|c|c|}
       \first-
       1 & 22 & 333 \\-
       \frac{1}{2} & 1 & 1 \\-
       \frac{1}{\frac{1}{2}} & 1 & 1 \\-
   \end{MAT}
\]
```

$$
\begin{array}{|c|c|c|}
\hline
1 & 22 & 333 \\\hline
\frac{1}{2} & 1 & 1 \\\hline
\frac{1}{\frac{1}{2}} & 1 & 1 \\\hline
\end{array}
\quad
\begin{array}{|c|c|c|}
\hline
1 & 22 & 333 \\\hline
\frac{1}{2} & 1 & 1 \\\hline
\frac{1}{\frac{1}{2}} & 1 & 1 \\\hline
\end{array}
\quad
\begin{array}{|c|c|c|}
\hline
1 & 22 & 333 \\\hline
\frac{1}{2} & 1 & 1 \\\hline
\frac{1}{\frac{1}{2}} & 1 & 1 \\\hline
\end{array}
$$

and this is another example

```
\[
   \begin{MAT}(b){|c|c|c|}
       \first-
       1 & 22 & 333 \\-
       \frac{1}{2} & 1 & 1 \\-
       \frac{1}{\frac{1}{2}} & 1 & 1 \\-
   \end{MAT}
   \quad
   \begin{MAT}(e){|c|c|c|}
       \first-
       1 & 22 & 333 \\-
       \frac{1}{2} & 1 & 1 \\-
       \frac{1}{\frac{1}{2}} & 1 & 1 \\-
   \end{MAT}
\]
```

1	22	333
$\frac{1}{2}$	1	1
$\frac{1}{\frac{1}{2}}$	1	1

1	22	333
$\frac{1}{2}$	1	1
$\frac{1}{\frac{1}{2}}$	1	1

3 An example with minimal size setting

It is possible to specify the minimal size of the item inside a MAT environment:

```
\[ \left[
   \begin{MAT}(@,50pt,20pt){c.c}
       1 & 22 \\.
       \frac{1}{2} & 1 \\
   \end{MAT}
\right] \]
```

$$\left[\begin{array}{c:c} 1 & 22 \\ \hdashline \frac{1}{2} & 1 \end{array} \right]$$

It is possible to specify the total minimal size of a MAT environment, as shown here

```
\[ \left[
   \begin{MAT}(e)[2pt,3cm,3cm]{c.c}
      1 & 22 \\.
      \frac{1}{2} & 1 \\
   \end{MAT}
   \right] \times \left[
   \begin{MAT}(e)[2pt,0pt,3cm]{c}
      x \\. y \\
   \end{MAT}
   \right] = \left[
   \begin{MAT}(e)[2pt,1cm,3cm]{c}
      2 \\. \frac{3}{2} \\
   \end{MAT}
   \right]
\]
```

$$
\left[
\begin{array}{c:c}
1 & 22 \\ \hdashline
\dfrac{1}{2} & 1
\end{array}
\right]
\times
\left[
\begin{array}{c}
x \\ \hdashline
y
\end{array}
\right]
=
\left[
\begin{array}{c}
2 \\ \hdashline
\dfrac{3}{2}
\end{array}
\right]
$$

4 An example with various size rules

This example shows the use of various size rule in MAT environment:

```
\[ \begin{MAT}(e,10pt,10pt){0c1c2c3c4c5c6c7c8c9}
   \first0
   * & * & * & * & * & * & * & * & * \\1
   * & * & * & * & * & * & * & * & * \\2
   * & * & * & * & * & * & * & * & * \\3
   * & * & * & * & * & * & * & * & * \\4
   * & * & * & * & * & * & * & * & * \\5
   * & * & * & * & * & * & * & * & * \\6
   * & * & * & * & * & * & * & * & * \\7
   * & * & * & * & * & * & * & * & * \\8
   * & * & * & * & * & * & * & * & * \\9 \end{MAT} \]
```


5 The \addpath command

Is is possible to add paths to the MAT environment. The syntax is the following

```
\begin{MAT} ...... {...}
   ...... \\
   ...... \\
   ...... \\
   \addpath{('x','y','rule')'path'}
   .
   .
   \addpath{('x','y','rule')'path'}
\end{MAT}
```

where

x and y are the integer coordinates of the starting corner. The down left corner is at $x = 0$, $y = 0$.

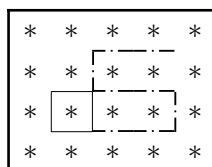**rule** is the code of a valid rule as described in table 3.

path is a string describing the path. Each letter of the string is a movement coded as follows:

Table 4.

letter	direction
l	left movement and drawing
r	right movement and drawing
u	up movement and drawing
d	down movement and drawing

The following example shows the use of \addpath,

```
\[ \begin{MAT}[5pt]{|ccccc|}
    \first-
    * & * & * & * & * \\
    * & * & * & * & * \\
    * & * & * & * & * \\
    * & * & * & * & *
    \addpath{(1,1,0)ruld}
    \addpath{(4,3,;)lldrrdll} \\-
\end{MAT} \]
```


IMPORTANT: The commands \addpath must be put **in front of** the last **** command.

This is another example

```
\[ \left(\begin{MAT}[5pt]{cccccc}
    1 & * & * & * & * & * \\
    0 & 11 & * & * & * & * \\
    0 & 0 & 111 & * & * & * \\
    0 & 0 & 0 & 1111 & * & * \\
    0 & 0 & 0 & 0 & 11111 & * \\
    0 & 0 & 0 & 0 & 0 & 11111
    \addpath{(0,5,.)rdrdrdrdrd} \\
  \end{MAT}\right) \]
```

$$\left(\begin{array}{cccccc}
1 & * & * & * & * & * \\
0 & 11 & * & * & * & * \\
0 & 0 & 111 & * & * & * \\
0 & 0 & 0 & 1111 & * & * \\
0 & 0 & 0 & 0 & 11111 & * \\
0 & 0 & 0 & 0 & 0 & 11111
\end{array}\right)$$

6   An example with reentrance

This final example shows a slightly more complex (reentrant) definition in which the MAT environment is used:

```
\def\rec(#1){\expandafter\recurse#1-\end}
\def\recurse#1#2\end{%
 \if\noexpand#1-\def\next##1##2{}%
 \else\let\next=\recursea\fi%
 \expandafter\next{#1}{#2}%
}%
\def\recursea#1#2{%
  \bgroup
    \begin{MAT}[0pt]{l:c:r}
      \aligntop
      \rec(#2) &      #1  & \rec(#2) \\;
            #1 & \rec(#2) & #1       \\;
      \alignbottom
      \rec(#2) &      #1  & \rec(#2) \\
    \end{MAT}
  \egroup
}
\small
\[
  \recurse\clubsuit\diamondsuit\heartsuit\end
\]
```