The package **EASYBMAT**

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Abstract

The **EASYBMAT** 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 **EASYBMAT** ........................ 2
2 An example with balancing ................................. 5
3 Some example with minimal size setting .................. 6
4 An example with various size rules ........................ 7
5 The \texttt{addpath} command .............................. 8
6 An example with reentrance ............................... 10
The package **EASYBMAT**

1 Some examples with **EASYBMAT**

The package is loaded by means the usual way:

```latex
\documentclass{article}
\usepackage[thinlines,thiklines]{easybmat}
```

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

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

or

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

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

<table>
<thead>
<tr>
<th>value of eq</th>
<th>effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>@</td>
<td>no balancing</td>
</tr>
<tr>
<td>r</td>
<td>equal rows heights</td>
</tr>
<tr>
<td>c</td>
<td>equal column widths</td>
</tr>
<tr>
<td>b</td>
<td>equal rows heights and equal column widths</td>
</tr>
<tr>
<td>e</td>
<td>equal rows heights and column widths</td>
</tr>
</tbody>
</table>
The package \texttt{EASYBMAT}

By \texttt{mx} and \texttt{my} you can modify the minimum size of the box in the BMAT environment. This must be a valid measure e.g. 2pt. This is useful in writing matrices and vectors.

- \texttt{[ex]} or \texttt{[ex,MX,MY]}. By \texttt{ex} you can specify the amount of extra space around the item in the BMAT environment. The default is 2pt. By \texttt{MX} and \texttt{MY} you can modify the minimum size of the whole block matrix in the BMAT environment. This must be a valid measure e.g. 10cm.

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

  \begin{table}[h]
  \centering
  \begin{tabular}{ccc}
  \hline
  c & centering \\
  l & flush left \\
  r & flush right \\
  \hline
  \end{tabular}
  \end{table}

- The second \{cc...c\} is the definition of the rows their alignment. The possible alignment for the rows are:

  \begin{table}[h]
  \centering
  \begin{tabular}{ccc}
  \hline
  c & centering \\
  t & flush top \\
  b & flush bottom \\
  \hline
  \end{tabular}
  \end{table}

\textbf{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:
The available rules for the rows and columns are

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>solid line with size $1/5$ of normal line</td>
</tr>
<tr>
<td>1</td>
<td>solid line with size $1/4$ of normal line</td>
</tr>
<tr>
<td>2</td>
<td>solid line with size $1/3$ of normal line</td>
</tr>
<tr>
<td>3</td>
<td>solid line with size $1/2$ of normal line</td>
</tr>
<tr>
<td>4</td>
<td>equivalent to $</td>
</tr>
<tr>
<td>5</td>
<td>solid line with size $2$ times of normal line</td>
</tr>
<tr>
<td>6</td>
<td>solid line with size $3$ times of normal line</td>
</tr>
<tr>
<td>7</td>
<td>solid line with size $4$ times of normal line</td>
</tr>
<tr>
<td>8</td>
<td>solid line with size $5$ times of normal line</td>
</tr>
<tr>
<td>9</td>
<td>solid line with size $6$ times of normal line</td>
</tr>
</tbody>
</table>

The main feature of the \texttt{BMAT} environment is that it is reentrant as shown here:
The package **EASYBMAT**

\[
\begin{BMAT}{c.c}{|c.c|}
1 & 2 \\
3 & 4
\end{BMAT}
\begin{BMAT}{c.c}{c.c}
 a & b \\
 c & d
\end{BMAT}
\end{BMAT}
\]

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

### 2 An example with balancing

The effect of various balancing is best seen below:
\begin{BMAT}{|c|c|c|}{|c|c|c|}
1 & 22 & 333 \\
\frac{1}{2} & 1 & 1 \\
\frac{1}{\frac{1}{2}} & 1 & 1
\end{BMAT} \quad
\begin{BMAT}(r){|c|c|c|}{|c|c|c|}
1 & 22 & 333 \\
\frac{1}{2} & 1 & 1 \\
\frac{1}{\frac{1}{2}} & 1 & 1
\end{BMAT} \quad
\begin{BMAT}(c){|c|c|c|}{|c|c|c|}
1 & 22 & 333 \\
\frac{1}{2} & 1 & 1 \\
\frac{1}{\frac{1}{2}} & 1 & 1
\end{BMAT}

3 Some example with minimal size setting

It is possible to specify the minimal size of the item inside a “BMAT” environment, as shown here

\begin{BMAT}(@,50pt,20pt){c.c}{c.c}
1 & 22 \\
\frac{1}{2} & 1
\end{BMAT}

\left[
\begin{BMAT}(@,50pt,20pt){c.c}{c.c}
1 & 22 \\
\frac{1}{2} & 1
\end{BMAT}\right]
The package \texttt{EASYBMAT}

It is possible to specify the total minimal size of a \texttt{BMAT} environment, as shown here

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

\[\begin{array}{ccc}
\begin{bmatrix} 1 & 22 \\ \frac{1}{2} & 1 \end{bmatrix} & \times & \begin{bmatrix} x \\ y \end{bmatrix} = & \begin{bmatrix} i2 \\ \frac{3}{2} \end{bmatrix}
\end{array}\]

4 \ An example with various size rules

This example shows the use of various size rule in \texttt{BMAT} environment:
The package \texttt{EASYBMAT}

\begin{BMAT}(e,10pt,10pt){0c1c2c3c4c5c6c7c8c9}{0c1c2c3c4c5c6c7c8c9}
\begin{BMAT} ...
\end{BMAT}

\section{The \texttt{\addpath} command}

It is possible to add paths to the “BMAT” environment. The syntax is the following

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

where

\textit{x and y} are the integer coordinate of the starting point. The down left corner is at \(x = 0, y = 0\).
The package **EASYBMAT**

**rule** is the code of a valid rule as described in table 4.

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

<table>
<thead>
<tr>
<th>letter</th>
<th>direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>l</td>
<td>left movement and drawing</td>
</tr>
<tr>
<td>r</td>
<td>right movement and drawing</td>
</tr>
<tr>
<td>u</td>
<td>up movement and drawing</td>
</tr>
<tr>
<td>d</td>
<td>down movement and drawing</td>
</tr>
</tbody>
</table>

The following example shows the use of `\addpath`,

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

This is another example
The package \texttt{EASYBMAT}

\[
\left(\begin{BMAT}[5pt]{cccccc}{cccccc}
1 & * & * & * & * & * \\
0 & 11 & * & * & * & * \\
0 & 0 & 111 & * & * & * \\
0 & 0 & 0 & 1111 & * & * \\
0 & 0 & 0 & 0 & 11111 & * \\
0 & 0 & 0 & 0 & 0 & 11111
\end{BMAT}\right)
\]

\addpath{(0,5,.)rdrdrdrdrd}
\end{BMAT}\right) \]

\[ \left(\begin{BMAT}[0pt]{l:c:r}{t;c;b}
\rec(#2) & #1 & \rec(#2) \\
#1 & \rec(#2) & #1 \\
\rec(#2) & #1 & \rec(#2)
\end{BMAT}\right)
\egroup
\end{BMAT}\right) \]

\[ \addpath{(0,5,.)rdrdrdrd} \]

\[ \left(\begin{BMAT}[0pt]{l:c:r}{t;c;b}
1 & * & * & * & * & * \\
0 & 11 & * & * & * & * \\
0 & 0 & 111 & * & * & * \\
0 & 0 & 0 & 1111 & * & * \\
0 & 0 & 0 & 0 & 11111 & * \\
0 & 0 & 0 & 0 & 0 & 11111
\end{BMAT}\right)
\egroup
\end{BMAT}\right) \]

\section{An example with reentrance}

This final example shows a slightly more complex (reentrant) definition in which the \texttt{BMAT} 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{BMAT}[0pt]{l:c:r}{t;c:b}
\rec(#2) & #1 & \rec(#2) \\
#1 & \rec(#2) & #1 \\
\rec(#2) & #1 & \rec(#2)
\end{BMAT}
\egroup
\end{BMAT}\right) \]

\[ \addpath{(0,5,.)rdrdrdrd} \]

\[ \left(\begin{BMAT}[0pt]{l:c:r}{t;c;b}
1 & * & * & * & * & * \\
0 & 11 & * & * & * & * \\
0 & 0 & 111 & * & * & * \\
0 & 0 & 0 & 1111 & * & * \\
0 & 0 & 0 & 0 & 11111 & * \\
0 & 0 & 0 & 0 & 0 & 11111
\end{BMAT}\right)
\egroup
\end{BMAT}\right) \]
The package \texttt{EASYBMAT}

It produces the following output: