Mathematics

Matrices

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August 2, 2018

Overview

Packages for matrices

Some packages very useful for mathematics and specifically for matrix computations are listed here below:

- *mathtools* which is mainly an upgrade of the very well-known *amsmath* package (the backbone for mathematics with LaTeX),
- *physics* which provides macros to generate easily matrices with specific patterns.

Matrices: principle

Types of matrices

Matrices can be written by using a `matrix`-like environment inside a mathematical equation environment such as the ones presented in B100 tutorial.
Several types of matrices exist. They differ with the type of delimiters surrounding the matrix:

`matrix`

$$\begin{matrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{matrix}$$

`pmatrix`

$$\begin{pmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{pmatrix}$$

`bmatrix`

$$\begin{bmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{bmatrix}$$

`Bmatrix`

$$\begin{Bmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{Bmatrix}$$

`vmatrix`

$$\begin{vmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{vmatrix}$$

`Vmatrix`

$$\begin{Vmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{Vmatrix}$$

Matrices: principle

Alignment within the matrix

By default, numbers are centred in each column of a matrix:

$$\begin{pmatrix} 2 & -3 \\ 42 & 0 \end{pmatrix}$$

A starred version of each `matrix` environment offers an optional argument where the alignment can be provided through a letter: `c` for center, `r` for right and `l` for left. Example with right alignment:

$$\begin{pmatrix} 2 & -3 \\ 42 & 0 \end{pmatrix}$$

More facilities

Specific matrices (1)

Zero matrix: `zeromatrix` or the shorter `zmat` command.
Examples:

$$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \qquad \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad \begin{vmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{vmatrix}$$

Identity matrix: `identitymatrix` or the shorter `imat` command.
Examples:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \qquad \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad \begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

More facilities

Specific matrices (2)

Diagonal matrix: `diagonalmatrix` or the shorter `dmat` command. Optional argument to fill spaces.
Examples:

$$\begin{pmatrix} a & & \\ & b & \\ & & c \end{pmatrix} \qquad \begin{pmatrix} 1 & & \\ & 2 & \\ & & 3 \end{pmatrix} \qquad \begin{pmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

Automatically filled matrix: `xmatrix` or the shorter `xmat` command. The starred version creates automatic indices.
Examples:

$$\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix} \qquad \begin{pmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{pmatrix} \qquad \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

More facilities

Combinations of patterns

Simple way: use one of the previous commands, then add the other elements above and/or below like in a "regular" matrix.
Examples:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \\ a & b \end{pmatrix} \qquad \begin{pmatrix} a & b & c \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

Issue: impossible to add elements on the right or on the left of a submatrix generated with the *physics*' commands.
Matrix as a single element: `matrixquantity` or the shorter `mqty` command.
Example:

$$\begin{pmatrix} 1 & 0 & e \\ 0 & 1 & d \\ a & b & c \end{pmatrix}$$