Matrix icons via L^AT_EX

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Abstract

Some macros for typesetting matrix icons are provided, based upon L^AT_EX's picture environment, which don't need coordinate awareness: just the (dimensionless) sizes of the 'boxes.'

Keywords: Matrix icons, L^AT_EX, picture environment, macro writing, education.

Introduction

In my Math into BLUes I used matrix icons for formatting the schematic flow of matrix decompositions, to mimick Wilkinson's diagrams as supplied in his The Algebraic Eigenvalue Problem. The crucial element is the creation of diagonal lines. I used Amy Hendrickson's `\diagline`, which is flexible and powerful, but suffers from non-uniformness over the line orientation, and because of that it is difficult to control the line thickness for diagonal lines.

In this paper I used the line fonts which come with L^AT_EX via the `\line` macro, as part of the picture environment.

Given the context of matrix icons the limited availability of line orientations does not hinder.

From literature I distilled that the following special matrix icons are useful

rectangular matrix

lower left triangular matrix

upper right triangular matrix

upper Hessenberg form

The above forms can be drawn easily in the picture environment. The macros in this paper hide that environment, and provide the pictures in a `\vbox`, for use at any place where a `\vbox` can be used, without to worry about 'coordinates.'

Examples

- Some matrix icons, Wilkinson(1965)

$$AL = LH$$

$$A = QR$$

via

```
\setlenght{\unitlength}{1ex}
$$\vcenter{\icmat44\kern\unitlength
  \icllt44=\icllt44\icuh413
  \qquad AL=LH}$$
$$\vcenter{\icmat63=\icmat63\kern
  \unitlength\icurt63\qquad A=QR}$$
```

The problems

For (portable) line diagrams within L^AT_EX the picture environment is generally used. The drawback is that one has to be aware of coordinates, to put everything in the right position.

Diagonal lines have to be built up, either from line elements provided by some fonts, see Lamport and Spivak, or from 'dots,' see Hendrickson.

An intrinsic problem is that in contrast with horizontal and vertical rules the line thickness of the diagonal lines can't be changed easily.

Design

Given the context of the limited number of matrix icons and their restricted shapes, I decided to

- build upon the line elements which come with the L^AT_EX fonts
- use the L^AT_EX picture environment
- parameterize the size via L^AT_EX's `\unitlength`
- box all the icons in a `\vbox`
- free the use from the knowledge of the picture environment, and the associated coordinates.

The macros

```
\def\icmat#1#2{%ICon MATrix(rectangular)
%#1 is ht of icon matrix, e.g. 4
%#2 is wd of icon matrix, e.g. 2
\vbox to#1\unitlength{\hrule
   \hbox to#2\unitlength{\vrule
     height#1\unitlength\hfil\vrule}%
          \hrule}%
}%end icmat
%
\def\icurt#1#2{%IConUpperRightTriangle
%#1 is ht of icon matrix, with UT
%the upper triangular part, e.g. 4
%#2 is wd of icon (upper triangular)
%matrix, e.g. 2
\vbox to #1\unitlength{\hrule
   \hbox{\picture(#2,#2)%
    \put(0,#2){\line(1,-1){#2}}%
    \endpicture\vrule}%
   \vfil}%
}%end icurt
%
\def\icllt#1#2{%IConLowerLeftTriangle
%#1 is ht of icon matrix, with LT
%the lower triangular part, e.g. 4
%#2 is wd of icon (lower triangular)
%matrix, e.g. 2
\vbox to #1\unitlength{\vfil
   \hbox{\vrule\picture(#2,#1)%
     \put(0,#2){\line(1,-1){#2}}%
     \endpicture}%
   \hrule}%
}%end icllt
%
\def\icuh#1#2#3{%IConUpperHessenberg
%#1 is size of icon matrix, with UH
% the upper Hessenberg part, e.g. 4
%#2 is wd of icon (upper Hesenberg)
% matrix, e.g. 1
%#3 is size Lower Left triangular part,
% #1-#2 (for simplicity the latter is
% added, could have been calculated,
% perhaps some inconsistency test could
% be incorporated)
```

```
\vbox to #1\unitlength{\offinterlineskip
   \hrule
   \hbox to#1\unitlength{\vrule height%
      #2\unitlength depth0pt\relax
      \hfil\vrule}%
   \hbox to#1\unitlength{\picture(#3,#3)%
   \put(0,#3){\line(1,-1){#3}}\endpicture
   \hfil\vrule}%
   \hbox to#1\unitlength{\hfil\vrule
    width#2\unitlength height.2pt\relax}%
   }%
}%end icuh
```

Conclusions

The macros for drawing matrix icons hide the use of LATEX's picture environment and make the use easier and more general. A drawback is still that the line thickness can't be varied, especially for the diagonal lines. Be my guest and extend the given ones with those you need. I welcome your results.

References

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