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<p style="text-align:center">Singular Value Consulting</p>

How to write multi-part definitions in LaTeX

Posted on **14 September 2009** by **John**

This post explains how to typeset multi-part definitions in LaTeX.

The absolute value function is a simple example of a two-part definition.

$$|x| = \left\{ \begin{array}{ll} x & \mbox{if } x \geq 0 \\ -x & \mbox{if } x < 0 \end{array} \right.$$

The Möbius function is a more complicated example of a three-part definition.

$$\mu(n) = \left\{ \begin{array}{ll} 1 & \mbox{if } n = 1 \\ 0 & \mbox{if } a^2 \,|\, n \mbox{ for some } a > 1 \\ (-1)^r & \mbox{if } n \mbox{ has } r \mbox{ distinct prime factors} \end{array} \right.$$

Here's how you could write LaTeX for the absolute value definition.

```
|x| =
\left\{
        \begin{array}{ll}
                x  & \mbox{if } x \geq 0 \\
                -x & \mbox{if } x < 0
        \end{array}
```

```
\right.
```

The right-hand side of the equation is an array with an opening brace sized to fit on the left. Braces are special characters and so the opening brace needs to be escaped with a backslash. LaTeX requires a `right` for every `left` but the dot in `right.` says to make the matching container on the right side empty.

Since this pattern comes up fairly often, it's handy to have a command to encapsulate it. We define `twopartdef` as follows.

```
\newcommand{\twopartdef}[4]
{
        \left\{
                \begin{array}{ll}
                        #1 & \mbox{if } #2 \\
                        #3 & \mbox{if } #4
                \end{array}
        \right.
}
```

Then we could call it as follows:

```
|x| = \twopartdef { x } {x \geq 0} {-x} {x < 0}
```

The command `threepartdef` is very similar to `twopartdef`.

```
\newcommand{\threepartdef}[6]
{
        \left\{
                \begin{array}{lll}
                        #1 & \mbox{if } #2 \\
                        #3 & \mbox{if } #4 \\
                        #5 & \mbox{if } #6
```

```
        \end{array}
    \right.
}
```

You could call `threepartdef` for the Möbius function as follows.

```
mu(n) = \threepartdef
{1}     {n=1}
{0}     {a^2 ,|, n \mbox{ for some } a > 1}
{(-1)^r} {n \mbox{ has } r \mbox{ distinct prime factors}}
```

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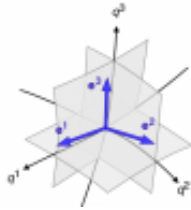Tags :　LaTeX

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15 thoughts on "How to write multi-part definitions in LaTeX"

gappy

14 September 2009 at 15:46

John,

This functionality is provided natively by LaTeX in the "cases"

environment. It's described in the LaTeX Companion (sec. 8.4.1).

Example:

|x| =

begin{cases}

x & text{if } x geq 0 \

-x & text{if } x < 0

end{cases}

(Editors note: To use the "cases" environment, add `usepackage{amsmath}`

to the preamble. — JC)

John

14 September 2009 at 15:53

Thanks. I didn't know that.

The "cases" environment wasn't part of LaTeX when I learned it, back

before version 2e. Back in my day … 🙂

Daniel Lemire

14 September 2009 at 17:04

I also hacked something similar for a recent paper of mine. I also did not know about the cases environment, though I'm a long time LaTeX user.

Alasdair

15 September 2009 at 01:06

If you're using LaTeX for maths (which you are!) then you should automatically also use the amsmath package, which contains many many commands for different sorts of displayed equations, of which cases is one. Not all of amsmath is part of standard LaTeX.

Stefan

7 October 2009 at 18:42

The cases environment will be a bit higher than the array environment, you could see if you would compare the examples above, because there's a fixed arraystretch of 1.2 internally. It may be ok, but if you want to stretch it less or more according to the content here's a possibility, amsmath: cases and arraystretch.

Lilian

17 March 2011 at 21:58

Hello, it is nice the amsmath contains several math functions, but for multi-part fuctions, I actually prefer John's solution. You have to type less than using "case".

Vita

24 May 2011 at 09:36

Lilian, you can use John's solution (i. e. defining a custom command) with cases as well ☺

Ibrahim

3 July 2011 at 04:34

How do I generate a numbered "Definition" environment that has multiple options in LaTeX? For example:

Definition 1.2 (Mathematics)

: is the study of patterns and structures.

: is the manipulation of numbers.

Vivek

15 October 2011 at 01:28

This article is really helpful to me.

Derik Evangelista

18 March 2012 at 16:27

Thank you! Very usefull.