Class 3 Lecture

E. Arthur Robinson, Jr.

1/18/2011

1 Where we have been and are going

We've seen basic LaTeX. We've discussed formulas and symbols. Today I want to talk about the following things:

1. Alignment of big formulas.
2. Matrices and tables.
3. Environments
4. Importing graphics.
5. Cross referencing.

I'll take these on at a time.

2 Alignment

2.1 Alignment of big formulas

Suppose you want to align a huge number of linked equations or inequalities, or simply break a large equation across a line. Here is an example from one of my papers.

$$\begin{aligned}\{\omega \boldsymbol{h} \cdot A^n \boldsymbol{p}_w\} &= \{\omega(\boldsymbol{g} - (\boldsymbol{g} - \boldsymbol{h})) \cdot A^n \boldsymbol{p}_w\} \\ &= \{\omega \boldsymbol{g} \cdot A^n \boldsymbol{p}_w - \omega (A^t)^n (\boldsymbol{g} - \boldsymbol{h}) \cdot \boldsymbol{p}_w\} \to 0.\end{aligned}$$

Here is another example from calculus:

$$\begin{aligned} u &= \arctan x & dv &= 1\,dx \\ du &= \frac{1}{1+x^2}dx & v &= x. \end{aligned}$$

Notice that each line (except the last) ends with the \\ (end of line) command.

Also notice how the nth alignment tab & in one line end up aligned with the same ones in later lines.

A version of the align command without the * will number all the lines. We'll return to this topic.

2.2 Matrices and tables

Matrices have an environment of their own called "array" that works much like align. It is a *math mode* environment (it only works inside an equation or such). It does not surround the matrix with any brackets. The "ccc" tells it three centered columns.

$$\begin{array}{ccc} 2 & 1 & 0 \\ 1 & 3 & 7 \\ 3 & 4 & 6 \end{array}$$

You can add brackets as follows:

$$\left(\begin{array}{ccc} 2 & 1 & 0 \\ 1 & 3 & 7 \\ 3 & 4 & 6 \end{array} \right)$$

or

$$\left[\begin{array}{ccc} 2 & 1 & 0 \\ 1 & 3 & 7 \\ 3 & 4 & 6 \end{array} \right].$$

Note that punctuation goes inside a displayed equation.

Now, if you add some minus signs things can get out of good allignment:

$$\left(\begin{array}{ccc} 2 & -1 & 0 \\ 1 & 3 & -7 \\ -3 & 4 & 6 \end{array} \right),$$

but you can fix this by right justifying the lines

$$\left(\begin{array}{ccc} 2 & -1 & 0 \\ 1 & 3 & -7 \\ -3 & 4 & 6 \end{array} \right),$$

Here is a final "matrix" example

$$\left| \begin{array}{ccc} 1 & 1 & 1 \\ 1 & 3 & -7 \\ 1 & t+1 & t^2+t+1 \end{array} \right|,$$

The "cases" environment can be used to define a function in cases. For this you must be using the "amsmath" package.

$$f(x) = \begin{cases} x + \alpha & \text{if } x < 1 - \alpha, \\ x + \alpha - 1 & \text{if } x \geq 1 - \alpha. \end{cases}$$

2.3 Tables

Some examples speak for themselves.

1	2	3
4	5	6
7	8	9

Likewise:

7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal

3 Environments

Notice the use of the center environment above. Without it we get:

7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal

Another common environment is a bulleted list

- First item,
- second item, and
- last item.

Or a numbered list

1. First item,
2. second item, and
3. last item.

We already discussed Theorems, Lemmas, Corollaries and proofs. Here are a couple of other useful environments. The first is called "quote" for long quotations.

> Five score years ago, a great American, in whose symbolic shadow we stand today, signed the Emancipation Proclamation. This momentous decree came as a great beacon light of hope to millions of Negro slaves who had been seared in the flames of withering injustice. It came as a joyous daybreak to end the long night of their captivity.
>
> —Martin Luther King, Jr.

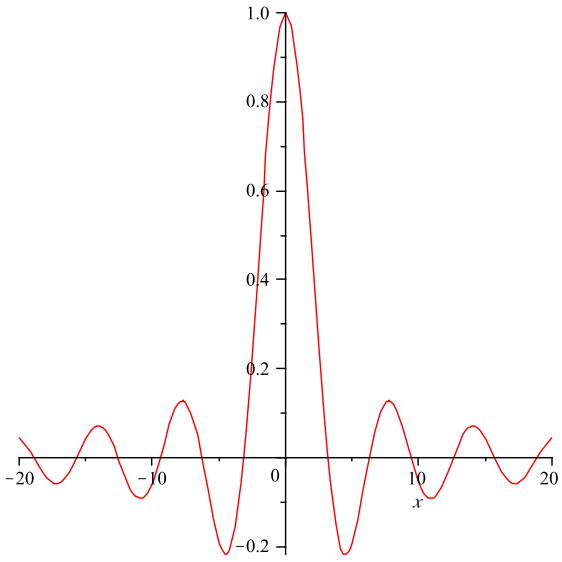
Another environment, useful for things like computer programs is called "verbatim"

```
What
    you
        see.
        {}
        $$$$$
        \\\\\
        ... is what you get .
```

4 Importing Graphics

You can import many kinds of files, but what I would recommend is sticking to pdf files (you can convert any kind of graphics to a pdf and then import it). Also, drawings work better that photos.

The picture I am using is one that I created using Maple (in my office). I saved it as a ".eps" file and then converted it to ".pdf"



5 Cross Referencing

,

Theorem 1 (Taking the derivative inside)**.** *Let $f(t,x)$ be C^2 on a domain $[c,d]\times[a,b]\subseteq\mathbb{R}^2$. Then*

$$\frac{d}{dt}\int_a^b f(t,x)\,dx=\int_a^b \frac{\partial f}{\partial t}(t,x)\,dx. \tag{1}$$

Proof. Since f is C^2 it has continuous 1st and 2nd partial derivatives, we can prove equation (1) by

...

This concludes the proof of Theorem 1. □

Corollary 2.

$$\frac{d}{dt}\int_{-\infty}^{\infty} e^{-tx^2}\,dx=\int_{-\infty}^{\infty} -x^2e^{-tx^2}\,dx. \tag{2}$$

Note that equation (2) in Corollary 2 is a special case of (1) from Theorem 1.