

Notes and Homework for Math 790

First here is some more practice (i.e. problems) in typesetting mathematics. The environment `\begin{array} ... \end{array}`, which is used inside of math mode, is used to typeset arrays such as matrices. Using what you find on page 46 of the notes to typeset the following.

(1)

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

(2) You can use `\mathbf{x}` to be bold letters in math mode. For example `\mathbf{x}` gives **x** rather than x . Now you typeset:

$$\mathbf{p} = \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix}$$

and

$$\mathbf{SU}(2) = \left\{ \begin{bmatrix} z & w \\ -\bar{w} & \bar{z} \end{bmatrix} : z, w \in \mathbb{C}, |z|^2 + |w|^2 = 1 \right\}.$$

(3) It is often useful to define things by cases such as

$$|x - 1| + |x + 1| = \begin{cases} -2x & \text{if } x < -1; \\ 2 & \text{if } -1 \leq x \leq 1; \\ 2x & \text{if } 1 < x. \end{cases}$$

Some people think this looks better if the left column is right justified.

$$|x - 1| + |x + 1| = \begin{cases} -2x & \text{if } x < -1; \\ 2 & \text{if } -1 \leq x \leq 1; \\ 2x & \text{if } 1 < x. \end{cases}$$

(4) The *determinant* of a 2×2 matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is denoted by $|A|$ and is given by

$$\left| \begin{bmatrix} a & b \\ c & d \end{bmatrix} \right| = ad - bc.$$

(5) Finally let's define a large matrix.

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$$

Now we want to be able to avoid having to type long commands. The command

`\newcommand{\junk}{ what \junk is to abbreviate }`

will replace `\junk` by the stuff in the second bracket. Thus putting

`\newcommand{\cartan}{\`Elie~Cartan}`

in the preamble means that typing `\cartan` will give `Élie Cartan`. In `TeX` terminology `\newcommand{\cartan}{\`Elie~Cartan}` defines the *macro* `\cartan`

Now you define macros that give the following.

- (a) `\R` which gives **R**.
- (b) `\beq` and `\eeq` that abbreviate `\begin{equation}` and `\end{equation}`
- (c) `\ga` (for Greek α) that gives α .
- (d) `\nn` to abbreviate `\nonumber`
- (e) Some of your own that you think might be useful and explain why you think that are nice.

It is also possible to define macros that take arguments. For example

`\newcommand{\pd}[2]{\frac{\partial #1}{\partial #2}}`

lets us type set

$$\frac{\partial u}{\partial t} = \frac{\partial u}{\partial x} \frac{\partial x}{\partial t} + \frac{\partial u}{\partial y} \frac{\partial y}{\partial t}$$

as just

`\pd{u}{t}=\pd{u}{x}\pd{x}{t}+\pd{u}{y}\pd{y}{t}`

Now you define macros that do the following.

- (a) `\od{y}{x}` gives $\frac{dy}{dx}$ and `\od{\xi}{t}` gives $\frac{d\xi}{dt}$.
- (b) `\spd{z}{x}{y}` gives $\frac{\partial^2 u}{\partial x \partial y}$.
- (c) `\mat{a}{b}{c}{d}` gives $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$.
- (d) Some others that you think would be useful and explain why.

For the problems on macros make a document with the macros in it and e-mail it to me so that I can test them.