GEORGIA TECH F'04
CS 8002 : PCPS AND HARDNESS OF APPROXIMATION

Lecture 0: Manual for Scribes

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You will need to use the latex document processing system. This document is not a latex manual, but it does show you some basic tricks. Several good latex references exist on the web, and your grad colleagues should have books on latex. (My favorite is the *Latex Companion*.)

A file called `template.tex` already exists in this directory that wil take care of formatting. A file called `macros.tex` contains shorthands for math commands as well as for frequently used formatting tricks. Send me email if you have latex questions.

We are using the `amsmath` package for typesetting, which does a few things differently from standard latex.

Some tricks and tips appear below. Look in the source file `howto.tex` to understand how to do these tricks.

1 General Formatting Tips

1. Theorems, lemmas, corollaries, proofs, definitions, examples, exercises, remarks, etc. are typeset inside special environments. (The environment names are `Thm, Lem, Cor, proof, Def, Exa, Ex, Rem` respectively.) Here is how you write a theorem.

THEOREM 1

If E denote energy, m denotes mass, and c denotes the speed of light, then

$$E = mc^2 \tag{1}$$

2. File `macros.tex` also contains macros to typeset the following (not an exhaustive list): set notation (e.g. $\{1, 2, 3, 4\}$), cardinality of a set (e.g. $|\{1, 2, 3\}|$), Real and natural numbers ($\mathbf{R}, \mathbf{N}$ respectively), probabilities (e.g. $\mathbf{Pr}[\text{coin comes up head}] = 1/2$), $\mathbf{Var}[X] = \mathbf{E}[X^2] - \mathbf{E}[X]^2$). If you want to add a new macro to `macros.tex`, *please send me email.* Do not edit `macros.tex`; I want all students to use the same version.

3. There are macros for writing pseudocode. Look in the source file to see how to generate the following piece of pseudocode.

input: $G = (V, E)$, s, t
output: YES if it discovers that t is reachable from s, and NO otherwise

guess the distance k between s and t
$p := s$
for $i := 1$ to k **do**

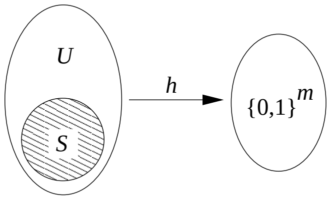

Figure 1: The bigger S' is, the more likely $h(S')$ will hit a given point in $\{0,1\}^m$.

non-deterministically pick a neighbor q of p
$p := q$
if $p = t$ **then accept**
else reject

4. You can include figures by using the `ffigure` command. You first create a figure using `xfig` (on Unix) or `Adobe Illustrator`, save it as a postscript file (the subscript should be `.eps`) in the same directory as the latex files. Lets say this figure is `12sets.eps`. Look in the source file to see how we can include this file and generate Figure 1.

   If you get any error messages while including figures, check that the .eps file begins with %! and if not, edit out the first line or two of junk.

   You will probably get better results if you draw the figures (in `xfig` or another program) in landscape orientation. Make it fill the entire page, since you can resize it when using the `ffigure` command.

2 General Math Formatting Tips

1. Use `align` to typeset a series of contiguous equations such as those occuring in a long derivation. (Do not use the old `eqnarray` command; it uses nonstandard typographical conventions.) In the source file you will see that an & tells the program which symbol to align on.

$$E = mc^2 \tag{2}$$
$$E + H + G = t \tag{3}$$

   Use the `equation` command for single equations.

$$E = mc^2 \tag{4}$$

   To mix text into math formulae, use the `text` command.

$$E = mc^2 \qquad \text{(Einstein)} \tag{5}$$

   While presenting a sequence of calculations (using the `align` command) we sometimes need to say something briefly in the middle, say to explain a step. We can do this with the `intertext` command.

$$A + B + C + D + E = R + S \tag{6}$$

intertext: which can be upperbounded using the inductive hypothesis by

$$\leq Q + N \tag{7}$$

2. If no alignment is needed, we use `gather` to make the group of equations look neat.

$$a + b = b + a \tag{8}$$
$$(a + b) \cdot (a - b) = a^2 - b^2 \tag{9}$$

3. There is also `alignat` for `align` type structures side by side.

$$L_1 = R_1 \qquad L_2 = R_2 \tag{10}$$
$$L_3 = R_3 \qquad L_4 = R_4 \tag{11}$$

4. Equations that do not fit into a line are typeset using the `split` environment, which allows alignment between lines using & as usual.

$$\begin{split}(a+b)^3 - (c+d)^3 - (a+d)^3 &= a^3 + b^3 + 3ab(a+b) + c^3 + d^3 + 3cd(c+d)\\ &\quad - (a^3 + d^3 + 3ad(a+d))\end{split} \tag{12}$$

5. To refer later to an equation, you need to label it with a `label` command. The command `notag` will make the equation unnumbered. The command `tag` will replace the equation number with some other designated symbol.

$$x^2 - y^2 = (x - y) \cdot (x + y) \tag{13}$$
$$x^3 - y^3 = (x - y)(x^2 + xy + y^2). \tag{$*$}$$

Using (13) and ($*$) we obtain

$$a + b = d \tag{14}$$

Now we give an unnumbered equation; note that the numbering resumes below

$$d + e = f$$

6. You can typeset equations involving “case” situations with the `cases` environment.

$$\delta_{i,j} = \begin{cases} 1 & \text{if } i = j \\ -1 & \text{if } i < j \\ 0 & \text{otherwise} \end{cases} \tag{15}$$

7. The `matrix` environment produces matrices. Below, we show the matrices produced using `matrix, pmatrix, bmatrix, vmatrix, Vmatrix` respectively.

$$\begin{matrix} a & b \\ c & d \end{matrix} \quad \begin{pmatrix} a & b \\ c & d \end{pmatrix} \quad \begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad \begin{vmatrix} a & b \\ c & d \end{vmatrix} \quad \begin{Vmatrix} a & b \\ c & d \end{Vmatrix}$$

This environment can handle matrices with up to 10 columns. To produce a matrix like $\left(\begin{smallmatrix} a & b \\ c & d \end{smallmatrix}\right)$ inside a text paragraph, use the `smallmatrix` environment and enclose with the appropriate parentheses. Try not to do this in the last line of the paragraph since that looks untidy, as here $\left(\begin{smallmatrix} a & b \\ c & d \end{smallmatrix}\right)$.

8. To use bold-faced letters inside math equations, use `mathbf` command. To get bold numbers, greek symbols etc., use the `boldsymbol` command.

$$\mathbf{A}_{\boldsymbol{\infty}} = \boldsymbol{\alpha} + d \tag{16}$$

9. Function and operator symbols (in addition to standard ones like `sin, cos, log`) can be defined using the `operatorname` command.

10. Typeset modular arithmetic using the `pmod` command.

$$x \equiv y + z \pmod{n}. \tag{17}$$

11. You may be familiar with the `frac` command in latex. In practice one needs to distinguish typographically between fractions inside paragraph (such as $\tfrac{x+y}{z^2+5}$) and ones that occur in displayed equations, such as

$$\frac{x+y}{z^2+5} = 8 \tag{18}$$

The former use the `tfrac` command and the latter the `dfrac` command. One can also specify the parentheses around displayed fractions with `fracp` and `fracb` commands. The advantage of these is that the size of the parentheses will change automatically with the size of the display; compare $\left(\tfrac{x+y}{z^2+5}\right)$with

$$\left(\frac{\left(\frac{x}{u}\right) + y}{z^2+5}\right) = 5 = \left[\frac{x/u + y}{z^2+5}\right]$$

12. Random examples of how to format some math expressions: $\binom{n}{k}$, $\exp(-x^2)$, $x \wedge y \vee \neg z$, $f : \mathbf{N} \to \mathbf{R}$.

3 Note on labels

IMPORTANT: When labelling equations, theorems, figures etc., use a prefix that includes the lecture number. For example `lec5:eqn10` or lec5:fig6. **Similarly, call your figures something like** `lec5fig1.eps` **instead of just** `fig1.eps`. **This will prevent naming conflicts when I try to latex the lecture notes all together.**