Assignment 2 - LaTeX

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Instructions

You need to submit a `.tex` file which when compiled with PDFLaTeX, (`pdflatex`), will generate an exact copy of this `pdf`. The instructions are similar to the ones for the lab handout. The list of packages used for this assignment follows:

- `amsmath`
- `amyssymb`
- `url`
- `graphicx`
- `xcolor`
- `listings`
- `hyperref`
- `multirow`
- `multicol`

Note that in this document, links (website references, emails, references, table of contents items, etc.) are clickable but do not have coloured boxes around them, giving the document a cleaner look[1]. Also, this "Instructions" section is actually the Abstract. You need to figure out how to change its displayed name.

The image in Subsection 3.2 can be found *here* and the file `regex.py` used for Listing 1 can be found *here*.

Your assignment will be evaluated based on the extent of similarity of your PDF with this PDF

[1] Hint: an optional argument to the `hyperref` package does this. (*this*, by the way, is a footnote.)

Contents

1 Typesetting text

Paragraphs are automatically indented from the margin (unless specified otherwise), for example :

This is a normal paragraph. It gets indented as one would expect. This is some random text inserted to increase the size of the paragraph. This text is also for the same reason.

This is *also* a paragraph but isn't indented! Notice how the first line of this paragraph sticks to the left margin, unlike its counterpart in the above paragraph[2].

You already know how to typeset **bold**, *italicized*, `typewriter` and serif text, or to make text small or large.

The list in the Abstract should give you some food for thought[3].

2 Mathematics

Here are some equations which have been numbered:

$$(a+b)^n = \sum_{k=0}^{k=n} \binom{n}{k} a^k b^{n-k} \tag{1}$$

$$\sum_{i=1}^{n} a_i \geq \sqrt[n]{\prod_{i=1}^{n} a_i} \text{ , where } a_i\text{s are positive reals.} \tag{2}$$

To write equation 2 correctly, you'll have to use `\text`, so that you can get normal text in math mode. Equation 2 can also be written as equation 3, without the use of `\text`. The $\mathbf{R}$ in equation 3 has been generated using the `\mathbb{R}` command, which requires the `amssymb` package.

$$\sum_{i=1}^{n} a_i \geq \sqrt[n]{\prod_{i=1}^{n} a_i} \quad , \forall a_i \in \mathbf{R}_+ \tag{3}$$

Here are a set of equations that have been aligned according to "=". Also note that they are not numbered:

$$\begin{aligned} (x+y)^3 &= (x+y)^2(x+y) \\ &= (x^2+y^2+2xy)(x+y) \\ &= x^3+y^3+3x^2y+3xy^2 \end{aligned}$$

Here are a few more equations:

$$20 \equiv 6 \pmod 7$$

[2]Hint: there's a command that does this.
[3]Hint: It has multiple columns!

$$\gcd(a,b) \mid pa + qb \tag{4}$$

$$F_n = \begin{cases} 0 & \text{if } n = 0 \\ 1 & \text{if } n = 1 \\ F_{n-1} + F_{n-2} & \text{if } n \geq 2 \end{cases} \tag{5}$$

$$\phi(n) = \sum_{\substack{1 \leq k < n \\ \gcd(k,n)=1}} 1 \tag{6}$$

$$= \quad n \cdot \prod_{p \mid n} \left(1 - \frac{1}{p}\right), \quad \text{where } p \text{ is prime} \tag{7}$$

$$\mathbf{S} = \{x \mid x \geq 0, x \in \mathbf{Z}\} \tag{8}$$

Equation 4 says that the gcd of two numbers divides the sum of their multiples while equation 5 is an inductive definition of the *Fibonacci Series*. Equations 6 and 7 are two ways of computing *Euler's Totient Function*. Equation 8 defines the set of all non-negative integers.

We're not done yet:

$$\boxed{{}^1\!/_6 + {}^5\!/_6 = 1} \tag{9}$$

$$x = x_0 + \cfrac{1}{x_1 + \cfrac{1}{x_2 + \cfrac{1}{x_3 + \cfrac{1}{x_4}}}} \tag{10}$$

$$\int_0^n \int_n^\infty (x^3 + y^2)\, dx.dy \tag{11}$$

$$A_{m,n} = \begin{pmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m,1} & a_{m,2} & \cdots & a_{m,n} \end{pmatrix} \tag{12}$$

Equation 9 has a box around it, equation 10 displays a typical continued fraction, equation 11 is an example of a double integral while equation 12 shows a generic matrix of dimensions $m \times n$.

3 Floats

Floats are containers for things in a document that cannot be broken over a page. LaTeX by default recognizes tables and figures as floats. Floats are there to deal with the problem of the object that won't fit on the present page, and to help when you really don't want the object here just now.[4].

You need to construct floats in this section.

3.1 Tables

Columns can be merged in tables. This is done using `\multicolumn`. Rows can also be merged using the `\multirow` command, which is part of a package called `multirow`.

Planet	**Attributes**		
	Radius (km)	Mass ($\times 10^{21}$kg)	Density (g/cm^3)
Mercury	2,439.7	330.2	5.43
Earth	6,371	5,973.6	5.515
Mars	3,390	641.85	3.94
Jupiter	69,911	1,898,600	1.33

Table 1: Planets

The following points about Table 1 are worth noting:

- The first column is left aligned, while the rest are all right aligned.
- The heading "Planets" spans 2 rows.
- The heading "Attributes" spans 3 columns and is center aligned.
- The line beneath the "Attributes" heading only spans rows 2, 3 and 4[5].

[4]Taken from the LaTeX Wikibooks page on Floats, Figures and Captions
[5]Hint: `cline`

3.2 Figures

You did an example of a simple figure, with a caption, in the Lab handout. Figure 1 builds upon the same concepts. It also has a border around it, using a command called `\fbox`.

Figure 1: LaTeX, at 30 degrees

4 Listings

Listing 1 shows a source code example in the Python programming language[6], displayed in the default Emacs python colour scheme.

```
1  #!/usr/bin/env python
2
3  # A simple regex match example in python
4
5  str = 'an example word:cat!!'
6  match = re.search(r'word:\w\w\w', str)
7  # If-statement after search() tests if it succeeded
8    if match:
9      print 'found', match.group() ## 'found word:cat'
10   else:
11     print 'did not find'
```

Listing 1: **regex.py**

There are few notable points about Listing 1:

- The `\ttfamily` font has been changed from its default value `cmtt` (Computer Modern Typewriter) to `pcr` (Courier) just before the use of the `\lstinputlisting` command.
  (It has also been reset to the default immediately after.)[7]
- The colours that have been used are[8]:
  - **Comments** `\color[cmyk]{0, 0.809, 0.809, 0.302}`
  - **Keywords** `\color[cmyk]{0.12, 0.60, 0.00, 0.45}`
  - **Strings** `\color[cmyk]{0.00, 0.76, 0.41, 0.45}`

[6] Python Programming Language – Official Website
[7] [4] tells you how to make these changes.
[8] Consulting [5] may help.

5 Macros

Macros, as shown to you in the handout, can be quite useful if you have to use a particular sequence (it could be a word or an equation or just about anything) many times in your document.

Take the word **pneumonoultramicroscopicsilicovolcanoconiosis**, for instance. It's a lung disease, and if you were writing a paper/thesis about it, you'd have to use the name quite a few times. The job can be simplified using a macro. If you put

```
\newcommand{\pumsv}{pneumonoultramicroscopicsilicovolcanoconiosis}
```

in the preamble of your document, you could just use `\pumsv` to get pneumonoultramicroscopicsilicovolcanoconiosis wherever needed. (Notice how this reduces the chance of making a spelling mistake, since the spelling only needs to be correct in the macro definition.)

If you hate typing `\LaTeX{}`, you can define a simple macro for that as well!

5.1 Macros that take arguments

Macros can also take arguments, like functions in your favourite programming language. You could have a macro that typesets the list a_0 to a_n given the argument a :

```
\newcommand{\series}[1]{\[#1_0,#1_1,#1_2,\ldots,#1_n\]}
```

So, typing `\series{x}` would produce

$$x_0, x_1, x_2, \ldots, x_n$$

typing `\series{\lambda}` would produce

$$\lambda_0, \lambda_1, \lambda_2, \ldots, \lambda_n$$

and so on. LaTeX macros can be made to take any number of arguments.

References

[1] LaTeX Tutorials, a Primer, *Indian TEX Users Group (TUG India)*, TUG India, 2002-2003

[2] LaTeX/Packages/Listings - Wikibooks, open books for an open world, `http://en.wikibooks.org/`

[3] The Not So Short Introduction to LaTeX 2_ε, OR, LaTeX 2_ε in 157 minutes, *Oetiker T., Hyna I. and Schlegl E.*, Version 5.01, April 6, 2001

[4] Fonts in LaTeX, *Freek Dijkstra*, `http://www.macfreek.nl/memory/Fonts_in_LaTeX`

[5] Using listings to include code in LaTeX, *Thomas Jansson*, `http://www.tjansson.dk/?p=419`