

# Lab 14: L<sup>A</sup>T<sub>E</sub>X

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## 1 Directions

Your lab assignment today is to write the code to produce this document.

1. First, write some code.
2. Then, compile it with `pdflatex`.
3. Check the pdf to see if it looks right.
4. When you're done, submit your tex file.
5. Good luck on finals!

## 2 Text Formatting

Sometimes, you *may* want to emphasize some text.

## 3 Math

Let  $i^2 = -1$ , or as you may recognize it,  $i = \sqrt{-1}$ .

Claim:  $e^{\pi i} + 1 = 0$ . Why on earth would this be true?

First, what does it mean for us to raise  $e$  to an imaginary power? Well, the Maclaurin series for  $e^x$  might help us:

$$e^x = \sum_{k=0}^{\infty} \frac{x^k}{k!} = 1 + x + \frac{x^2}{2} + \frac{x^3}{3!} + \frac{x^4}{4!} + \cdots \quad (1)$$

(Hint: `\cdots` makes a centered ellipsis.)

So, plug in  $ix$ :

$$e^{ix} = \sum_{k=0}^{\infty} \frac{i^k x^k}{k!} = 1 + ix + \frac{i^2 x^2}{2} + \frac{i^3 x^3}{3!} + \frac{i^4 x^4}{4!} + \cdots \quad (2)$$

Now we get to use our nice rule that says  $i^2 = -1$ :

$$e^{ix} = 1 + ix - \frac{x^2}{2} - \frac{ix^3}{3!} + \frac{x^4}{4!} + \frac{ix^5}{5!} - \dots \quad (3)$$

Let's rearrange a little bit:

$$e^{ix} = \left(1 - \frac{x^2}{2} + \frac{x^4}{4} - \dots\right) + i\left(x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots\right) \quad (4)$$

If you put on your Maclaurin series glasses and squint a bit, it turns out that all this hootenanny reduces to

$$e^{ix} = \cos(x) + i \sin(x) \quad (5)$$

And since  $\cos(\pi) = -1$  and  $\sin(\pi) = 0$ ,  $e^{\pi i} = -1$ .

## 4 Figures

If you like drawing pretty figures, you should look at TikZ.

If you want to read more about complex numbers and fractals, read <http://acko.net/blog/how-to-fold-a-julia-fractal/>.

