Programming Assignment 0: LaTeX Practice

Response by: **Nathan Brunelle (njb2b)**

Collaborators: None

Resources: The quote from problem 1 came from J.R.R. Tolkien's "The Lord of the Rings".

Problem 1: I cannot live without...

The brave things in the old tales and songs, Mr. Frodo, adventures, as I used to call them. I used to think that they were things the wonderful folk of the stories went out and looked for, because they wanted them, because they were exciting and life was a bit dull, a kind of a sport, as you might say. But that's not the way of it with the tales that really mattered, or the ones that stay in the mind. Folk seem to have been just landed in them, usually their paths were laid that way, as you put it. But I expect they had lots of chances, like us, of turning back, only they didn't. And if they had, we shouldn't know, because they'd have been forgotten.

Problem 2: Express yourself (mathematically)

The main reason for using LaTeX this semester is to present math more neatly and clearly. There are two main ways to include math in your documents. The first is inline math, which you use when you want to include math among regular English text. This is done by putting your math between $ symbols. For example, the statement "if $x \in \mathbb{N}$ then $S \neq \emptyset$" is produced using inline text. For each line below, add on the mathematical symbol/expression we've described using inline text. The first two are done for you.

– The symbol for set membership: $\in$

– The fraction one half: $\frac{1}{2}$

– The expression square root of 2: $\sqrt{2}$

– The fraction 1 divided by the square root of 2: $\frac{1}{\sqrt{2}}$

– The mathematical symbol pi: π

– The expression "S is a subset of the real numbers": $S \subseteq \mathbb{R}$

– The expression "the empty set is a proper subset of the rational numbers": $\emptyset \subset \mathbb{Q}$

Problem 2: The Finest Gambit

Reductio ad absurdum, which Euclid loved so much, is one of a mathematician's finest weapons. It is a far finer gambit than any chess play: a chess player may offer the sacrifice of a pawn or even a piece, but a mathematician offers the game. [Excerpt from *A Mathematician's Apology,* G.H. Hardy, 1940, p. 94]

Learn how to write math and construct proofs by reproducing the proof that $\sqrt{2}$ is irrational. Try to make it look exactly like the example proof. You will need to use the "align" environment, as well as the "align*" environment.

Definition 1 *A rational number is a fraction $\frac{a}{b}$ where a and b are integers.*

Show $\sqrt{2}$ is irrational.

Proof.

For a rational number $\frac{a}{b}$, without loss of generality we may suppose that a and b are integers which share no common factors, as otherwise we could remove any common factors (i.e. suppose $\frac{a}{b}$ is in simplest terms). To say $\sqrt{2}$ is irrational is equivalent to stating that 2 cannot be expressed in the form $(\frac{a}{b})^2$. Equivalently, this says that there are no integer values for a and b satisfying

$$a^2 = 2b^2 \tag{1}$$

We argue by *reductio ad absurdum* (proof by contradiction). Assume toward reaching a contradiction that Equation 1 holds for a and b being integers without any common factor between them. It must be that a^2 is even, since $2b^2$ is divisible by 2, therefore a is even. If a is even, then for some integer c

$$\begin{aligned} a &= 2c \\ a^2 &= (2c)^2 \\ 2b^2 &= 4c^2 \\ b^2 &= 2c^2 \end{aligned}$$

therefore, b is even. This implies that a and b are both even, and thus share a common factor of 2. This contradicts our hypothesis, therefore our hypothesis is false.

$\square$

Problem 4: Vanity

Learn how to include drawings in your documents with the "`\includegraphics {image}`" command by submitting a caricature of Professor Brunelle. (Any image will do, but the best caricatures will receive special recognition...and fun!)