# Class 2: Proof Methods

**Schedule**

Before **Friday (tomorrow), 6:29pm**:

– Read, print, and sign the Course Pledge. You should print the PDF version for signing, and submit a scan of your signed pledge using Collab.
– Read Jeremy Kun's *Habits of Highly Mathematical People*.
– Submit a Course Registration Survey (which includes some questions based on Kun's essay).

Next week:

– Before Tuesday's class: Read MCS Chapter 2
– Before Thursday's class: Read MCS Chapter 3
– Due Friday at 6:29pm: **Problem Set 1** (will be posted tomorrow)

## Notes and Questions

An integer, $z$, is **even** if there exists an integer $k$ such that $z = 2k$.

Is this a *definition*, *axiom*, or *proposition*?

An integer, $z$, is **odd** if there exists an integer $k$ such that $z = 2k + 1$. (Note that there is no connection between the variables used here, and to define even above.)

To prove an implication, $P \implies Q$: 1. assume $P$. 2. Show chain of logical deductions that leads to $Q$.

**Odd-Even Lemma:** If an integer is not even, it is odd. Note: A *lemma* is just a name for a theorem, typically used for proving another theorem.

How should one decide what can be accepted as an axiom, and what must be proven?

What is the purpose of a *proof*? (in cs2102? in software development? in algorithm design?)

## Proving "If and Only If"

Strategy: To prove $P$ if and only if $Q$:

1. Prove $P \implies Q$.
2. Prove $Q \implies P$.

*Definition.* The *standard deviation* of a sequence of values $x_1, x_2, \ldots, x_n$ is

$$\sqrt{\frac{(x_1 - \mu)^2 + (x_2 - \mu)^2 + \ldots + (x_n - \mu)^2}{n}}$$

where $\mu$ is the mean of the values:

$$\mu ::= \frac{x_1 + x_2 + \ldots + x_n}{n}$$

.

**Theorem 1.6.1.** The standard deviation of a sequence of values, $x_1, x_2, \ldots, x_n$ is 0 *if and only if* all of the $x_i$ values are equal to the mean of $x_1, x_2, \ldots, x_n$.

The book proves this using a chain of iff implications; prove it using the two-implications strategy.

*In physics, your solution should convince a reasonable person. In math, you have to convince a person who's trying to make trouble.* Frank Wilczek

  