PHYS 177
winter 2019

## lecture 2: numerical precision

learning goals
- recall how real numbers are represented digitally
- anticipate potential issues w/ lack of precision

Python ℝ numbers stored w/ 64 bits

$$r = \pm\ m \times 2^{E}$$

(1 bit, 52 bits, 11 bits)

m is the mantissa, stored as a binary fraction:

$$m = 1 + \frac{m_1}{2} + \frac{m_2}{2^2} + \frac{m_3}{2^3} + \dots$$

* notebook example

representation of 0.1 in binary fractions is infinite

standard example: represent 1/3 in decimal form

* notebook example

difference of large numbers, multiple scales lose precision

quadratic eq. roots $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$$= \frac{2c}{-b \mp \sqrt{b^2-4ac}}$$

multiply top and bottom by $-b \mp \sqrt{b^2-4ac}$

→ slightly different results

be cautious when mixing scales or when there are near cancellations