Infinite series (16th and 17th century)

- Indian mathematician Nilakantha Somayaji (1444–1544)
- $\pi = 3 + \frac{4}{2\times3\times4} - \frac{4}{4\times5\times6} + \frac{4}{6\times7\times8} - \frac{4}{8\times9\times10} + \cdots$

- German mathematician Gottfried Wilhelm Leibniz (1646-1716)
- Scottish mathematician James Gregory (1638-1675)
- $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots$

- Swiss mathematician Leonard Euler (1707-1783)
- (science-math connection related to Basel problem http://bit.ly/BaselPi)
- $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots$

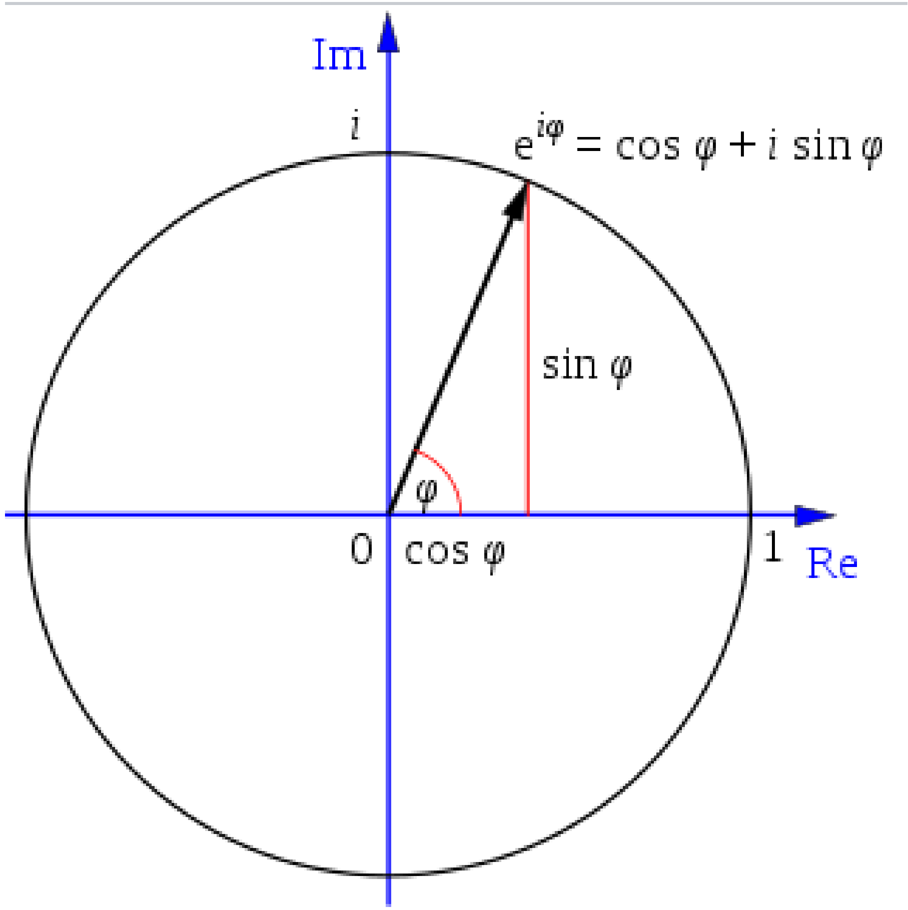
Nilakantha series

- $\pi = 3 + \frac{4}{2\times3\times4} - \frac{4}{4\times5\times6} + \frac{4}{6\times7\times8} - \frac{4}{8\times9\times10} + \cdots$

- *Partial sum:*

- $u_n = 3 + \sum_{k=1}^{n} \frac{4(-1)^{k-1}}{(2k)(2k+1)(2k+2)} = 3 + \sum_{k=1}^{n} \frac{(-1)^{k-1}}{k(k+1)(2k+1)}$

Euler’s formula



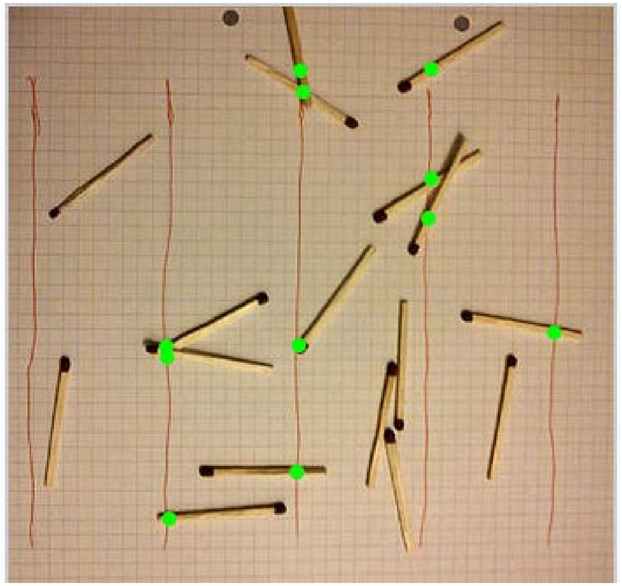
- $e^{i\pi} = \cos(\pi) + i \cdot \sin(\pi)$
- $e^{i\pi} = -1 + i \cdot 0$

$$e^{i\pi} + 1 = 0$$

$$\pi = -i \cdot \ln(-1)$$

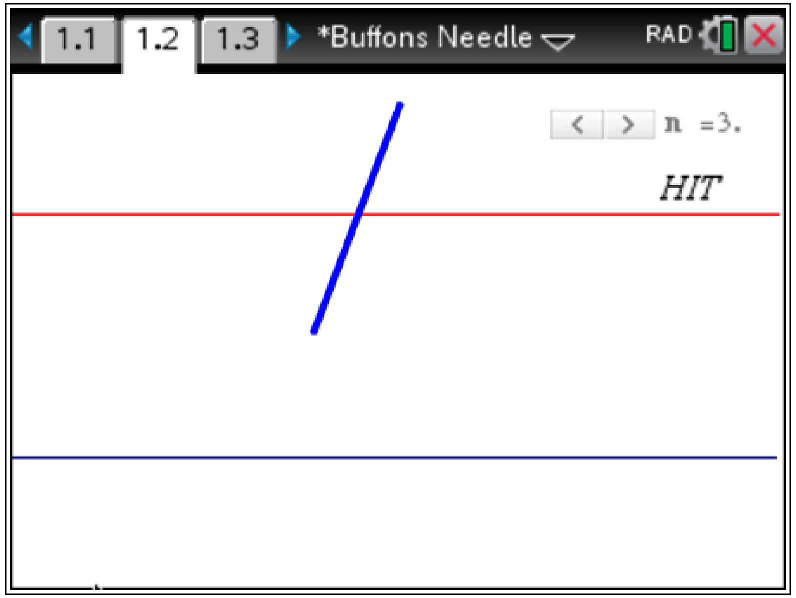
Buffon’s Needle Problem (French mathematician Georges-Louis Leclerc, Comte de Buffon, 18th century)

- Suppose we have a floor made of parallel strips of wood, each the same width, and we drop a needle onto the floor. What is the probability that the needle will lie across a line between two strips?
- Consider a special case when the length of the needle is equal to the distance between the strips.



Hands-on version of activity shows 11 hits out of 17 throws

TI-Nspire simulation (available at Australian TI site)



Estimating π from Buffon's needle problem

- P - is the probability that the needle crosses the line
- Region $x \le L\,cos(\theta)$ out of region $0 \le x \le l$ where $0 \le \theta \le \frac{\pi}{2}$,
- $P = \frac{\int_0^{\frac{\pi}{2}} l cos(\theta) d\theta}{\int_0^{\frac{\pi}{2}} l d\theta} = \frac{sin\left(\frac{\pi}{2}\right)}{\frac{\pi}{2}} = \frac{2}{\pi}$
- $\pi = \frac{2}{P}$