APHY 477 / 477y / 577

# LECTURE 03: RANDOM NUMBER PRODUCTION

# Introductory Basics, First Examples

- [https://www.albany.edu/physics/phy577/randomNumbers.cpp](https://www.albany.edu/physics/phy577/randomNumbers.cpp) (wrapping it up)
  - On board: how to generate any random number from uniform 0-1, and any shape of Gaussian
  - [https://cplusplus.com/reference/random/](https://cplusplus.com/reference/random/) Beware of integers versus floating point numbers, and of unphysical solutions (negatives, some things that can't be zero, fractional?)

# What is the Drake Equation?

Multiple Ns: can mean multiple galaxies in universe, or multiple versions of OUR galaxy.

Note that there is a lot less BS in this formula these days.

$$N = R_* \times f_p \times n_e \times f_e \times f_i \times f_c \times L$$

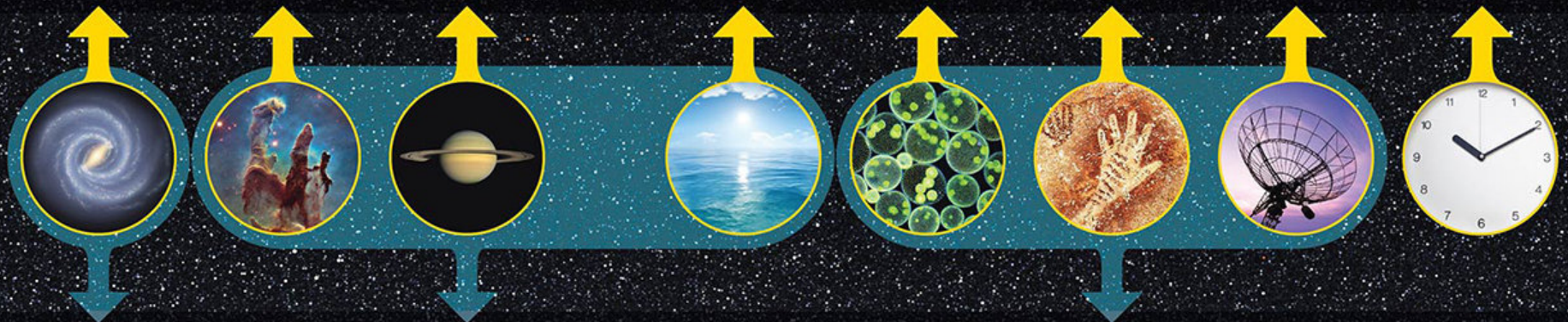| The number of technologically advanced civilizations in the Milky Way galaxy | The rate of formation of stars in the galaxy | The fraction of those stars with planetary systems | The number of planets, per solar system, with an environment suitable for life | The fraction of suitable planets on which life actually appears | The fraction of life-bearing planets on which intelligent life emerges | The fraction of civilizations that develop a technology that releases detectable signs of their existence into space | The length of time such civilizations release detectable signals into space |

$$A = N_{ast} \times f_{bt}$$

The number of technological species that have formed over the history of the observable universe

The number of habitable planets in a given volume of the universe

The likelihood of a technological species arising on one of these planets

If N large: Fermi Paradox then. Where is everyone??

# Life in Space?? the code can be done in only < 50 lines!

- Study the Drake Equation from astronomy (HW)
- You will make ~decent guesses as to mean and width and shape for a statistical distribution for each of the parameters within the equation and justify your choices (good references do exist)
  - possible "shapes" include Gaussian, skew, truncated Gaussian, Poisson, exponential, power, flat (uniform), and constant. There are NO "perfect" answers!
- You'll make a histogram of the probability density of results after $O(100{,}000)$ runs of code
  - Determine the min, max, mean, median, mode (peak), RMS, width (quote the variance), skewness
- Validation of your result - is the shape of it right?

# Why Now?

- One reason we are doing this is because of the 2004 naval Nimitz incident (in addition: I often teach the introductory astronomy course here :)
  - https://www.nytimes.com/2017/12/16/us/politics/pentagon-program-ufo-harry-reid.html (there were other incidents)
- I should also mention the crazy story of a 5-year-old FOIA request to the DIA about crashed UFO parts
  - https://therooster.com/articles/off-world-updates-responding-to-ufo-info-request-pentagon-declassifies-five-mind-bending-reports-on-metamaterials-aerospace

# Some Checking

- https://www.lesswrong.com/posts/MdGp3vs2butANB7zX/the-fermi-paradox-what-did-sandberg-drexler-and-ord-really

- The Drake equation is quite old (1961)

- Some formulae, more modern, slightly more complicated, which do take more variables into account, do exist

# The 3-Door Monty Hall Problem!

- Also known as the gameshow host paradox
  - Who's already heard of this, knows the solution?
- https://www.youtube.com/watch?v=LeV0l3jrP30
  - Writing python code from scratch in video
- Let's play it out on the board together first
  - Then https://www.albany.edu/physics/phy577/MontyHall.cpp

# Just like my Monty Hall example:

- A similar but different puzzle with a non-intuitive answer. The Boy vs. Girl Paradox
- For background, explanatory reading see
  - https://jakubmarian.com/the-day-of-the-week-boy-or-girl-paradox-explained/
  - https://www.jesperjuul.net/ludologist/2010/06/08/tuesday-changes-everything-a-mathematical-puzzle/
- 1/3 and 13/27 probability cases
  - Convergence to ½ with addition of more information

# For HW #2 (2024) due Th Feb. 8th

- "Solve" the Drake Equation (1 plot). # of civs
- Bonus: Modify eq. to make "better" -w/ ref(s)