Monte Carlo Simulation Project Outline

Research Question:
How is percent difference associated with run length, if at all?

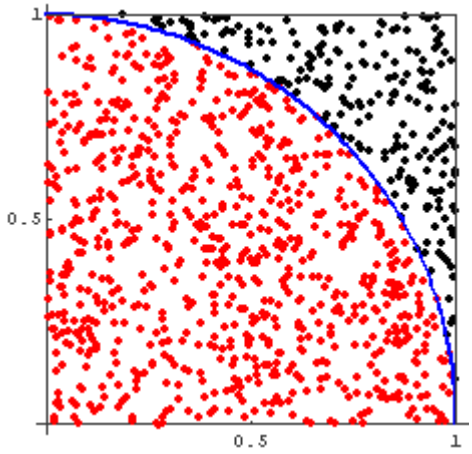
We will be using Python for our data collection.

Code Part:

Overarching goal: Calculate approximate values of PI using Monte Carlo simulations of different lengths (1 million - Excel row max) and compare results from 6 trials[1] (averaged over 10 runs[2]).

Specific goals:

- Code should have adjustable limit on runs.
- Code should be able to allow me to export trial data into an Excel worksheet
    - I will use JSON dumps to store the data and export it from there. [3]
    - I will also take screenshots of the trial to have a visual representation.
- Calculate individual run and trial percent difference to actual value of PI
- Mark points inside circle as red, circle itself blue, points outside black to make it more obvious
    - Also mark down how many of each type per run and sum it up at the end.



Plan:

- To calculate a value of Pi after a complete run, then divide number of points inside circle (NON-INCLUSIVE) by total number of points.
    - Should give individual run value of Pi over an entire trial. Will take average manually from data collected.
- Use Mathplot and Numpy Python libraries to achieve this task.

[1] A trial is defined as a complete set of runs at a set length
[2] A Run is defined as 1 completion of a code cycle
[3] Red bullet point means I expect to have the most difficulty achieving this

- Use 64 Bit python for better performance of the simulations (time-wise).

Data:

- 6 trials will be run.
    - Runs have varying length, starting at 10, going up by powers of 10 to 1 million.

Analysis:

- We will analyze how percent difference between experimental and theoretical values of Pi decreases with increase in run length.
- Visual Graph will be a histogram (Runs will spit out values of pi that it estimates)
- Collect and analyze summary data per trial
    - Ex. Standard deviation, mean, median, etc. + graphics
- Note any unusual patterns/outliers

Additional resources:

- https://academo.org/demos/estimating-pi-monte-carlo/
- https://www.geeksforgeeks.org/estimating-value-pi-using-monte-carlo/
- http://mathfaculty.fullerton.edu/mathews/n2003/montecarlopimod.html