Lab Assignment 10
The Monty Hall Problem

ACS II

Spring 2018

Assigned March 29th, 2018
Due April 6th, 2018

Monte Carlo Simulations

In this lab assignment, well look at using Monte Carlo Simulations to gain insight into problems that may prove intuitively difficult. We consider the Monty Hall Problem. The Monty Hall problem is named for the original host of the television game show Lets Make a Deal. The problem is presented as follows. A contestant is presented with three doors. Behind two of the doors, there is nothing, but behind one of the doors is a fabulous prize. The contestant picks one of these doors, and the host then opens one of the other doors, revealing it to be one of the doors containing nothing. The contestant is then given the option to switch their selection to the remaining unopened door. After they either switch doors or keeps his original selection, they receive the prize behind the door they currently hold

Exercise I

Write program that simulates the Monty Hall problem for 10000 trials. Each trial, randomly initialize 3 doors (two losers, and one winner) and then have the program randomly select one of those doors as the 'chosen door'. Discard one of (or the only) losing door that is not the chosen door. In this exercise, youll have the 'chosen' door never switch after discarding one of non-chosen doors. Then, determine if the 'chosen' door has the prize behind it for each of the trials. Keep track of the percentage of time the chosen door wins or loses and estimate his probability of winning using the never-switch stragety

Exercise II

Conduct the exact same experiment as above, but in this case, modify your code so that the chosen door is always swapped from the original selection, after the discard step. Estimate the probability of winning using this strategy.

Exercise III

Now, generalize your Monty Hall code such that it takes two integer arguments; the m, total number of doors at play in the game (which can range from 3 to ∞), and n, the number of losing doors opened by the host before being given the chance to switch (which can range from 1 to m - 2). Run a series of Monty Carlo simulations on the phasespace of m and n, (with $m < 100$) and produce a contour plot of the estimated probability of winning if the player always switches, with m as the x-axis variable, and n as the y-axis variable, and z as the win probability for each chosen combination of m and n . Compare your results with the theoretical win rate of $\frac{m-1}{m(m-n-1)}$, and comment on the general trend.

Exercise IV

Modify your code from Exercise I to work with OpenMP. Report the wall time needed with 1, 2 and 4 cores.

Submission and Grading

To get credit for this assignment, you must upload the following information to Canvas by 11:59pm, April 6th, 2018

- your source code files
- Your report as a single file in pdf format, including results from your work and relevant discussion of your observations, results, and conclusions.

This information must be received by 11:59pm, April 6th, 2018. Upload the required documents to Canvas. As stated in the course syllabus, late assignment submissions will be subject to a 10% point penalty per 24 hours past the due date at time of submission, to a maximum reduction of 50%, according to the formula:

*[final score] = [raw score] - min(0.5, 0.1 * [# of days past due]) * [maximum score]*