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ISTA 220 – Exercise 6B

16 September 2018

Monte-Carlo Method Questions

1. Why do we multiply the value from step 5 above by 4?

We multiply the value from step 5 by 4 because the value returned in step 5 is an estimate of Pi based on the upper right quadrant of the given circle. In order to make a complete estimate of Pi we simply multiply the result by 4 to account for the other 3 quadrants.

1. What do you observe in the output when running your program with parameters of increasing size?

The first thing that I observed is that the ratio of overlap was more or less consistent at every parameter size, roughly 60-70% of the random coordinates generated fell within the blue circle. Secondly, I noticed that the larger the parameter size, the more accurate the results became. At 10 parameters my Pi estimate could range anywhere from 2.4 to 3.6, but as we got into the 1000 and 10000 parameter range it was always consistently 3.0000 to 3.3000. The last thing I noticed was that the range of absolute difference between the estimate and Pi grew smaller because of the increase accuracy.

1. If you run the program multiple times with the same parameter, does the output remain the same? Why or why not?

No, the output will be different every time because the parameter only determines the size of the array that generates the coordinates. The coordinates themselves are created by a random number generator, and such are completely different in each new iteration of the program.

1. Find a parameter that requires multiple seconds of run time. What is that parameter? How accurate is the estimated value of ?

The parameter that took the longest (that wouldn’t throw an out of memory exception) was 100,000,000. It took around 5 seconds to completely finish computing, and returned 78,531,060 overlapping coordinate sets. This resulted with a Pi estimate of 3.1412424 which is only 0.000350253589793237 away from Pi.

1. Research one other use of Monte-Carlo methods. Record it in your exercise submission and be prepared to discuss it in class.

An engineer could use a Monte-Carlo method to simulate the effectiveness of an insulation product he is developing. He would do this by defining the upper and lower limits of effectiveness, and then generating random numbers around that range to get a simulated result of what the overall average effectiveness would be.