Oregon State University

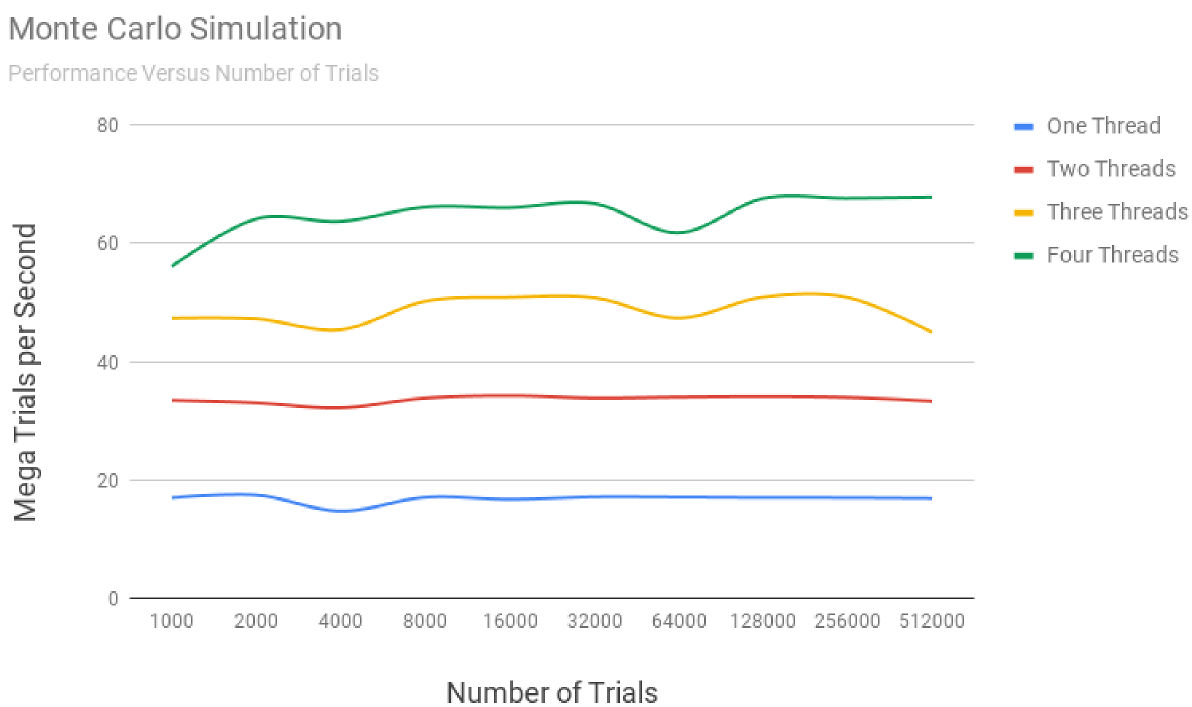
Project 1 Writeup

1. **Summary**

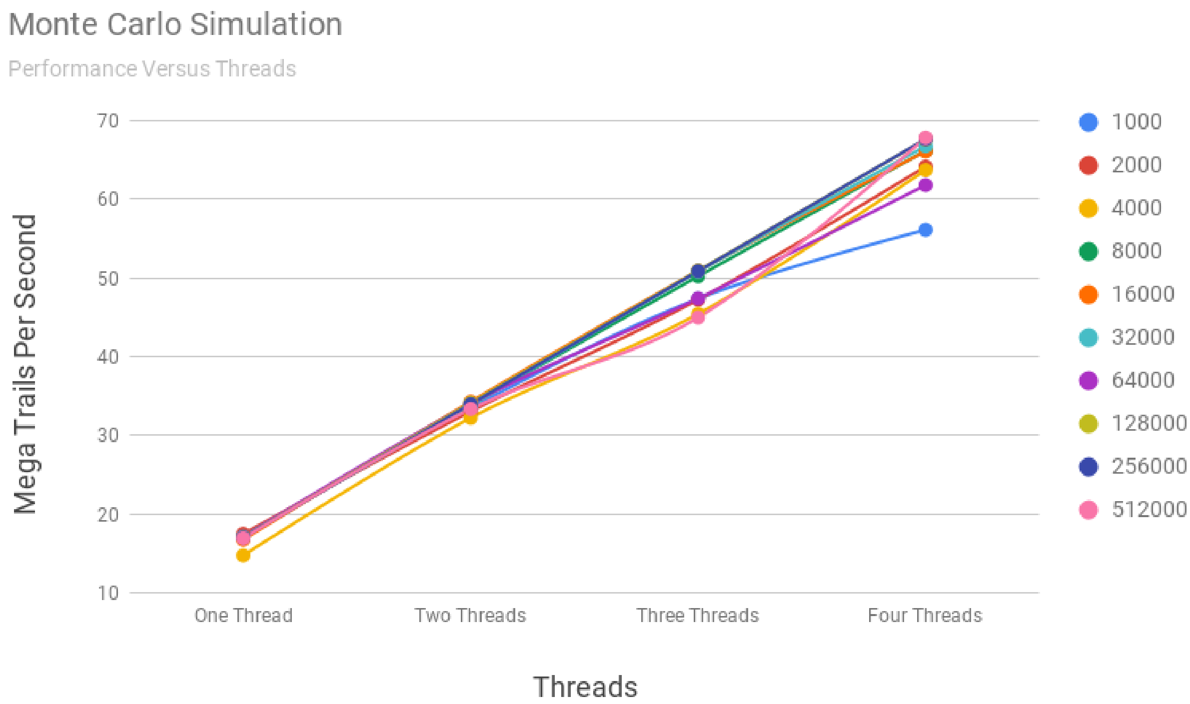
   Probability Estimate: **0.19**.

   I ran this Monte Carlo simulation on the flip3 engr server. I chose to run the same program with one thread, two threads, three threads, and four threads with input sizes 1000, 2000, 4000, ... 512000.

2. **Performance Results**



   There is a dip for an input size of 64000, which probably reflects a slight dip in server load since these program executions were executed serially through a shell script. There's an interesting dip in performance for the three threaded execution for large input sizes.



This graph illustrates that the performance generally increases as the number of threads increases. Interestingly, the the blue line that represents an input size of 1000 seems to increase at a slower rate for the four threaded execution, which might be explained by the fact that smaller input sizes are more greatly affected by the overhead involved in delegating work among threads. Or it could be a fluke.

3. **Parallel Fraction**

My estimate for the parallel fraction is **1**. I used the results from executing the code with four threads and with 512,000 number of trials to estimate the parallel fraction. If I choose instead the results from two threads or three threads, the parallel fraction changes to 0.98 or 0.93 respectively, so the estimate should be understood to have some error < 0.1.

Let S_1 and S_4 be the speeds of the program executed with one thread and four threads respectively. From my results, $S_1 = 16.96$ and $S_4 = 67.84$, so the speedup is $\frac{67.84}{16.96} = \mathbf{4}$.

From Amdahl's law, we can solve for the parallel fraction, P_f:

$$
\begin{aligned}
S &= \frac{1}{\frac{F_p}{n} + (1 - F_p)} \\
\frac{F_p}{n} + (1 - F_p) &= \frac{1}{S} \\
\frac{F_p}{n} - F_p &= \frac{1}{S} - 1 \\
F_p(\frac{1}{n} - 1) &= \frac{1}{S} - 1 \\
F_p &= \frac{\frac{1}{S} - 1}{\frac{1}{n} - 1} \\
F_p &= \frac{n(\frac{1}{S} - 1)}{1 - n} \\
F_p &= \frac{n}{1 - n}(\frac{1}{S} - 1) \\
F_p &= \frac{n}{n - 1}(1 - \frac{1}{S})
\end{aligned}
$$

Subsituting 4 for n and 4 for S:

$$
\begin{aligned}
F_p &= \frac{4}{4 - 1}(1 - \frac{1}{4}) \\
F_p &= \mathbf{1}
\end{aligned}
$$