

Project 1: Monte Carlo Simulation

By Caleb Knight

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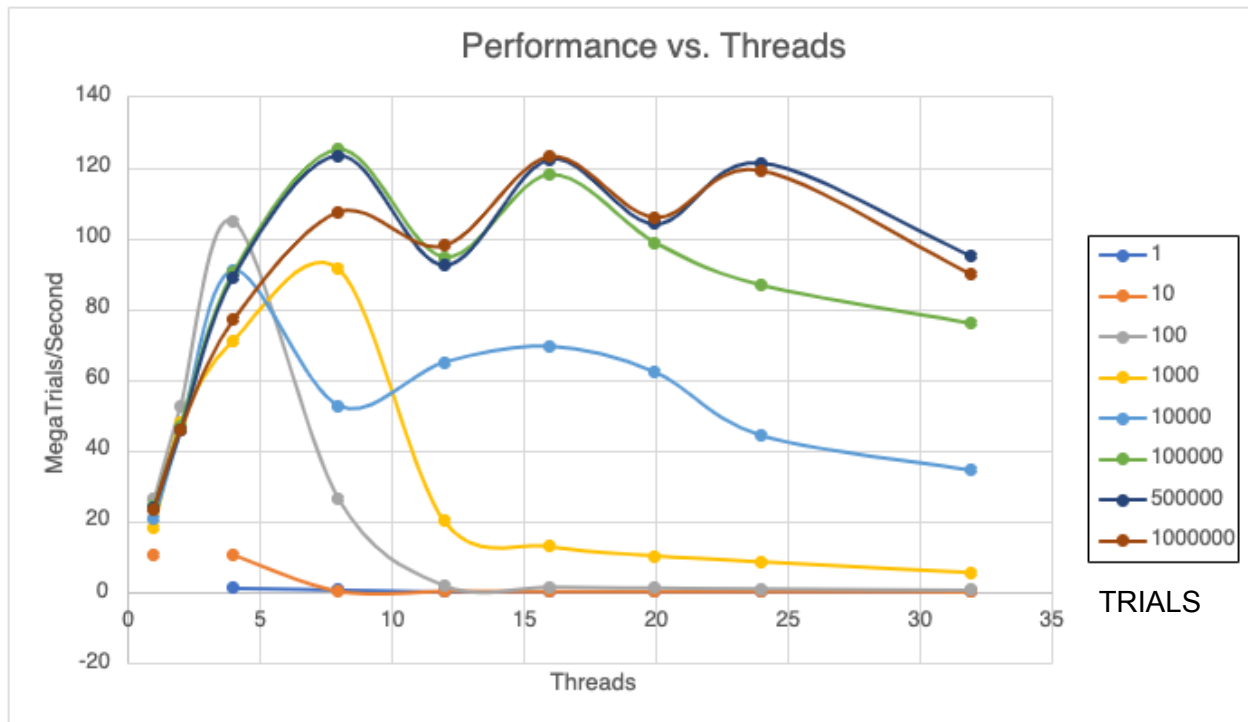
Simulation Results:

I ran this simulation with a multitude of threads, all using a multitude of trials.

In the table below, you can see the threads I used (on the left column) and the number of trial each ran (the top row)

When running the simulation, running it with 2 threads and with 8 threads had the highest avg probabilities. When I ran it with 8 threads, I got a **42.0135%** average (over all different sizes of trials). Out of the 8 runs, I had one outlier so when removing it (it got 100% on the first run) I averaged **33.73%**. So, running 8 threads 500,000 times gave me a **31.53%** probability which is the closest to the average so I feel the most accurate.

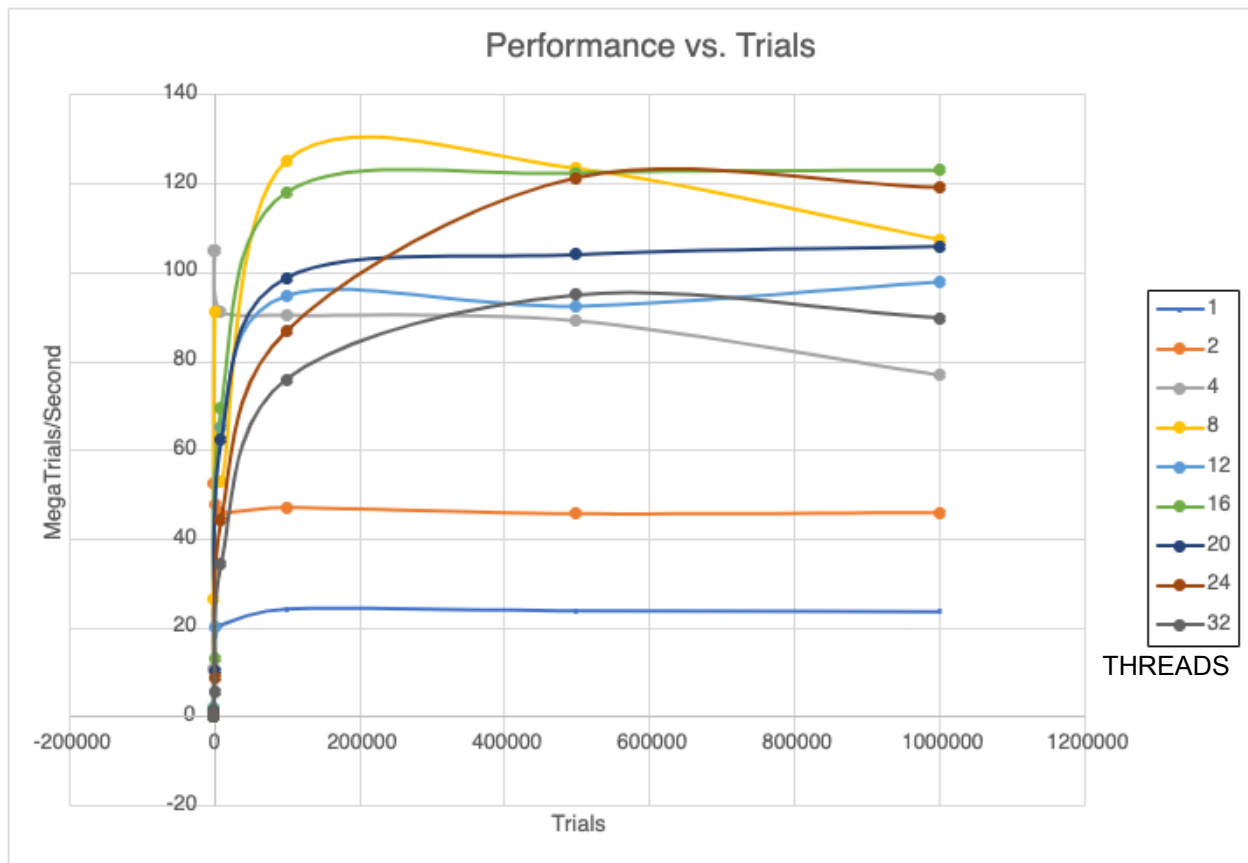
Threads vs NUMTRIALS								
Threads	Trials							
	1	10	100	1000	10000	100000	500000	1000000
1	inf	10.49	26.21	18.24	20.49	24.15	23.73	23.52
2	inf	inf	52.43	47.66	45.64	46.97	45.59	45.85
4	1.05	10.49	104.86	71.09	90.98	90.26	89.03	76.8
8	0.52	0.13	26.21	91.18	52.63	125.02	123.33	107.33
12	0.02	0.2	1.78	19.97	64.93	94.62	92.28	97.79
16	0.02	0.13	1.35	12.83	69.44	117.95	122.25	122.97
20	0.01	0.11	1.1	10.21	62.14	98.71	103.93	105.78
24	0.01	0.08	0.89	8.56	44.24	86.73	121.21	119.05
32	0	0.05	0.54	5.46	34.38	75.87	94.83	89.68



Above, our Performance vs Threads graph we see that when the trial count 1 or 10, it doesn't do very good at all. At 100 and 1000 we see a peak early, and then it falls off quickly before plateauing.

10,000 seems to be the turning point because it isn't the same as 100 or 1000, it recovers for 12 to 20 threads. But, after that, from 100,000 to 1,000,000 trials, the three simulations all seem to follow each other pretty well.

It appears there is a very healthy improvement up to around 8 threads and then when we try 12 threads, all three simulations noticed a significant drop. At 16 threads we see an improvement back to where we were before, and then at 20 we drop again. We make another improvement (using 500k or 1m threads) at 24 threads but 32 threads is worse than all other thread counts above 4 threads.



Here is our Performance vs Our number of Trials. While there is a lot going on here, I notice two major things.

First, over all different numbers of threads 10,000 trials seemed to be close to the peak performance. After 100k trials we had a few decrease, and a few increase. But, by the time we reach 500k trials, we are flattening out.

Secondly, we once again see that 8 threads and 16 threads stand out. 8 threads does great up to 100k trials. Then by 1mil trials, it falls to tie with 20 threads. But, 16 threads goes almost as high in performance as 8 threads, but doesn't fall. It stays up and at 1mil trials it is the leading performer.

Calculate $F_{parallel}$

These calculations will be based on 8 threads ran 500,000 times.

$$S = \frac{P_N}{P_1} = \frac{P_8}{P_1} = \frac{123.33}{23.73} = 5.2038$$

$$S = 5.2038$$

Now I will use the Speedup Value to calculate my $F_{parallel}$

$$\begin{aligned} F_{parallel} &= \frac{n}{n-1} * 1 - \frac{1}{S} \\ &= \frac{8}{7} * \left(1 - \frac{1}{5.2038}\right) \\ &= 1.1429 * (0.808) \\ &= 0.9235 \\ &= F_{parallel} = 0.9235 \end{aligned}$$