Kevin Harvell
harvellk@oregonstate.edu

Project 1 - Monte Carlo Simulation

Raw Data

# of Threads	# of Trials	Probability	Peak Performance (in MegaTrialsPerSecond)
1	100000	0.1909	19.2549
1	200000	0.19041	19.2871
1	400000	0.189433	19.3245
1	800000	0.189747	19.2369
1	1600000	0.190566	19.1644
1	3200000	0.190317	19.1874
1	6400000	0.190332	19.2338
1	12800000	0.190221	19.1316
2	100000	0.19068	38.3483
2	200000	0.19095	38.509
2	400000	0.190355	38.5528
2	800000	0.189468	38.5851
2	1600000	0.190029	38.4252
2	3200000	0.190018	38.3145
2	6400000	0.190215	38.4209
2	12800000	0.190471	38.3661
4	100000	0.19038	76.6302
4	200000	0.190455	77.1018
4	400000	0.18962	76.8446
4	800000	0.19032	76.7489
4	1600000	0.190274	76.7814

4	3200000	0.190465	76.7508
4	6400000	0.190428	76.6181
4	12800000	0.190381	76.6669
6	100000	0.19118	115.017
6	200000	0.19191	105.686
6	400000	0.19079	115.023
6	800000	0.190578	114.951
6	1600000	0.190095	114.92
6	3200000	0.19024	114.883
6	6400000	0.190231	114.828
6	12800000	0.190367	114.794
8	100000	0.1923	152.532
8	200000	0.191015	152.97
8	400000	0.189718	153.401
8	800000	0.190459	153.872
8	1600000	0.190725	153.036
8	3200000	0.190159	153.427
8	6400000	0.190164	153.043
8	12800000	0.19031	152.898
10	100000	0.18878	138.708
10	200000	0.189985	139.163
10	400000	0.19017	138.989
10	800000	0.189586	142.605
10	1600000	0.189795	140.428
10	3200000	0.190305	147.018

10	6400000	0.190362	155.006
10	12800000	0.190206	170.883
12	100000	0.19149	152.798
12	200000	0.189395	166.293
12	400000	0.19087	136.731
12	800000	0.19	152.752
12	1600000	0.190044	166.205
12	3200000	0.190323	168.501
12	6400000	0.190433	175.852
12	12800000	0.190157	178.485
14	100000	0.19214	192.566
14	200000	0.18981	192.768
14	400000	0.19101	194.861
14	800000	0.190276	194.348
14	1600000	0.190093	193.88
14	3200000	0.190314	196.572
14	6400000	0.190206	194.277
14	12800000	0.190286	200.198
16	100000	0.18873	221.736
16	200000	0.190525	221.717
16	400000	0.190207	219.328
16	800000	0.189894	222.093
16	1600000	0.190313	220.515
16	3200000	0.190208	220.305
16	6400000	0.190136	221.45

16	12800000	0.190357	223.59
18	100000	0.19154	191.576
18	200000	0.189565	238.129
18	400000	0.189035	249.962
18	800000	0.189354	249.201
18	1600000	0.189847	247.323
18	3200000	0.19025	247.394
18	6400000	0.190174	224.77
18	12800000	0.190319	245.843
20	100000	0.19011	274.903
20	200000	0.188925	276.242
20	400000	0.189608	275.633
20	800000	0.190656	274.829
20	1600000	0.190042	201.9
20	3200000	0.190275	270.991
20	6400000	0.190337	267.133
20	12800000	0.190325	267.137

Data Formatted for Graphs

	100000	200000	400000	800000	1600000	3200000	6400000	12800000
1	19.2549	19.2871	19.3245	19.2369	19.1644	19.1874	19.2338	19.1316
2	38.3483	38.509	38.5528	38.5851	38.4252	38.3145	38.4209	38.3661
4	76.6302	77.1018	76.8446	76.7489	76.7814	76.7508	76.6181	76.6669
6	115.017	105.686	115.023	114.951	114.92	114.883	114.828	114.794
8	152.532	152.97	153.401	153.872	153.036	153.427	153.043	152.898
10	138.708	139.163	138.989	142.605	140.428	147.018	155.006	170.883

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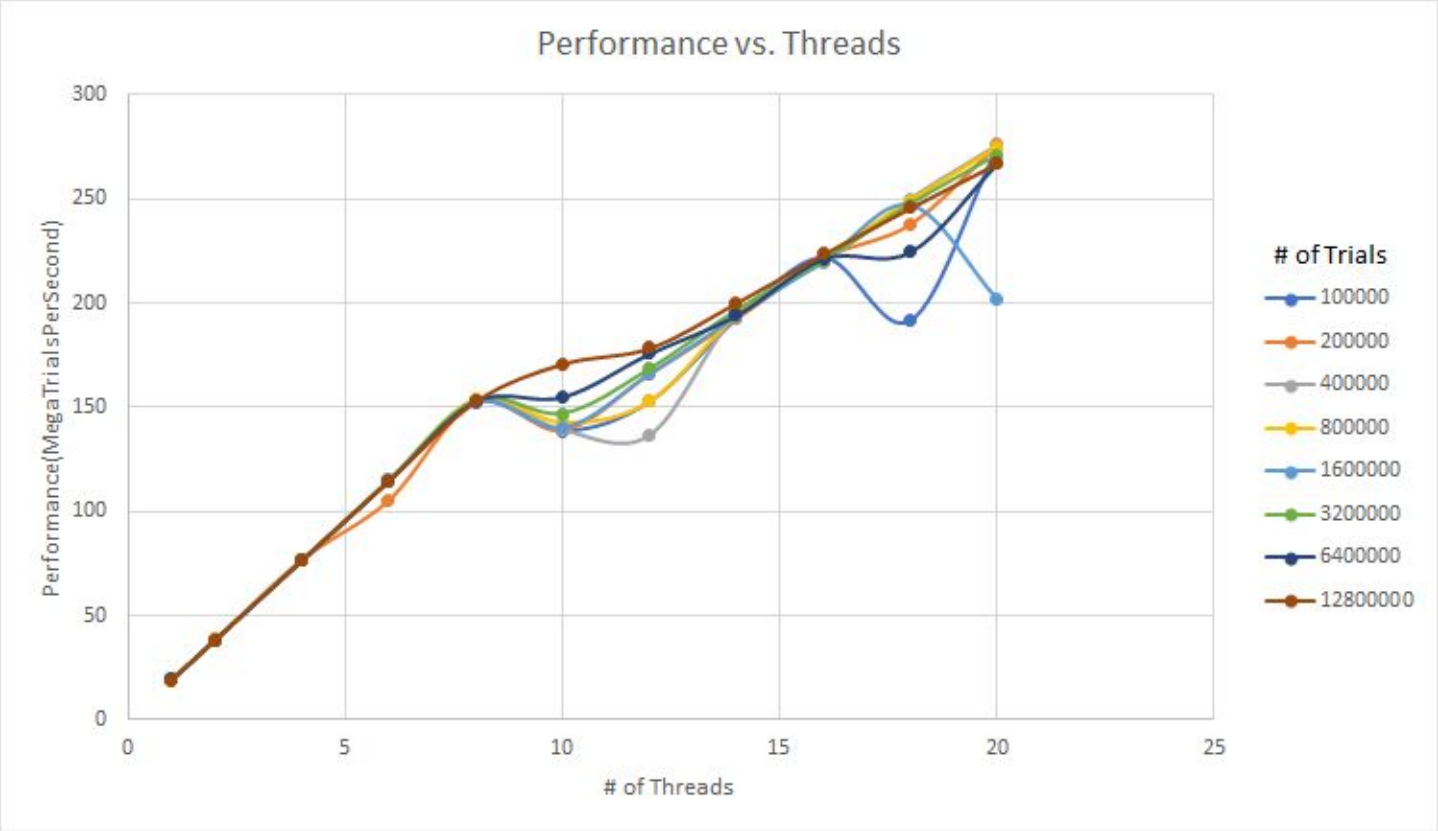
12	152.798	166.293	136.731	152.752	166.205	168.501	175.852	178.485
14	192.566	192.768	194.861	194.348	193.88	196.572	194.277	200.198
16	221.736	221.717	219.328	222.093	220.515	220.305	221.45	223.59
18	191.576	238.129	249.962	249.201	247.323	247.394	224.77	245.843
20	274.903	276.242	275.633	274.829	201.9	270.991	267.133	267.137



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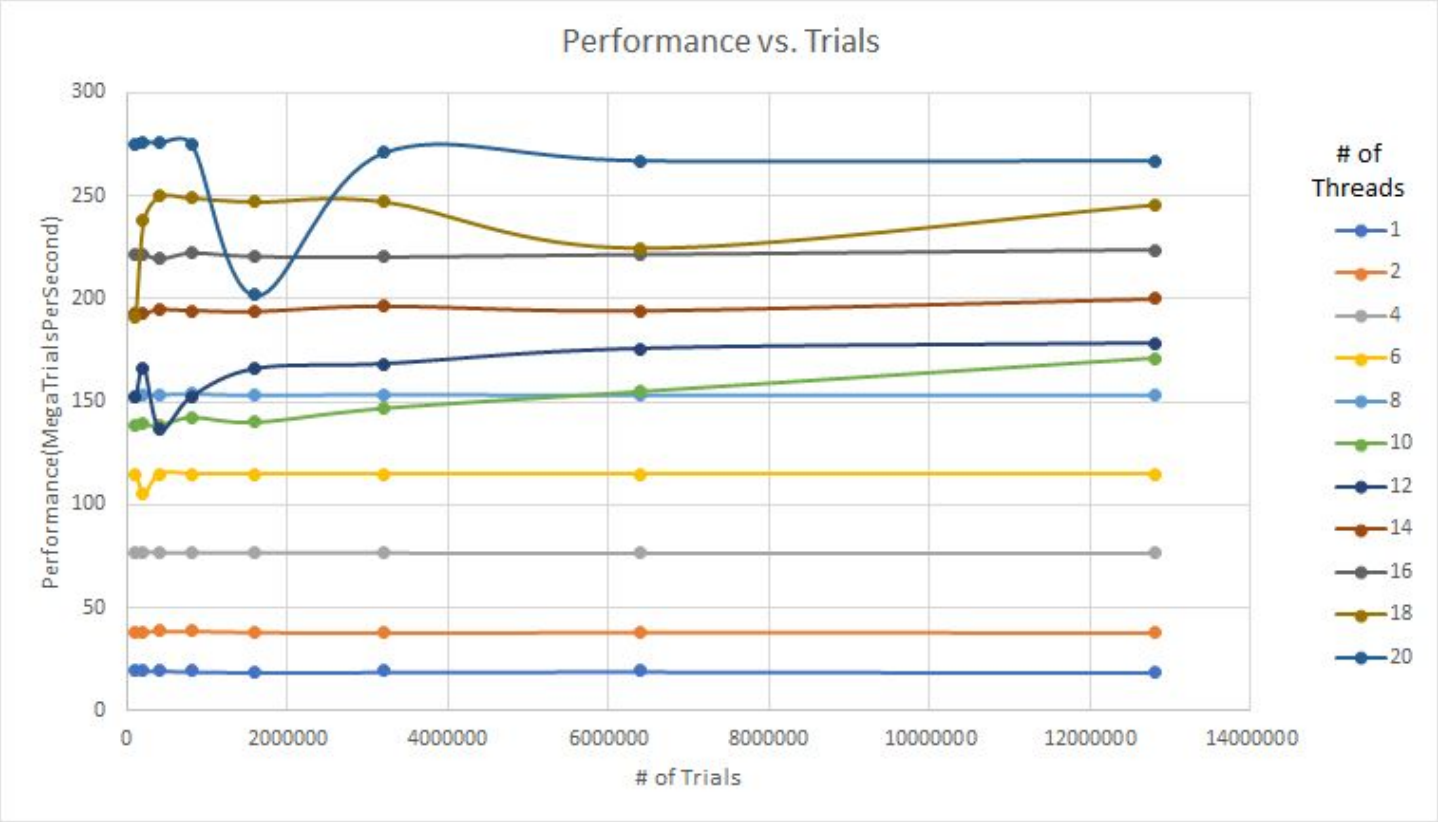

Using any of the 12,800,000 number of trial runs, the probability of hitting the plate is approximately 19%.

The speedup using 1 core, 12,800,000 trials and 4 cores, 12,800,000 trials is:

S = 76.6669 / 19.1316 = 4.007344

Parallel Fraction(Fp) = (4 / 3) * (1 - (1 / S))

= (4 / 3) * (1 - 1 / 4.007344)) = 1.00611

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The following chart uses the above formulas for each of the threads I tested with 12,800,000 trials:

Number of Threads	Speed Up	Parallel Fraction
1	-	-
2	2.005379	1.002682
4	4.007344	1.000611
6	6.00023	1.000008
8	7.991909	0.999855
10	8.931976	0.986714
12	9.329329	0.973976
14	10.46426	0.974009
16	11.68695	0.975397
18	12.8501	0.976425
20	13.96313	0.977245

Summary:

I found this to be an interesting assignment. I have learned about the Monte Carlo simulation before but have never had an opportunity to program it and analyze it in such a unique way. I found it particularly interesting how my Parallel Fraction numbers were so close to 1. I believe that might be due to my large trial size of 12.8M. As the number of trials grow, it seems that parallel programming becomes more efficient. These Fp numbers that are close to 1 indicated that most of the program is running in parallel. For the most part, adding cores to the the problem directly affected performance up until 10 cores where increases in performance became more marginal.