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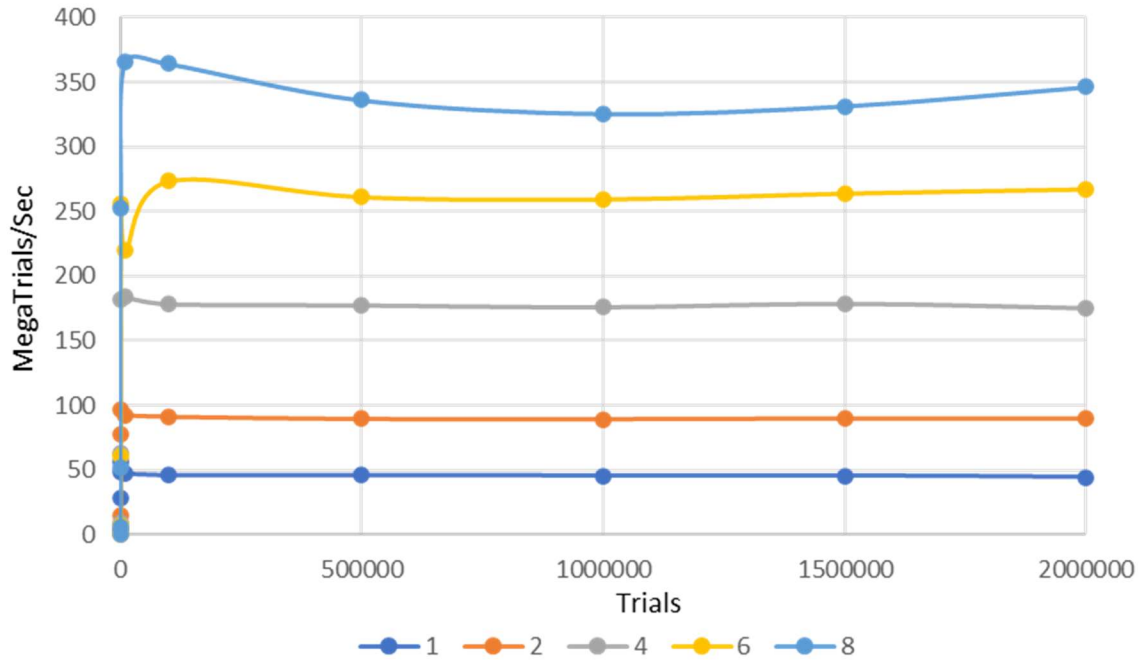
Project 1

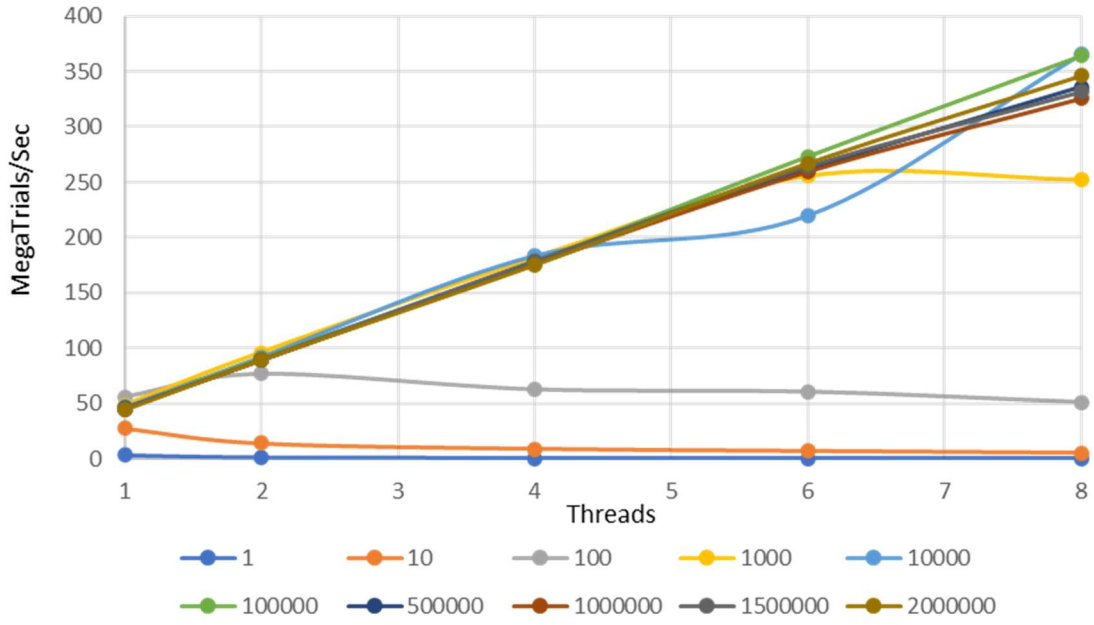
1. Data table of the performance numbers as a function of NUMT and NUMTRIALS.

	1	2	4	6	8
1	3.79	1.37	0.82	0.63	0.5
10	28.02	14.26	9.22	7.32	5.54
100	56.4	77.04	63.01	60.94	51.39
1000	48.71	96.18	181.79	255.42	251.95
10000	47.01	92.51	183.73	220.01	365.36
100000	45.73	91.15	178.4	273.38	364.17
500000	45.76	89.43	177.48	261.18	335.99
1000000	45.53	89.26	176.1	259.5	325.46
1500000	45.54	89.86	178.8	263.99	331.41
2000000	44.44	89.64	175.33	267.32	346.24

2. Performance vs Trials, with colored line being the number of OpenMP threads.



3. Performance vs Threads, with the colored line being the number of trials



4. Estimate of the Probability.

Threads	Trials	Probability	MegaTrials/Sec
1	1	0	3.79
1	10	60	28.02
1	100	58	56.4
1	1000	56.7	48.71
1	10000	57.32	47.01
1	100000	57.13	45.73
1	500000	56.98	45.76
1	1000000	56.95	45.53
1	1500000	56.96	45.54
1	2000000	57.06	44.44
2	1	0	1.37
2	10	70	14.26
2	100	58	77.04
2	1000	56	96.18
2	10000	56.37	92.51
2	100000	57.07	91.15
2	500000	56.96	89.43
2	1000000	56.98	89.26
2	1500000	57.04	89.86
2	2000000	57.04	89.64
4	1	100	0.82
4	10	60	9.22
4	100	55	63.01
4	1000	55.7	181.79
4	10000	56.94	183.73
4	100000	56.88	178.4
4	500000	56.95	177.48
4	1000000	56.96	176.1
4	1500000	56.99	178.8
4	2000000	57.02	175.33
6	1	0	0.63
6	10	50	7.32
6	100	58	60.94
6	1000	57	255.42
6	10000	57.44	220.01
6	100000	57.16	273.38
6	500000	57.08	261.18
6	1000000	57.09	259.5
6	1500000	57.01	263.99
6	2000000	57.04	267.32
8	1	0	0.5
8	10	50	5.54
8	100	51	51.39
8	1000	57.2	251.95
8	10000	57.19	365.36
8	100000	57.06	364.17
8	500000	57.12	335.99
8	1000000	57.08	325.46
8	1500000	57.06	331.41
8	2000000	56.96	346.24

According to the results, regardless of the number of threads utilized, the converged probability is around 57%.

5. Estimate of the Parallel Fraction.

$$speedup = \frac{performance\ of\ 8\ threads}{performance\ of\ 1\ thread} = \frac{364.24}{44.44} \simeq 7.79$$

$$Fp = \frac{n}{n-1} * \frac{speedup - 1}{speedup} = \frac{8}{8-1} * \frac{7.79 - 1}{7.79} \simeq 0.996$$

Therefore, the Parallel Fraction is around 99.6%

6. Why do the graphs look the way they do? What are they telling you?

The patterns in the two graphs are results of the limited number of CPU cores, which causes bottlenecks when additional threads are added. Amdahl's Law which states that only a portion of a process can be parallelized and limits the speedup that should be achieved through multithreading.

The first graph shows the relationship between performance and the number of trials, with different colored lines representing the number of threads used. It identifies a specific range of the thread numbers and trials numbers where you can expect the best performance. When operating in this range, we can optimize the performance of the parallel computing tasks. However, beyond this range, the benefit of adding more threads decreases.

The second graph shows the relationship between performance and the number of threads, with each colored line representing a different number of trials. It indicates that performance improves with an increase in the number of threads but only up to a certain limit. After reaching the limit, the addition of extra threads does not contribute to performance improvement. As Dr. Bailey said, over 8 threads might even get worse performance since the flip machine has only 8 cores and those threads must swap between the 8 cores.