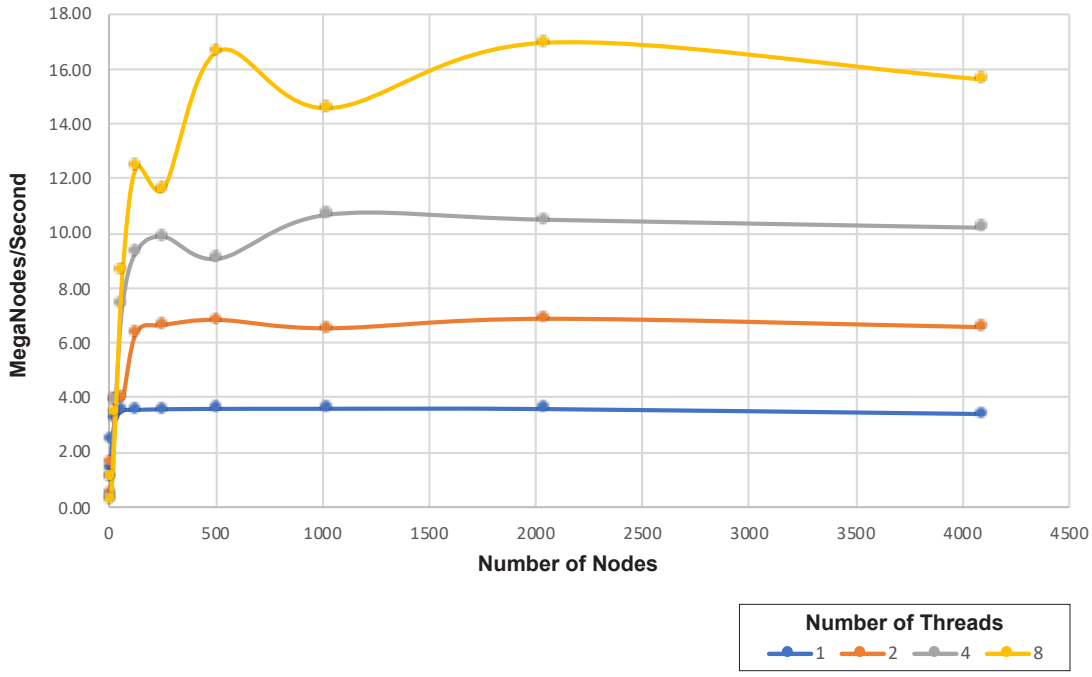
Kristin Schaefer

Project #2 : Numeric Integration with OpenMP Reduction

Machine: OSU flip

Performance vs. NUMT & NUMNODES

NUMT \ NUMNODES	8	16	32	64	128	256	512	1024	2048	4096
1	1.38	2.48	3.21	3.52	3.55	3.57	3.59	3.59	3.58	3.40
2	0.49	1.62	3.90	3.96	6.37	6.65	6.84	6.53	6.88	6.57
4	0.35	1.13	3.90	7.43	9.33	9.87	9.07	10.68	10.50	10.20
8	0.29	1.13	3.48	8.61	12.42	11.63	16.66	14.57	16.96	15.62



What patterns are you seeing in the speeds? Why do you think it is behaving this way?

The maximum performance, 16.96 MegaNodes/Second, was achieved with 8 threads and 2048 nodes. In general, as the number of threads increases and the number of nodes increases, the performance increases. However, when the number of nodes increases above 2048, the performance decreases. This is most likely a temporal cache coherence problem. A large data set and a greater number of cores will increase performance to a certain extent. After the data set grows so large, the data is processed faster than information can be retrieved from memory and the performance decreases.

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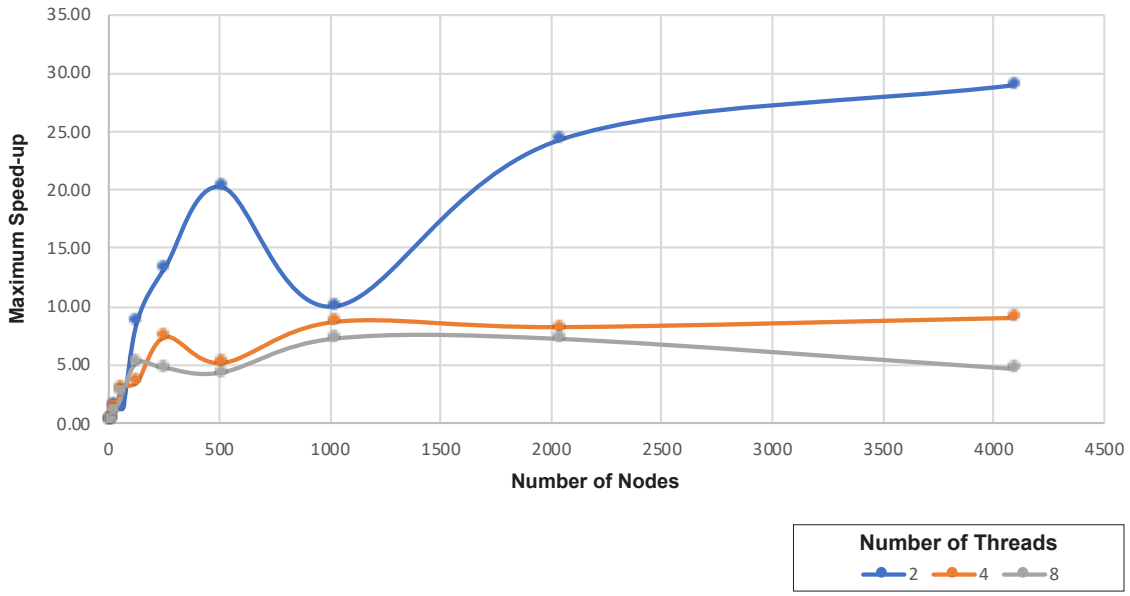
Parallel Fraction vs. NUMT & NUMNODES

NUMT \ NUMNODES	8	16	32	64	128	256	512	1024	2048	4096
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	-3.66	-1.06	0.35	0.22	0.88	0.93	0.95	0.90	0.96	0.97
4	-3.93	-1.58	0.24	0.70	0.83	0.85	0.81	0.88	0.88	0.89
8	-4.21	-1.37	0.09	0.68	0.82	0.79	0.90	0.86	0.90	0.89

Maximum Speed-up vs. NUMT & NUMNODES

NUMT \ NUMNODES	8	16	32	64	128	256	512	1024	2048	4096
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	0.21	0.49	1.54	1.29	8.69	13.40	20.23	10.01	24.35	28.99
4	0.20	0.39	1.31	3.35	5.75	6.70	5.15	8.68	8.23	9.02
8	0.19	0.42	1.10	3.08	5.43	4.80	9.68	7.20	10.16	9.44



What is the Parallel Fraction for this application, using the Inverse Amdahl equation?

The maximum Parallel Fraction for this application is 0.97, with 2 threads and 4096 nodes.

Given that Parallel Fraction, what is the maximum speed-up you could ever get?

The maximum speed-up is 28.99, again with 2 threads and 4096 nodes. I was surprised to see that the maximum speed-up (2 threads and 4096 nodes) did not correspond to the case which had the greatest performance (8 threads and 2048 nodes). I think this is due to the higher set-up cost, or $F_{sequential}$, that comes with adding more threads.

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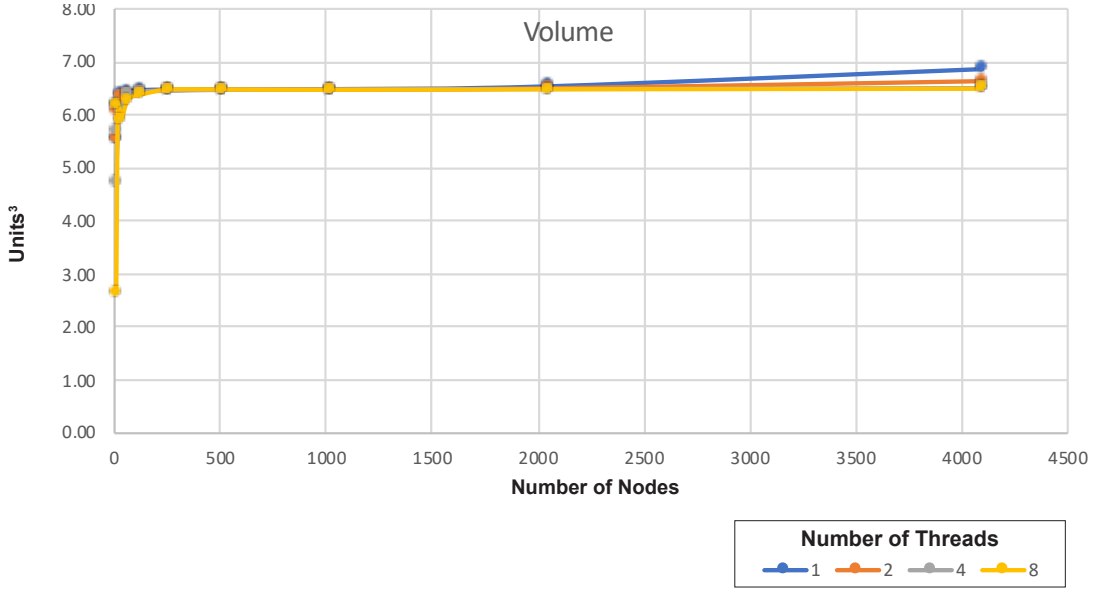
Volume vs. NUMT & NUMNODES

NUMT \ NUMNODES	8	16	32	64	128	256	512	1024	2048	4096
1	5.54	6.19	6.39	6.45	6.47	6.48	6.48	6.49	6.54	6.86
2	5.54	6.08	6.35	6.39	6.44	6.46	6.48	6.48	6.50	6.64
4	4.71	5.70	6.12	6.39	6.44	6.46	6.47	6.48	6.49	6.51
8	2.65	6.19	5.92	6.29	6.39	6.48	6.48	6.47	6.48	6.49



Actual volume estimate: As the number of threads and nodes increases, the volume of the superquadric converges to approximately 6.50 units^3.