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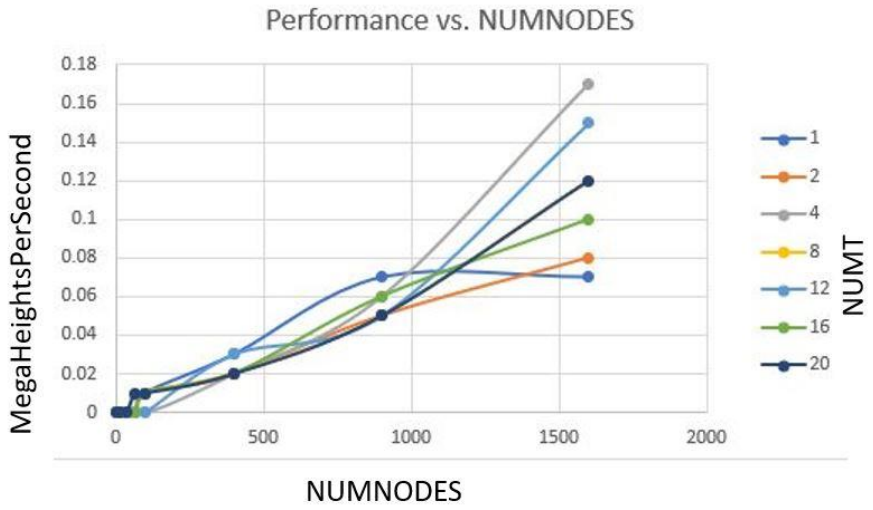
CS 475 Parallel Programming
4/26/2022

Project #2: Numerical Integration with OpenMP Reduction

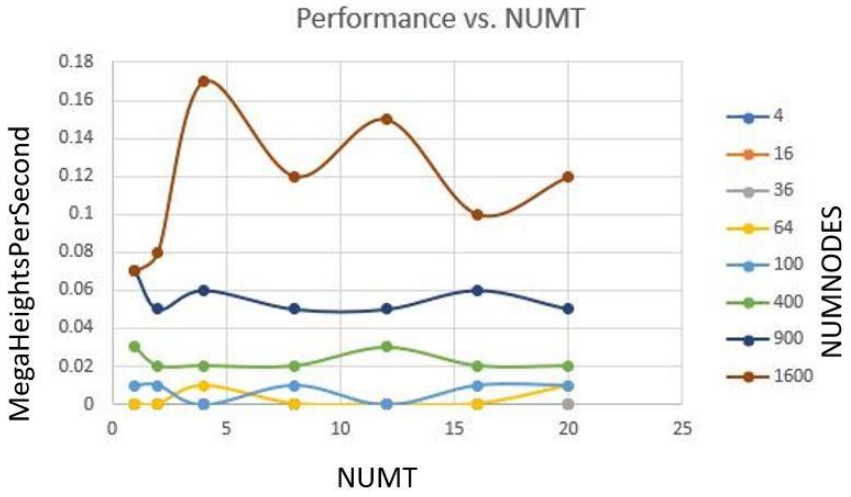
1. Tell what machine you ran this on
    - I ran project 2 on the flip server
2. What do you think the actual volume is?
    - Based on the largest NUMNODES (1600) I have tested so far, I believe the actual volume is around 7.75.
3. Show the performances you achieved in tables and two graphs showing:
    - Table:

NUMT	NUMNODES	Volume	MegaHeightsPerSecond
1	4	0	0
1	16	6.85	0
1	36	7.44	0
1	64	7.6	0
1	100	7.64	0.01
1	400	7.74	0.03
1	900	7.75	0.07
1	1600	7.75	0.07
2	4	0	0
2	16	6.85	0
2	36	7.44	0
2	64	7.6	0
2	100	7.64	0.01
2	400	7.74	0.02
2	900	7.75	0.05
2	1600	7.75	0.08
4	4	0	0
4	16	6.85	0
4	36	7.44	0
4	64	7.6	0.01
4	100	7.64	0
4	400	7.74	0.02
4	900	7.75	0.06
4	1600	7.75	0.17
8	4	0	0
8	16	6.85	0
8	36	7.44	0
8	64	7.6	0
8	100	7.64	0.01
8	400	7.74	0.02
8	900	7.75	0.05
8	1600	7.75	0.12
12	4	0	0
12	16	6.85	0
12	36	7.44	0
12	64	7.6	0
12	100	7.64	0
12	400	7.74	0.03
12	900	7.75	0.05
12	1600	7.75	0.15
16	4	0	0
16	16	6.85	0
16	36	7.44	0
16	64	7.6	0
16	100	7.64	0.01
16	400	7.74	0.02
16	900	7.75	0.06
16	1600	7.75	0.1
20	4	0	0
20	16	6.85	0
20	36	7.44	0
20	64	7.6	0.01
20	100	7.64	0.01
20	400	7.74	0.02
20	900	7.75	0.05
20	1600	7.75	0.12

    - Performance as a function of NUMNODES with colored lines showing different NUMT values:



- Performance as a function of NUMT with colored lines showing different NUMNODES values:



4. What patterns are you seeing in the speeds?
    - Since higher MegaHeightsPerSecond values indicate faster speed, the speed appears to be increasing as the number of nodes are also increasing.
5. Why do you think it is behaving this way?

- I think this may be the effect of the Gustafson-Baris Observation, where the Fp of a program increases as more data is used. As such, more of the elapsed time is associated with the parallel portion of the program, which is faster and more efficient at handling large data sets than the sequential portion.

6. What is the Parallel Fraction for this application, using the Inverse Amdahl equation?
    - S (Speedup from 1 - 20 threads @ NUMNODES = 1600) = 0.12/ 0.07 = 1.71
    - Fp = (n/n-1) * (1 - (1/S) = (20./19.) * (1. - (1./1.71)) = ~0.44
7. Given that Parallel Fraction, what is the maximum speed-up you could *ever* get?
    - Maximum Speedup = 1/1-Fp = 1/1-0.44 = 0.56