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Introduction to High Performance Computing
Term 2014/2015 (Winter)

Exercise 8

- **Return electronically (MOODLE) until Tuesday, 15.12.2014 23:55.**
- **Include name and your account (introhpc[xx]) on the top sheet.**
- **A maximum of two students is allowed to work jointly on the exercises.**

8.1 Reading

Read the following two papers and provide reviews as explained in the first lecture (see slides):

- Richard C. Murphy and Peter M. Kogge. 2007. On the Memory Access Patterns of Supercomputer Applications: Benchmark Selection and Its Implications. *IEEE Trans. Comput.* 56, 7 (July 2007), 937-945.
- Richard Murphy. 2007. On the Effects of Memory Latency and Bandwidth on Supercomputer Application Performance. In *Proceedings of the 2007 IEEE 10th International Symposium on Workload Characterization* (IISWC '07). IEEE Computer Society, Washington, DC, USA, 35-43.

(25 points)

8.2 n-Body Problem – Implementation

Implement an MPI version of the n-Body problem using the partitioning and communication model developed in the last exercise. All constraints from the previous exercise are still valid. Your program should work with any process count from 1 to 24.

Ensure the correct functionality by using the visualization tool provided.

(30 points)

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8.3 n-Body Problem – Experiments

- Measure the average time for object counts of 128, 512, 1024, 2k, 4k, 8k. Report the average time of one iteration by performing for instance 100 iterations, measuring the time with a suitable function (e.g., *gettimeofday()* in Linux) and dividing by the number of iterations. Do not include time for initialization or output. Use compiler-specific optimizations to minimize the runtime.

- Increase the number of processes from 2 to 24 for these object counts.

- Fill out the following tables and interpret results!

	Time/iteration					
Object count	NP=2	NP=4	NP=8	NP=12	NP=16	NP=24
128						
512						
1024						
2k						
4k						
8k						

	Speedup (compared to NP=1 execution time)					
Object count	NP=2	NP=4	NP=8	NP=12	NP=16	NP=24
128						
512						
1024						
2k						
4k						
8k						

	Efficiency (compared to NP=1 execution time)					
Object count	NP=2	NP=4	NP=8	NP=12	NP=16	NP=24
128						
512						
1024						
2k						
4k						
8k						

(15 points)

Total: 70 points