

**EECE5640**  
**High Performance Computing**  
**Homework 4**

**\*Submit your work on Turnitin on Blackboard**

1. (30) Develop a C/C++ program that initializes a 1024x1024 integer matrix, and then performs matrix inversion on this matrix as fast as possible. You can use serial programming, pthreads or OpenMP for this assignment. The fastest program will win a prize, and all reasonable answers will get full credit. Make sure to providing timing analysis as part of your code submission.

- a.) Evaluate your program for both strong scaling and weak scaling.
- b.) Evaluate your performance for both dense and sparse matrices.

\*Answers to this question should be included in your homework write-up in pdf format, should include a C/C++ program submitted on Blackboard, and submitted through Turnitin.

2. (30) Using the code provided in the matrix-matrix.c example on Blackboard, show how you can identify the size of the L1 data cache on the system where it is run. Discuss the detailed experiments that you ran, and confirm online that your findings match the configuration of the L1 data cache on the system where you carried out this experiment.

\*Answers to this question should be included in your homework write-up in pdf format, and submitted through Turnitin.

3. (20) On the Discovery Cluster, develop an MPI program that computes pi using the dartboard method. You can find a discussion of this method in the MPI tutorial provided on Blackboard. Vary the number of tasks and report on the execution time of your program.

\*Answers to this question should be included in your homework write-up in pdf format, and submitted through Turnitin. You should include a C/C++ program submitted through Turnitin.

4. (20) Read the paper on Blackboard titled “MPI on Millions of Cores.” Given that this paper was published in 2010 (9 years ago), can you comment on what changes have occurred since 2010 that could positively and/or negatively impact our ability to fully exploit parallelism on millions of cores? Many of the papers today discuss exascale computing. Select a recent paper on exascale-computing and compare/contrast the barriers identified in the two papers that impact our ability to achieve these milestones.

**This problem is extra credit for the undergraduates in the class, though is required by graduate students.**

\*Answers to this question should be included in your homework write-up in pdf format, and submitted through Turnitin.