



Lab Exam 2

In this assignment you are to fix MPI bugs in three codes and program a matrix multiplication using MPI.

1. Login to reinhardt via ssh (`ssh <yourusername>@reinhardt.cs.wit.edu`)
2. Copy the folder named **LE2** into your home directory. It is located in `/assignments`
3. The three bugged programs are already written, fix them. Include a brief description of the fix in your writeup to submit to Blackboard
4. Write a **makefile** and PBS script for your matrix multiplication program.
5. Write a matrix multiplication algorithm using MPI.
6. Verify that your code produces the correct result by comparing the serial output to your version of the code.
7. Do **NOT** run the program on the login node.
8. Time your code with a variety of ranks and create a scaling plot (either strong or weak).
9. Upload the completed plots to Blackboard, along with the bug fix descriptions.

A Matrix multiplication can be written as

$$\mathbf{AB} = \mathbf{C}$$

Matrix **A** is copied to every processor. Matrix **B** is divided into blocks, along the rows, and distributed among processors, i.e. the data for matrix **B** should be distributed among the ranks who perform the actual multiplication. They then send back their results to the rank 0 for output. Think about how matrix **B** should be laid out in memory for efficient distribution. Use whatever type of MPI parallelism that you see fit.

Use the following text matrix:

$$A(i, j) = 2i + j$$

$$B(i, j) = i + 3j$$

Confirm that your algorithm works correctly for small matrices first, then increase the size (and turn off the printing) to get the timings.

In your writeup:

- Briefly describe how you fixed the bugged MPI programs.
- For the matrix multiplication, include a scaling plot and a brief description of the MPI algorithm that you used.
- Time the communication in your matrix multiplication code as the size of the matrix increases, and include the plot.