WITS UNIVERSITY

School of Computer Science and Applied Mathematics
UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

COMS4040A & COMS7045A: MPI Lab 2

May 11, 2025

Objectives

- Design and implement parallel algorithms for some common problems using the MPI point-to-point and collective communication functions. These problems include dense matrix-vector, dense matrix-matrix multiplications, and sorting.

Programming

1. Write an MPI program to compute the element-wise addition of two vectors. Consider the following designs in your implementation:
   - To read in the dimension of the vectors, process 0 prompts the user, reads in the value, and broadcasts the value to the other processes;
   - Process 0 generates random values for two input vectors. Process 0 then sends the needed components of the input vectors to other processes by using `MPI_Scatter`, and collecting the addition results back using `MPI_Gather`.
2. Complete the different MPI versions of the *trapezoidal rule* discussed in the class.
3. Implement matrix-vector multiplication using MPI based on the example discussed in the class.
4. Implement a parallel dense matrix-matrix multiplication using MPI.
5. Implement the odd-even transposition sort using MPI according to the parallel algorithm given in the class.
6. Design and implement the parallel version of *quicksort* (`Lec11 slides`), *hyperquicksort* (`Lec11 slides`) and *mergesort* using MPI, respectively.