MSIM 715/815: Homework # 3 — [Pass/Fail]

Due Oct. 24, 2025 by 11:59pm via Canvas

Download and compile[1] on an ODU HPC cluster the `mpi_prime.c` and `ser_prime.c` prime-number calculation programs provided with the assignment. .

1. What type of parallelism (data- or task-based) is used in the parallel code?

2. Find values W (defined by the parameter `LIMIT` in the programs) for the numbers to scan that give (almost) an ideal speedup on 4 cores in three following scenarios: (I.2) one core per node (II.2) two cores per node and (III.2) four cores per node are used in the experiments. **To submit:**

   (a) Provide the values W_i, $i = 1, 2, 3$ that you have found for the three scenarios I.2, II.2, and III.2.

   (b) Perform at least three runs with sequential and parallel codes for each value in item 2a in each scenario. Provide the averaged speedup and the output of the command "`scontrol show j $SLURM_JOBID`" for each scenario.

3. Modify the program to keep the value W of the numbers to scan constant *per core* while increasing the number of cores. Experiment with sequences of eight different core numbers, starting from 4 cores, in the two following scenarios: (I.3) use single node, sequence terminates with the maximum number of cores available on the allocated node; (II.3) use two nodes and the sequence terminates at 40 cores *total*. **To submit:**

   (a) Provide the output of "`scontrol show j $SLURM_JOBID`" for each scenario.

   (b) Plot the time versus the number of cores used for each of the two scenarios I.3 and II.3 (Submit two figures).

   (c) Populate a table or annotate the plots with the *total* values for the numbers to scan in a given run, the maximum prime found and the total number of primes calculated by the program for each core count in the two scenarios I.3 and II.3.

   (d) How good is the weak scalability obtained? Justify your answer.

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[1]Hint: you can check the batch script *slurmHex_script_template* for how to compile an MPI program on the Wahab cluster.