

## Lab-4 (Parallel version of lab-2)

**There will be three sub-problems in this assignment. All the sub-problems have to be supplemented with a brief write-up with the following details (wherever necessary): bullet points are common for all three sub-problems.**

1. Context:

Brief description of the problem.

Complexity of the algorithm (serial and parallel).

Compute to memory access ratio

Memory bound vs compute-bound problem

Optimization strategy.

2. hardware details: CPU model, memory information details, no of cores, compiler, optimization flags if used, precision used. Max. Theoretical performance.

3. Input parameters. Output. How accuracy is checked.

4. Problem Size vs. Time (Serial) **curve**. Observations and comments about the results.

5. Speed-up vs. Number of cores (Lab-207: 2,4 cores, Cluster: 4,8,12,16 cores) (Parallel) for all problem sizes.

5. If more than one implementation, curves for all algorithms in the same plot.

6. Wherever necessary, use log scale and auxiliary units.

7. Measure the performance of the code in MFLOPS/sec. and plot problem size vs performance plot. How does it compare with the theoretical performance of the machine where the code is being executed?

**Run time should be significant so that the run time can be measured properly using timer functions. Start with a small problem size and go to the maximum possible problem size as far as possible.**

All runs need to be performed on Two machines → lab machine (207) and cluster.  
**At least 5** times for statistical analysis of fluctuations in run-time.

Different problems for different groups.

Lab Number	Group 2-17	Group 18-33
1	Problem A-1	Problem A-2
	Problem B-1	Problem B-2
	Problem C-1	Problem C-2

Problem A-1 -> Integration of a function using Trapezoidal rule. Verify your code by using it for the calculation of pi.

Problem B-1 -> Summation of two vectors followed by addition of constant  $[A(i)+B(i)] + k$

Problem C-1 -> Sorting - Quick Sort

Problem A-2 -> Calculation of pi using series (take large value of "N" for summation).

Problem B-2 -> Multiplication of Two vectors followed by summation.  $[A(i)*B(i)] + [A(i)+B(i)]$

Problem C-2 -> Sorting - Merge Sort

For all problems:

Step-1 - Parallel code development with proper comments

Step-2 - Run the codes on two machines: Lab 207 machine and HPC Cluster

Step 3 - Collect data for 5 runs which can be used for statistical analysis

Step 4 - Accurate run-time Data collection using scripts (algorithmic and end-to-end)

Step 5 - Upload data and commented code via a Google form

**The same input files will be provided to all the groups for comparison purposes.**

Bonus marks for the top team (each sub-problem) - (20% of total assignment marks)

Run-time Performance comparison of all teams will be shown in the next - labs.

More details will be provided for assignment submission and run-time data submission before the deadline.