Assignment 5: Now to Distributed Memory - MPI

Fall 2024

Due: Wednesday, Nov 20, 11:59 pm

Coding Task 1: Convert the Matrix Multiplication program to parallel using MPI. Use ***matrixMul.c*** as your starter code.

Coding Task 2: Convert the sequential program finding prime numbers using Sieve of Eratosthenes to parallel using MPI. Use ***prime.c*** as your starter code.

Coding Task 3: Convert the sequential program numerical integration using trapezoidal rule to parallel using MPI. Use ***integrate.c*** as your starter code.
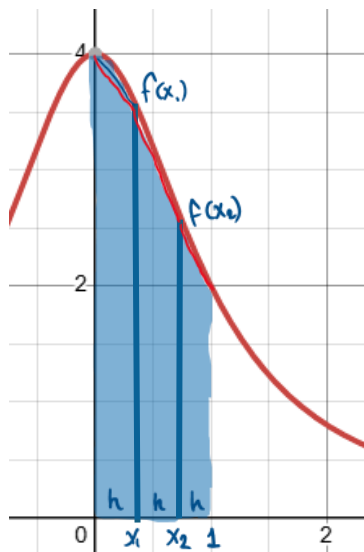
Trapezoidal Rule of Numerical Integration

$$\int_0^1 \frac{4}{1+x^2}\, dx \quad \text{-> area under the curve of each trapezoid}$$

$$A_i = \frac{h}{2}\big(f(x_i) + f(x_i + 1)\big)$$

$$Estimated\ Area = \sum_{i=0}^{N-1} A_i$$

Task 4: Benchmark the time it took for your sequential and MPI versions for tasks 1, 2, and 3 using the table below:

Note: Please use **MPI_Wtime()** for timing as shown below.

```
// Initialize MPI environment
MPI_Init(&argc, &argv);

// Get the start time
double start_time = MPI_Wtime();

// do stuff

// Get the end time
double end_time = MPI_Wtime();

// Calculate and print the elapsed time
double elapsed_time = end_time - start_time;
printf("Elapsed time: %f seconds\n", elapsed_time);

// Finalize MPI environment
MPI_Finalize();
```

Matrix Multiplication (for matrix size 1,000)					
	Sequential	1 process	2 processes	4 processes	6 processes
Time					
Sieve of Eratosthenes (for n 10,000,000)					
	Sequential	1 process	2 processes	4 processes	6 processes
Time					
Trapezoidal Rule Integration (for interval size 1,000,000,000)					
	Sequential	1 process	2 processes	4 processes	6 processes
Time					

D2L Discussion Task 5: Discuss your observations from coding tasks 1, 2, and 3 in detail. How does MPI compare with the previous tools like Pthreads and OpenMP.

Deliverables:

- A zipped folder named A5 submitted to D2L dropbox that contains:
  o Your source code files for coding tasks 1, 2, and 3.

- o   A pdf file for screenshots showing your codes work as expected and for task 4.
- o   A discussion post for Task 5 under D2L discuss – MPI.
- o   A README.txt file
- Available on GitHub inside the folder where you added me as a collaborator.

Total Points (100)

- Code runs and works as expected – Task 1: 25 points
- Code runs and works as expected – Task 2: 25 points
- Code runs and works as expected – Task 3: 25 points
- Clear documentation – Task 4: 5 points
- Clear, detailed explanation & replied to at least 2 peer posts – Task 5: 10 points
- Proper commenting and screenshot of code output: 5 points
- Available on GitHub: 5 points