# CSD 204 Lab
# Lab 4: Multithreading

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**Deadline - 23rd Feb 2025, 11:59PM**

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## Goal

In this assignment, you will explore the fundamentals of multithreading using pthread in C/C++. These tasks will help you understand how parallel processing can improve performance and where synchronization mechanisms are required to avoid unexpected issues like race conditions.

1. Write a C/C++ program to perform the **sum of one million numbers (from 1 to 1,000,000)** first using the **Sequential Approach** with a single process and then by the method of multithreading by using pthread. While doing it using pthread, vary the number of threads like 2, 4, 6, 8, 10, 12, 16 and so on.

**Analysis & Graph:**

Plot a **graph**

- **X-axis:** Number of Threads (1, 2, 4, 6, 8, …)
- **Y-axis:** Execution Time (in milliseconds or microseconds)

Discuss how increasing the number of threads affects the performance in terms of execution time. **[25 Marks]**

2. Write a C/C++ program to **sort 10,000 random integers** using **pthread**. Your task is to **generate an array of 10,000 random integers** ranging from 1 to 100000. **Sort the array** using two different approaches. First is **Single-threaded sorting** and the second is **Multithreaded sorting** using pthread, where the array is divided among multiple threads. Vary the number of threads from 2, 4, 6, 8, 10 and so on. **Compare the performance** of both approaches using graph and analyse the results. **[25 Marks]**

**Hint-** Use rand() to generate 10,000 random numbers.

3. Write a C/C++ program to demonstrate the **race condition** using 2 threads which will increment the global counter initialized to zero by a fixed value. **Implement two versions** of the program that are Without **Lock** and **With Lock.** Compare the results of both the implementations and discuss the results in detail. Also explain the behavior of the two implementations. **[25 Marks]**

**Submission Format:-** You have to upload: (1) The source code in the following format: Assgn4Src-<Name>.c (2) Report: Assgn4Report-<Name>.pdf. Name the zipped document as: Assgn4-<Name>.zip

**Note: Please follow this naming convention mentioned above.**

**Grading Policy:-** The policy for grading this assignment will be -

(1) Coding Problems will be of 75% weightage in total. (25% each for 3 problems)
(2) Result and observation analysis in the form of report - 15%
(3) Code documentation and indentation: 10%.

**Please note:**
- All assignments for this course have a late submission policy of a penalty of 10% each day after the deadline of six days. After that, it will not be evaluated.
- All submissions are subjected to plagiarism checks. Any case of plagiarism will be dealt with severely.