



YEDITEPE UNIVERSITY

**CSE 331
OPERATING SYSTEMS DESIGN
SPRING 2024**

ASSIGNMENT I

**Last Submission Date:
31 March 2024, 23:59**

UNIX PROCESSES AND POSIX THREADS

In this assignment, you will compare three programming concepts: multiprocess, multithreaded, and single-process programming. So you will write a multi-process, two multi-threaded, and a single-process program. For each program, you will write a code that finds the product of two square matrices. Matrices are to be implemented as arrays and their dimensions will be $N \times N$ and consist of random values between 1 and 10 as elements of the array. N will be up to 40000. The specific implementation details of each one of the programs are given in the implementation part.

IMPLEMENTATION (70 pts)

a) Multi-Process program (30 pts): This multi-process program will create child processes and each child process will do the corresponding row multiplication. For example, $N=40$, then 40 child processes will be created by the main process and each child does its row multiplication. In addition, every child process should do its operation concurrently. At the end, the parent process should print all the elements of the matrix multiplied. Also, it should calculate the total time of execution. Write your code in hw1a.c

b) Multi-Threaded Program With Mutual Exclusion (20 pts): This multi-thread program will create threads and each thread will do the corresponding row multiplication. For example, if $N=40$, then 40 threads will be created by the main thread and each thread does its row multiplication. In addition, every thread should do its operation concurrently. In this part of the assignment, each thread should access the elements of the matrices by using mutual exclusion for the multiplication. At the end, the main thread should print all the elements of the matrix multiplied. Also, it should calculate the total time of execution. Write your code in hw1b.c

c) Multi-Threaded Program Without Mutual Exclusion (10 pts): This multi-thread program will create threads and each thread will do the corresponding row multiplication. For example, if $N=40$, then 40 threads will be created by the main thread and each thread does its row multiplication. In addition, every thread should do its operation concurrently. In this part of the assignment, each thread should access the elements of the matrices without using mutual exclusion for the multiplication. At the end, the parent process should print all the elements of the matrix multiplied. Also, it should calculate the total time of execution. Write your code in hw1c.c

d) Single Process Program (10 pts): This program will do whole matrix multiplication in a single process. This program should not create a new child process or threads. At the end of the calculation, it should print all elements of the matrix multiplied. It should calculate the total time of execution. Write your code in hw1d.c.

REPORT (30 pts)

You are asked to write a report that expresses the design, implementation, and execution flow of your programs including your understanding of processes and threads. By obtaining **total execution times** (not CPU time) from each program you have written, compare multi-process and multi-threaded programming concepts. Express the total execution time variations for each program by playing with the N value. **In addition, compare those programming concepts with another choice of your metric which you consider crucial for the expression of the difference.** Explain your results clearly and support them with graphics in your report.

SUBMISSION RULES

- Writing clean, readable code and using comments are recommended.
- Include the student name and ID at the top of the code, as comments are required.
- Filenames of the C files must be hw1a.c, hw1b.c, hw1c.c, and hw1d.c.
- For report files, only PDF format is accepted. The filename of the report file must be Report1.pdf
- This homework will be sent to YULEARN.
- The submission must be zipped only as a zip file, no other zip formats will be evaluated.
- The name of the zip file should consist of student ID, assignment type, and number, excluded from space and special characters.
- Your C files will be checked for plagiarism using the MOSS system.
- Do not send your files via email. The files sent by email will **not** be taken into account!
- Any copied work **(including ChatGPT etc. generated text or code!!!)** will be evaluated as 0 points and the assignment will not be accepted!!!
- You are welcome to ask questions and come up with new ideas about the homework, but reading the instructions explained here carefully, and studying from the course book are highly recommended to have a general understanding before asking questions. More creative ideas can get higher points.

The due date for this assignment is strictly 31 March at 23:59 and submit your own work to stay away from consequences. Good luck...