CS 332/532 – 1G- Systems Programming

HW 4

Deadline: 11/24/2024 Sunday 11:59pm

No extensions will be provided

Objectives

In this assignment, you will explore the use of processes, threads, pipe operations, and file handling in C programming. You will also leverage UAB-approved AI tools to assist you in your development process.

Teamwork

You may work alone or in pairs (team of two). If working in pairs, one submission is sufficient, but it must include individual contributions from each team member.

Description

Tasks:

1. **Process Management:**
    - Write a C program where the **parent** process creates **three threads**. Each thread should:
        - Generate 500 random integer numbers (between 0 - 1000).
        - Send the numbers to a pipe, ensuring data integrity and preventing data override through proper synchronization.
2. **Pipe Operations:**
    - Implement pipe operations for communication between the parent and child processes.
    - Ensure the child process can read from the pipe without data loss or race conditions.
3. **Child Process and Thread Creation:**
    - Create a child process that spawns **ten threads**. Each thread should:

        - Read 150 numbers from the pipe.
        - Calculate the sum of these numbers.
4. **Calculate Average:**
    - After all threads in the child process have completed their execution, calculate the average of the sums obtained by each thread.
    - Print the average to a text file, **using standard output redirection**.
5. **AI Tool Usage:**
    - Document the use of **UAB-approved** AI tools in your project:
        - Describe how the tools helped you with coding, debugging, or understanding concepts.
        - Include specific prompts you used and the outputs you received from the AI.
        - UAB approved tools: https://www.uab.edu/ai/tools
6. **Signal Implementation:** *(Graduate Students Only)*
    - Implement a signaling mechanism that allows the parent process to notify the child process when all numbers have been generated. Ensure that the child process only begins reading from the pipe after receiving this signal.

Submission

Independent Completion Form:

- If working in pairs, each member must document their individual contributions to the project.

Project Report:

- Include all AI prompts and results.
- Provide instructions on how to compile and run the project.
- Summarize your approach and findings.

Project Files:

- Submit all project files, including the Makefile, in a compressed (.zip) format.

****GitHub Submission is also required for this homework (If you are working with a partner, we want to see each of your contribution through github)

Grading Rubrics

Functionality of the code	40 points
Proper use of processes, pipes, and threads with concurrency	30 points
File operations implementation	20 points
Quality of report and documentation	10 points
Total	**100 points**