CENG 305 – Operating Systems – Fall 2022
Project – 1 (Due date: 4/12/2022 23:59)

Multi-process and multi-thread calculation of mean absolute deviation and range

The **range** of a set of data is the difference between the largest and smallest values.

The **mean absolute deviation** of a set of data is the average distance between each entry and the mean. It shows the variability in data.

The steps of the mean absolute deviation (MAD) algorithm:

1. Calculate the mean.
2. Calculate the difference between each data point from the mean using positive distances. These are called absolute deviations.
3. Sum up those deviations together.
4. Divide the sum by the number of values in the vector.

Aim: The aim of this project is to use and create multiple processes and threads inside a process and gain an experience in the basics of parallel programming.

This is a teamwork assignment; you are going to work in a group of 5 or 6 students. If you could not find any group, we will assign you to a random group.

Cheating and studying together with the other project groups is strictly prohibited. A group should never show its codes to another group whether in seeking aid or giving it. A student may ask a fellow student a general question that does not pertain to a particular programming assignment but may not ask any programming aid.

Disciplinary action to be taken against cheating is arranged by the Rules and Regulations Governing Student Disciplinary Actions in Institutions of Higher Education.

You will implement three programs.

a) **mad_sequential.c** ; Basic program

b) **mad_process.c** ; Program with 2 processes

c) **mad_threads.c** ; Program with 2,3,4 threads according to the parameter

For process communications you should handle inter-process communication (IPC) between processes by yourself. Please pay an extra attention for communication part which is the most important portion for (b) part.

For multithreaded program you need to take necessary precautions for data consistency for the shared variables in your project if it is necessary.

Requirements:

1. A report. The format of the report should be the same with Group_XX_project-1_report.docx. Change XX with your group ID. The report should contain a summary of your project, implementation details, which IPC mechanism is preferred, what is the most changeling part in the project.
2. Your program should adopt one of the IPC mechanisms that we covered in the class.
3. Writing and reading directly from a file, instead of using IPC mechanism, is strictly prohibited. (otherwise gets 0 point)

4. You will use C programming language in Linux environment. Your project consists of three files called **mad_sequential.c, mad_process.c and mad_thread.c .** The name of the data file and number of threads for the multi-threaded program will be taken as parameters from the user.
5. Your program should call **fork()** system call for (b) part and **pthread_create()** for (c) part.
6. You will upload your project to aybuzem.aybu.edu.tr after compressing them in a single ZIP file name **groupXX_project1.zip**. The compressed ZIP file should include:
    a. three source files.
    b. A text file which includes your compilation commands that you used (gcc … -o ….. etc.) for each parts. This is a simple text file that has just 2-3 lines.
    c. Project report in PDF format.

Notes:

- The codes that give compilation error or run-time error will get **0.**
- Only one member of a group is required to submit the project. Otherwise you may lose -10 points.

Example:

Here some example executions for the project.

```
>> gcc mad_thread.c -o mad_thread

>> ./mad_thread tiny.txt 3

Program is reading tiny.txt

3 threads are created

Range is 1023.3

MAD is 187.55

Execution time for Range and MAD algorithm is 12.46 seconds.
```

```
>> gcc mad_process.c -o mad_process

>> ./mad_process tiny.txt

Program is reading tiny.txt

The child process is created

Range is 1023.3

MAD is 187.55

Execution time for Range and MAD algorithm is 13.19 seconds.
```

Please do not try to put some fake results in your report. The teaching assistant and I will test, run and analyze your projects separately and carefully on our computers.

Good luck!