**CENG342 Project-1**

Due: April 24, 2023

*Penalty for late submission is 20% per day.*

You cannot share or upload any of assignments of CENG342 to any web page, forum site or send somebody who does homework for money. If you take a similar attitude, you will be in opposition to the law on the protection of personal data and violation of copyrighted verbatim. In addition, disciplinary action will be arranged by the Rules and Regulations Governing Student Disciplinary Actions in Institutions of Higher Education.

This is a teamwork assignment; you are going to work in group of 3-4 students.

In this project, you are going to implement a parallel image processing algorithm. You are going to utilize multi-process parallelism via MPI library. Image processing tools provide a large range of different algorithms for all kinds of circumstances. A simple and effective algorithm is **resizing an image**. It changes the size of the input image and produces another image in desired size.

For the sake of simplicity, you only implement a parallel program that downscalesan image to half of its size. Before writing parallel program, you must first write the sequential program. Then you should make it parallel.

The program takes two inputs: the first for the input image and the second for the output image. Your program should perform a parallel **downscaling** algorithm on the input image and then store the results into a new image.

You need to measure the time for only **downscaling** and make tables that compare timings of your algorithms with varying number of processes. In addition, you must make 2 more tables for speed-up and efficiency values of your parallel algorithm.

There are many downsizing algorithms already proposed in the literature, such as bilinear, bicubic, sinc, Lanczos and so forth (excluding Nearest Neighbor, sampling). You are free to choose any algorithm in your program.

You may look at this link:

https://towardsdatascience.com/image-processing-image-scaling-algorithms-ae29aaa6b36c

\*If the size of input image is 400x400 then the size of output image should be 200x200.

**What is required?**

1. Report
   * A report that includes your names and surnames and appropriate title and small description.
   * Very short pseudocode of your **parallel** algorithm with at most **12 lines**.
   * Brief explanation: Steps of your parallel algorithm in terms of 4 steps of Foster’s methodology.
     + Furthermore, you should discuss which parallelism you adopted, task or data parallelism, with the reasoning behind it.
   * 3 Tables; for elapsed timings, speed-ups, and efficiencies of your parallel algorithm by using 1,2, and 4 Processes, if your PC has more cores than 4 you can increase the number of processes. For accurate timing please **take an average of at least 3 tests.**
   * Another 3 Tables for experiments on the server (16-core) that is provided for you to run your parallel code on it.
2. Source codes named seq\_main.c and mpi\_main.c written in C/C++ programming language for sequential and parallel programs, respectively. A Makefile description for compiling the source codes.
3. Bonus (20 pts): The CPU installed in the server is heterogenous that is 8 cores of 16 cores is faster than the other 8 cores (8 Performance and 8 Efficiency cores). Find a way to efficiently distribute your work on the cores so that load-balance on the cores will be optimum. Thus, you can reach the maximum speed-up.

**Notes:**

* Working together with other groups is prohibited.
* Submit your codes together with your report (**PDF** **format**) in a zip file named project1-GroupX.zip into AYBUZEM. (Replace X with your group number.)
* One member in each group should upload the exam on behalf of their group. That is, there should be only one submission for each group in the Aybuzem.