**CENG342 Project-1**

Due: April 22, 2021, Thursday 23:55

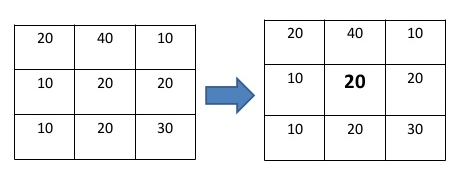
*Penalty for late submission is 10% per day.*

You can ask questions through AYBUZEM forum system.

This is a teamwork assignment; you are going to work in the same groups. Due to the coronavirus precautions, team members should collaborate and work remotely at their home. You can use any instant messaging program like Discord or Skype etc., to arrange video calls for collaboration in the project, i.e., work sharing, figuring out the project requirements etc.

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 kind of circumstances. A simple and effective algorithm is the **smoothing algorithm**. It calculates the average of each pixel’s value and its eight neighbors. You may consider an image as a 2-D array of color values, namely a matrix, the smoothing algorithm can be applied to all values of this matrix, namely the pixels of an image.

Following figure shows the smoothing process for the center point which becomes the averages of it’s 8 neighbors after smoothing. For further explanation you may look at the video on the youtube: <https://www.youtube.com/watch?v=ZoaEDbivmOE> .



1. Write a sequential program smooth.c that takes two inputs; the first for the name of input image and the second for the name of output image. Your program applies a smoothing algorithm on the input image and then store the results into a new image. This part does not contain any parallel processing.
2. Write a parallel program with MPI named mpi\_smooth.c that also takes two inputs; the first for the input image and the second for the output image. Your program applies a parallel smoothing algorithm on the input image and then store the results into a new image.
3. For both programs you need to measure the time for only smoothing process and make a table that compares timings of your algorithms with varying number of processes. You need to make 2 more tables for speed-up and efficiency values of the parallel algorithm.

An initial program for reading and writing an image is provided. You should modify this code by adding smoothing algorithm for sequential algorithm and parallel smoothing algorithm with MPI functions for mpi\_smooth.c .

**What is required?**

1. Report
   * Small report which includes your names and surnames and appropriate title and small description.
   * Very short pseudocode of your **sequential** and **parallel** algorithms with at most **10 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 MPI Processes. For accurate timing please **take average of at least 3 tests.**
2. Code

Source codes named smooth.c, mpi\_smooth.c written in C/C++ programming language.

**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 uzem.

\*You may look <https://github.com/nothings/stb> for further details of reading and storing images.