

# CSE 340 Midterm 3

Olcay Taner YILDIZ

## I. QUESTION (18 POINTS)

Write a function which reads and combines the array stored in different files. Processor 0 will read the file 0.txt, processor 1 will read the file 1.txt, etc. Each file has the following structure:

```
3
10 2 8
```

The first number  $N$  shows the number of integers stored in that file. After that, there are  $N$  integers in the file. After the execution of the function, each processor will have all elements stored in an array. (Hint: Use `MPI_Allgatherv`)

## II. QUESTION (16 POINTS)

Write the function `scatter_all` which scatters the elements in an array  $a$  stored in the processor 0 in the following way: Processor 0 will get first element, processor 1 will get second and third elements, processor 2 will get fourth, fifth and sixth elements, etc. (Hint: Use `MPI_Scatterv`)

## III. QUESTION (16 POINTS)

Write the function `gather_all` which gathers the elements in all processors into an array  $a$  residing in processor 0. All processors including processor 0 has  $k$  elements of the array  $a$ . (Hint: Use `MPI_Gatherv`)

## IV. QUESTION (16 POINTS)

Write the function `from_everyone_to_everyone` which reads  $p$  integers for processor 0,  $2p$  integers for processor 1,  $3p$  integers for processor 3, etc. Afterwards, processor 0 sends 1 integer to each processor, processor 1 sends 2 integers to each processor, processor 2 sends 3 integers to each processor, etc. At the end, each processor will have  $p(p + 1)/2$  elements. (Hint: Use `MPI_Alltoall`)

## V. QUESTION (18 POINTS)

Write the function `how_many_exact` which finds the number of exact integers from 1 to 1000000. An integer is exact if it is equal to the sum of its divisors except itself. For example, 6 is an exact integer, its divisors are 1, 2, 3, whose sum is  $1 + 2 + 3 = 6$ . You must ensure the load balancing between worker processors by using `MPI_Irecv` and `MPI_Isend`.

## VI. QUESTION (16 POINTS)

Write the function `is_sorted` which returns 1 if the elements in the array  $a$  are sorted, 0 otherwise. You can assume that all processors have  $n/p$  elements of the array  $a$ .