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Department of Engineering Sciences
IKC-MH.57
Introduction to High Performance and Parallel Computing
Take-home Midterm Examination
Nov 24, 2023 16:00 – Dec 18, 2023 23:59
Good Luck!

NAME-SURNAME:

SIGNATURE:

ID:

DEPARTMENT:

DURATION: Due to Dec 18, 2023

◇ **Answer all the questions**
◇ **Prepare your report/code(s).**
◇ **Copy your files into a directory named as your ID.**
◇ **Upload a single file by compressing this directory to UBYS.**

Question	Grade	Out of
1		30
2.1		10
2.2		10
2.3		10
3		40
TOTAL		

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1. **(30 Pts)** Summation of numbers is performed both in serial and parallel ways. For parallel computation, the environment is the networked workstations and the sequential computation is also done in the same cluster. (see the link: MPI Hands-On; Performance Analysis)

   i Complete the following tables. Data should belong to your results.

N/Time	$nproc = 1$	$nproc = 2$	$nproc = 3$	$nproc = 4$	$nproc = 5$	$nproc = 6$
10000						

N/Speed-Up	$nproc = 2$	$nproc = 3$	$nproc = 4$	$nproc = 5$	$nproc = 6$
10000					

N/Efficiency	$nproc = 2$	$nproc = 3$	$nproc = 4$	$nproc = 5$	$nproc = 6$
10000					

   ii Analyze the tables in detail.

   iii How many processor should be used for a specific value of N? Why?

2. (30 Pts) Answer the following questions. **Choose only 3 of them.**

   i Describe the Flynn's classification for computers. Which type of the computer we have made use of?

   ii Is it possible to have a system efficiency (E) of greater than %100? Discuss.

   iii Describe Blocking and Nonblocking Message-Passing.

   iv Compare briefly the point-to-point and collective communications.

   v What could be your criteria to choose a shared- or distributed-memory programming technique.

   vi Discuss the concept of communication overhead.

3. (40 Pts) The following program calculates the factorial as sequentially.

```c
#include <stdio.h>
#include <stdlib.h>
#define max_rows 20
int array[max_rows];
int main(int argc, char **argv)
{
  int i, num_rows;
  long int factorial;
  printf("please enter the number for the factorial: ");
  scanf("%i", &num_rows);
  if(num_rows > max_rows) {
    printf("Too many numbers.\n");
    exit(1);
  }
  /* initialize an array */
  for(i = 0; i < num_rows; i++) {
    array[i] = i+1;}
  /* compute factorial */
  factorial = array[0];
  for(i = 1; i < num_rows; i++) {
    factorial *= array[i];}
  printf("The %d! is %li\n", num_rows, factorial);
}
```

Design a parallel version of the same program using MPI calls.