

National University of Computer and Emerging Sciences, Lahore Campus



Course:	Parallel and Distributed Computing	Course Code:	CS-3006
Program:	BS (Computer Science)	Semester:	Spring 2023
Duration:	N/A	Total Marks:	35
Submit Date:	06-Apr-2023	Weight	2.5%
Section:	BCS (6E-6F)	Page(s):	6
Exam:	Assignment 02	Roll No.	

Name & Section:

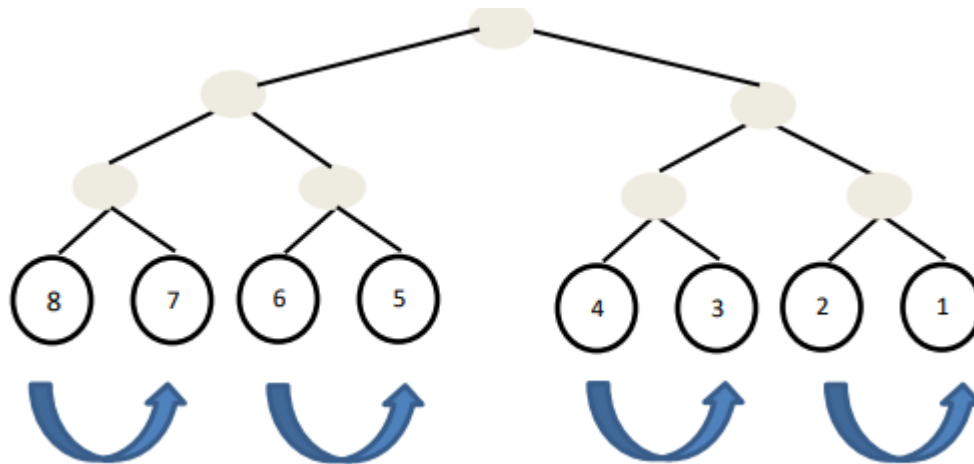
Submit assignment in Wednesday's class on 05 Apr 2023. Submission after that will not be accepted.
Attempt all questions on the assignment paper. Rough sheets can be used but it should not be attached. If you think some information is missing then assume it and mention it clearly.

Question # 1: [6+4 marks, CLO # 1] – Distributed Operating Systems

Provide a comparison of Network Operating System, Distributed Operating System, and Middleware. Briefly explain the goals of a middleware platform.

Question # 2: [2 + 2 + 2 + 2 + 2 marks, CLO # 3] – Prefix Sum

Briefly explain the concept of “Prefix-sum”. Now consider the following complete binary tree where we have to perform the operation “Prefix-sum”. Assume that the value to be contributed by each node is equal to $(8 - ID)$. Show the calculation at each step and provide the final value at each node at the end of the operation.



Question # 3: [8 + 6 + 1 marks, CLO # 2] – Message Passing Interface

- (i) Write the output for the following piece of code assuming that there are 4 MPI processes. Assume there is no syntax error.

```
int main(int argc, char** argv) {
    MPI_Init(&argc, &argv);
    MPI_Status status;
    int p, i, b;
    MPI_Comm_size(MPI_COMM_WORLD, &p);
    int my_rank;
    MPI_Comm_rank(MPI_COMM_WORLD, &my_rank);
    int a=my_rank;
    int sendTag=a;
    int recvTag=1;
    int next=(my_rank+1)%p; //determine my right node
    int previous=((my_rank-1+p)%p); //determine my left node
    MPI_Sendrecv(&a, 1, MPI_INT, next, sendTag, &b, 1, MPI_INT, previous, recvTag,
MPI_COMM_WORLD, &status);
    printf("I\'m %d: Received:%d from %d and Sent:%d to %d\n ",
my_rank , b, previous, a, next);
    MPI_Finalize();
}
```

OUTPUT:

- (ii) Assume these are the contents of sbuf in the processes P0, P1 and P2:

P0	2	3	1	7	11	0
P1	5	2	5	1	7	11
P2	2	4	4	10	4	5

Show the contents of rbuf in the same processes after this MPI command:

`MPI_Scan(sbuf, rbuf, 6, MPI_INT, MPI_SUM, MPI_COMM_WORLD);`

Hint: (MPI_Scan is used for prefix-sum).

Contents of rbuf:

P0						
P1						
P2						

Rough work:

- (iii) When we need the result of a reduction operation by all of the processes, which MPI operation will we use (just one)?