National University of Computer and Emerging Sciences, Lahore Campus

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Question 1: What is the one extra parameter used in MPI_Recv() that is not used in MPI_Send(), and in what circumstances would it be of greater importance? (5)

Question 2: What modification would be required in the following code to perform scatter operation instead of one to all broadcast? (10)

```
1.    procedure ONE_TO_ALL_BC(d, my_id, X)
2.    begin
3.       mask := 2^d - 1;                  /* Set all d bits of mask to 1 */
4.       for i := d - 1 downto 0 do        /* Outer loop */
5.           mask := mask XOR 2^i;         /* Set bit i of mask to 0 */
6.           if (my_id AND mask) = 0 then /* If lower i bits of my_id are 0 */
7.               if (my_id AND 2^i) = 0 then
8.                   msg_destination := my_id XOR 2^i;
9.                   send X to msg_destination;
10.              else
11.                  msg_source := my_id XOR 2^i;
12.                  receive X from msg_source;
13.              endelse;
14.          endif;
15.      endfor;
16.   end ONE_TO_ALL_BC
```

Question 3: Write output for following piece of code assuming that that there are 4 MPI processes. [Assume there is no syntax error] (10)

```
int main(intargc, char** argv) {
MPI_Init(&argc,&argv);
MPI_Statusstatus;
int p;
int i;
MPI_Comm_size(MPI_COMM_WORLD, &p);
int my_rank;
MPI_Comm_rank(MPI_COMM_WORLD, &my_rank);
int a = my_rank;
int b;
int sendTag=1;
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:

Question 4: **Suppose we have to perform one-to-all broadcast in this mesh where the source is node 0. How this operation could be performed using recursive doubling with minimum number of steps. Explain with details and mention the cost of this operation! (5)**

Question 5: Write summary of Slide 17 (detailed and hand written). (25)

Question 6: Write all MPI commands and functions, their syntaxes and details (hand written). (20)