Sample

Duration: 4 questions, 100 Minutes

closed notes/books, you can use a handwritten A4 size cheatsheet, please show your work

Name:....................................
ID#:....................................

Question 1 [25pts]: Given a 2D-mesh topology with \( p \) nodes, what is its diameter and bisection width? Now assume you can add \( 2(\sqrt{p} - 1) \) more edges on this network, what is the optimum placement of these edges that improves both the diameter and the bisection width? What is the new diameter and bisection width?

*Hint: you can start with a small \( p \) and generalize your solution*
Question 2 [15pts]: Suppose you observe a speedup that is larger than \( p \) where \( p \) is the number of processing elements, explain all possible reasons.
Question 3 [35pts]: Consider the 2D partitioning of a large $n \times n$ dense matrix on $p$ processing elements (i.e. each process is assigned a block of size $n/\sqrt{p} \times n/\sqrt{p}$). What would be the most suitable network topology for computing the transpose of the matrix. Give the parallel running time of the algorithm on the network topology you have proposed.

*Hint:* the transpose (i.e. $A^T$) of a matrix $A$ is defined as $[A^T]_{(i,j)} = [A]_{(j,i)}$ in which the subscripts denote the row and column indices of a matrix element.
Question 4 [25pts]: Assume a large number of MPI processes execute the following pseudo code segment where nb_procs is the number of MPI processes and rank is the process rank:

```plaintext
for i=1 to nb_procs-1
    if (rank = i-1) then
        MPI_Send(datas,n,MPI_DOUBLE,i,tag,MPI_COMM_WORLD)
    end if
    if (rank = i ) then
        MPI_Recv(datar,n,MPI_DOUBLE,i-1,tag,MPI_COMM_WORLD,&status)
    end if
end for
```

Explain what this code segment is intending to do. How would you modify it to make it run faster?