Sample Midterm

Duration: 4 questions 110 Minutes

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

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

Question 1 [25pts]: Serial and parallel running time of an algorithm are given to be $T_s = n^2 \times t_c$ and $T_p = n^2 \times t_c/p + \log_2 p \times t_s + p \times \log_2 n \times m \times t_m$, respectively. What is the speed up, efficiency and parallel overhead? Plot the speed up, efficiency and parallel overhead as a function of $p$ and show what happens as $p$ goes to infinity.
Question 2 [25pts]: Consider the parallel bitonic merge sort algorithm as we have seen in the class. Map it to a linear array network topology and give the parallel running time. In your analysis, take congestion into account if the links are congested.
Question 3 [25pts]: Given a 2D-mesh topology with $p$ nodes ($\sqrt{p} \times \sqrt{p}$), what is its diameter and bisection width? Now assume you can add 2 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?
Question 4 [25pts]: Let $k$-to-all broadcast be a collective communication operation in which the result of the operation is equivalent to each of $k$-nodes performing a one-to-all broadcast operation. Give an efficient algorithm for completing this operation and analyse its cost on a $p$-node hypercube assuming $k$ is a power of 2 and $k < p$. Note: you can assume any initial placement of data.