

CS121 Problem Set 2

Instructions: This problem set is due before 7:30pm on March 29, 2018. Submit a hardcopy of your solutions to the TA, or email your solutions to shwcshw@163.com.

- 1) a) Suppose we have a problem for which there is a sequential algorithm running in time n on an input of size n . Now, consider a parallel algorithm for the problem which has parallel running time $n/p + 2 \log p$ when using p processors. Is it possible to maintain isoefficiency for this parallel algorithm? If so, give the necessary relationship between n and p .

b) Suppose now the sequential running time is n^2 and the parallel running time is $n^2/p + n^3/\sqrt{p}$. Can this algorithm maintain isoefficiency, and if so, what is the necessary relationship between n and p ?
- 2) Simulate the following MPI collective communications operations by writing code that uses only MPI point-to-point routines:
 - a) `MPI_Bcast(buf, count, datatype, root, comm)`
 - b) `MPI_Reduce(sendbuf, recvbuf, count, datatype, op, root, comm)`
- 3) Given a balanced binary tree, describe a procedure to perform all-to-all broadcast that takes time $(t_s + t_w m p / 2) \log p$ for m -word messages on p nodes. Assume that only the leaves of the tree contain nodes, and that an exchange of two m -word messages between any two nodes connected by bidirectional channels takes time $t_s + t_w m k$ if the communication channel (or a part of it) is shared by k simultaneous messages.
- 4) For the same situation as in problem 3, give another algorithm all-to-all broadcast that takes time $(t_s + t_w m) (p-1)$.

Hint: Try to embed a p process ring in the tree.