HOMEWORK 2: DUE 21 SEPT 2007, IN CLASS

CSE 40833/60833: INTRO TO PARALLEL ALGORITHMS AND PROGRAMMING

Problem 2.1 (5 points)

Let X = x_0x_1 ... x_{n-1} and Y = y_0y_1 ... y_{n-1} be two strings of characters each of length n. We define lexicographic ordering on X and Y as follows: If x_i = y_i for all $1 < i < n$, then X = Y . Otherwise, let j be the smallest integer at which x_j and y_j differ, *i.e.*, x_i = y_i for all $1 \leq i < j$ and $x_j \neq y_j$. If $x_j > y_j$, then $X > Y$. If $x_j < y_j$, then $X < Y$. Give a parallel algorithm to find if $X > Y, X = Y$ or $X < Y$. It should run in $O(\frac{n}{p} + \log p)$ computation time and O $((\tau + \mu) \log p)$ communication time.

Problem 2.2 (5 points)

The Fibonacci sequence is defined by:

$f_k = f_{k-1}$ + f_{k-2}

where f_0 = f_1 = 1.

Give a parallel algorithm to compute the first n Fibonacci numbers using p processors and analyze its running time.

Problem 1.3 (5 points)

A sequence of nested parenthesis is said to be well- formed if both of these statements are true:

(1) there are an equal number of left and right parenthesis
(2) each right parenthesis is matched by a left parenthesis that occurs to its left in the sequence.

For example, ((() ()) ()) is well-formed but ()) (is not. A nested parenthesis sequence of length n is distributed across p processors. Design a parallel algorithm to determine if this sequence is well-formed and provide its running time.

Problem 1.4 (5 points)

Let A be an array of n elements. We are given an array L of the same length such that $L[i]$ is the label of the element $A[i]$. Assume that each label is an integer in the range 1, 2, ..., k, where k is a constant. We want to assign a unique rank in the range 1, 2, ..., n to each element of $A[i]$ according to the following rules:

(1) If $A[i]$ and $A[j]$ have different labels, the element with the smaller label should have the lower rank.
(2) If $A[i]$ and $A[j]$ have the same label, the element at the lower index should have the lower rank.

Design a parallel algorithm to compute the ranks and present its running time.