ICS 491: Parallel Algorithms
Homework 4

Due: May 1, 2014

1 Matrix multiplication

Write out the pseudocode for an $O(\log n)$-time, $O(n^3)$-work matrix multiplication algorithm of multiplying two $n \times n$ matrices. Analyze your algorithm and prove it to be correct.

2 Half-plane intersections (Exercise 6.31)

Let P be a simple polygon with n vertices. The **kernel** of P, denoted by $K(P)$, is the set of points q in P such that, for any point z on the boundary of P, the segment zq lies entirely in P. (See Figure 6.21 in the textbook for an example of a polygon and its kernel).

1. Show that $K(P)$ is the intersection of n half-planes defined by the edges of P.
2. Deduce an $O(\log n)$ time algorithm to compute $K(P)$. What is the total number of operations used?

3 Segmented Prefix Sums (Exercise 6.23)

Suppose that you are given an array A of length n with some of its elements marked, and you want to compute the prefix sums of each subarray consisting of the elements of A between two consecutive marked elements (the marked elements themselves are assigned arbitrarily to the subarrays). Show how to perform this task in $O(\log n)$ time using a total of $O(n)$ operations.

4 Convex hull intersections

Let U and L be a sequence of n points each of two convex polygonal chains. U and L are given in sorted order by increasing x-coordinates. Write out the pseudocode for a parallel algorithm that finds where the two polygonal chains intersect. Analyze the time and work complexity of your algorithm and prove its correctness.