

**22C : 031 Algorithms**  
**Homework 3**  
**Due Thursday, October 18**

You are expected to do the homework assignments on your own without consulting human and non-human sources (like web pages or books) for the solutions.

1. The  $L_1$  (or Manhattan) distance two points  $p = (p.x, p.y)$  and  $q = (q.x, q.y)$  in the plane is defined to be  $d(p, q) = |p.x - q.x| + |p.y - q.y|$ . Consider the problem of computing the closest pair (under the Manhattan distance) among a given set of  $n$  points in the plane. You are required to implement two algorithms for this problem. The first is the straightforward one that goes through all pairs of points to find the closest pair. The second is an adaption of the  $O(n \log n)$  algorithm in the textbook to the Manhattan distance case. (The adaptation is straightforward.) The inputs to both algorithms is an array of  $n$  points.

To test the algorithms, write a procedure that generates a point with  $x$  and  $y$  coordinates independently set to be random integers in the range  $[0, 100000]$ . Your point sets will be generated by repeated use of this procedure.

2. For each choice of  $n$  from

$\{100, 200, 1000, 2000, 10000, 15000\}$ ,

run each of the two algorithms five times and report the average (wall clock) time taken. You will have to add some code to calculate the time taken.

You can use either Java or C# as the programming language for this this homework. Instructions for submitting this homework will be added to the course webpage soon.