

Programming Assignment 1

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1 Problem Statement

Area covered by union of Trapeziums We had seen the problem of computing the total area covered by a set of rectangular posters. Consider its variation where the posters are in the shape of trapeziums. These are right angle trapeziums: for any poster, its base is on the x-axis, two of its edges are parallel to y-axis. More precisely, the coordinates of the four corners of the i -th poster are of the form $(a_i; 0)$; $(c_i; 0)$; $(a_i; b_i)$; $(c_i; d_i)$ for some positive numbers a_i ; b_i ; c_i ; d_i . The goal is to compute the total area covered by the union of these posters and the total length covered on the x-axis.

2 Algorithm

Solution proposed uses **Divide and Conquer** approach to solve the problem, we will recursively divide the set of trapeziums into two halves and merge the respective skylines of the two halves at the merge step. The main part of the algorithm is the merge step, in the solution code, I have written different cases for merging the two sets of skylines based on the orientation of the x coordinates of two corresponding lines belonging to each set and whether these two lines are intersecting or not. I have two iterators i and j for the first set and second set respectively for denoting i -th and j -th line of the first and second set respectively. Now based on the comparison of the x coordinates of the end points of these two line segments, I either increment i or j and hence iterating over the first and second sets just only once which means this merge step is of order $O(n)$. There are total 9 different orientations possible for the alignment of the x-coordinates of the starting and ending points of two lines, one picked from the first set and the other from the second set, these are distributed over *if* and *else* statements in the code. I have pictorially described all the cases possible and my code just checks through these cases while merging two skylines.

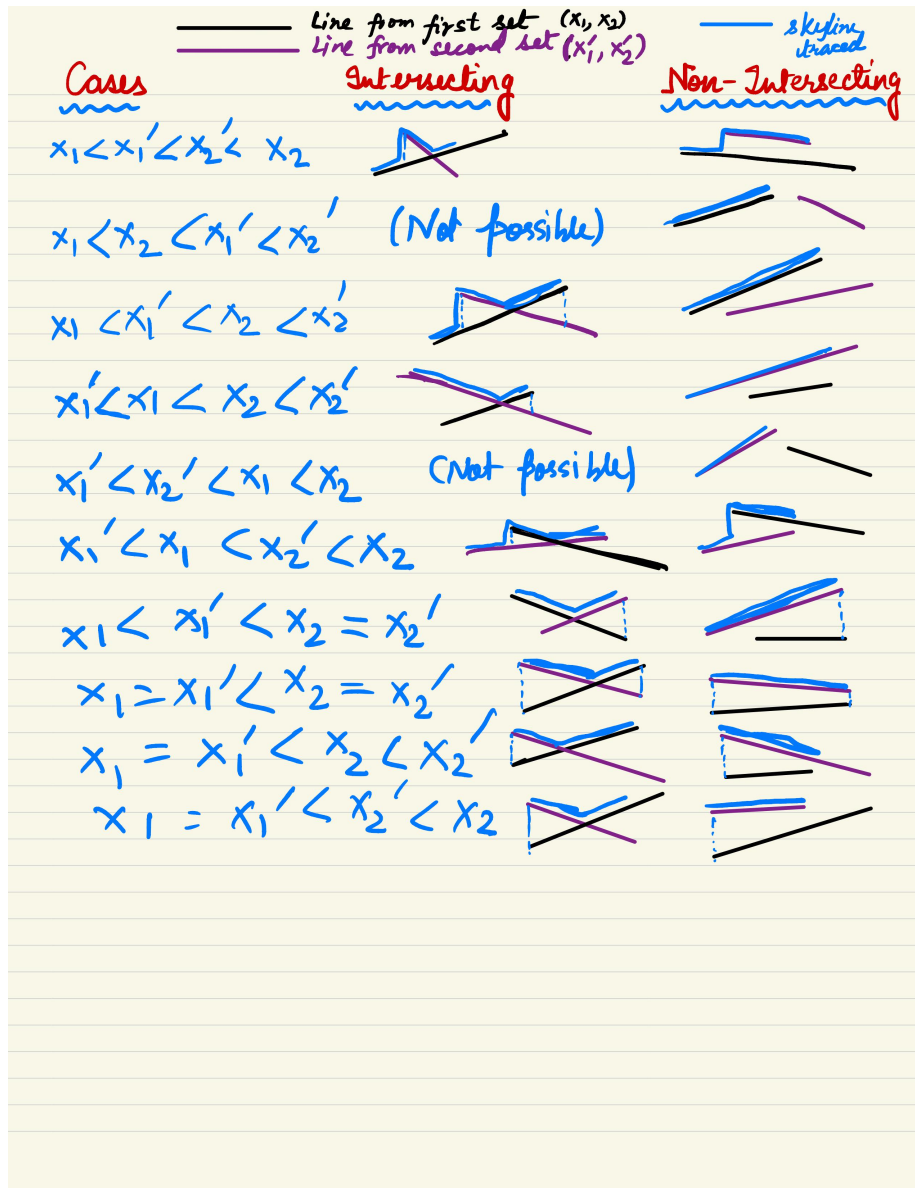


Figure 1: Different Orientations Possible for X Coordinates of Two Lines