

CS504 PhD qualifying exam

1. What is the worst-case running time of the algorithm for performing a 3-dimensional range query on a kd-tree storing n points in 3D? Justify your answer.

2. (a) Show that the set of edges of a Delaunay triangulation of a set P of points in the plane contains the Euclidean minimum spanning tree (EMST) of P .

(b) Use this result to give an efficient algorithm to compute an EMST of P . Analyze the running time of your algorithm.

3. What is the lower bound for computing the convex hull of a set of n points in the plane? Justify.

4. Let $p := (p_x, p_y)$ be a point in the plane. The dual of p , denoted p^* , is the line defined as $p^* := (y = p_x x - p_y)$. The dual of a line $l : y = mx + b$ is the point p such that $p^* = l$. In other words, $l^* := (m, -b)$.
 - (a) Prove that the above duality transform is incidence and order preserving.
 - (b) What is the dual of a line segment whose endpoints are p and y ?
 - (c) What is the dual of the collection of points inside a given triangle with vertices p , q , and r ?