CMPS 6130 Computational Geometry – Spring 20

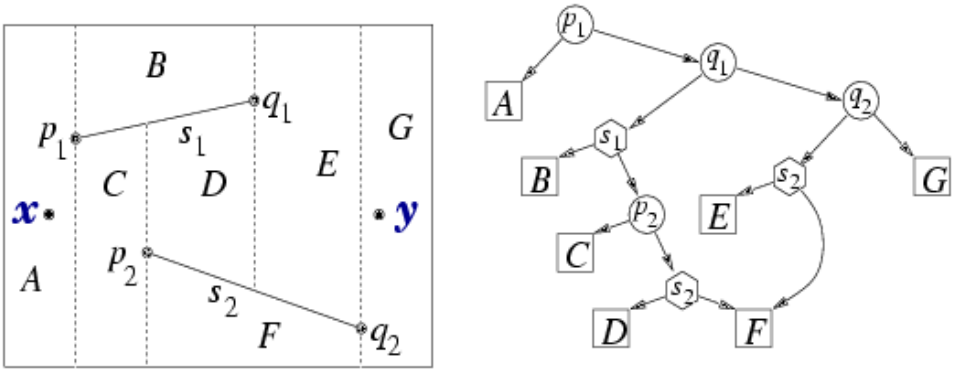
2/13/20

5. Homework (grad)

Due **2/20/20** before class

Please justify all your answers. Often it helps to draw pictures.

1. **Trapezoidal Map (10 points)**
   Consider the following instance of the trapezoidal map point location data structure. The left side shows the map, and the right side shows the corresponding DAG. Describe the resulting trapezoidal map and DAG after segment $\overline{xy}$ has been added.



2. **RIC For Convex Hulls in 3D And 2D (10 points)**

   Recall that the boundary of the convex hull of a set of n points in $\mathbb{R}^3$ can be thought of as a "planar" subdivision and hence can be represented using a DCEL in $O(n)$ space. So the complexity of such a convex hull is $O(n)$.

   (a) Please study the randomized incremental construction algorithm for computing convex hulls in $\mathbb{R}^3$ that is described in the "3D convex hull slides" and in sections 11.2-11.3 in the textbook. You don't need to understand all the details of the algorithm, but the goal is to get a general idea of how the algorithm and its analysis work.

   (b) Describe and analyze a randomized incremental construction algorithm for computing convex hulls in $\mathbb{R}^2$. Your algorithm should be an adaptation of the algorithm in $\mathbb{R}^3$, it should use a conflict graph, and you should use backwards analysis to analyze the expected runtime. Note that in $\mathbb{R}^2$ the algorithm and the analysis are quite a bit simpler than in $\mathbb{R}^3$. Also note that while the algorithm is related to the incremental insertion algorithm that we covered in class, the randomized approach is different in that there is no pre-sorting of the input points, and the conflict graph needs to be maintained.