CS 6463 Computational Geometry, Fall 10

9/8/10

1. Homework

Due **9/22/10** before class

Always justify the runtime and the correctness of your algorithms.

1. **Convex Hulls (15 points)**
   This exercise is about computing the convex hull of objects other than points.

   (a) Let S be a set of n line segments in the plane. Prove that the convex hull of S is exactly the same as the convex hull of the $2n$ endpoints of the segments. *Hint: It is enough to use the definition of the convex hull as the intersection of convex sets.*

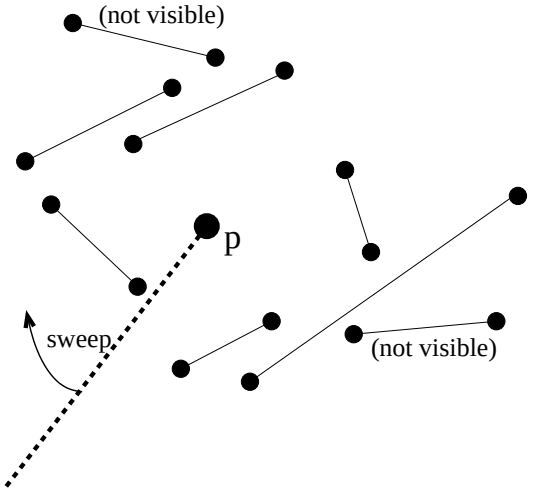
   (b) Let $\mathcal{P}$ be a non-convex polygon. Describe an algorithm that computes the convex hull of $\mathcal{P}$ in $O(n)$ time. *Hint: Use a variant of Graham's scan where the vertices are not treated in lexicographic order but in some other order.*

2. **Line Segment Intersection (5 points)**

   Let $a, b, c, d \in \mathbb{R}^2$. Show how to check whether the two line segments $\overset{\vdash\dashv}{ab}$ and $\overset{\vdash\dashv}{cd}$ intersect using a constant number of half-plane tests (or orientation tests).

3. **Visible Segments (10 points)**
   Let S be a set of n disjoint line segments in the plane, and let p be a point not on any of the line segments of S. We wish to determine all line segments of S that P can see, i.e., all line segments of S that contain some point q so that the open segment $\overset{\vdash\dashv}{pq}$ does not intersect any line segment of S.

   Give an $O(n \log n)$ time algorithm for this problem that uses a rotating half-line with its endpoint at p.



4. **Guarding the Boundary vs. the Interior (5 points)**
   Give an example of a polygon together with a placement of vertex guards, such that the whole polygon boundary is guarded but not the whole interior.