Abteilung Algorithmik
Institut für Betriebssysteme
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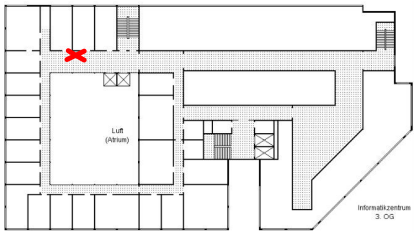
WS 11/12

Computational Geometry
Homework Set 3, 05. 12. 2011

Solutions are due Wednesday, December 21th, 2011, until 11:25 in the cupboard for handing in practice sheets. **Please put your name on all pages!**



Exercise 1 (Monotonicity): Show:

a) For every $n \in \mathbb{N}$ there is a polygon with at least n vertices that is monotone with respect to any line.

b) There is a polygon with 10 or more vertices that is not monotone with respect to any line.

(5+10 points)

Exercise 2 (Doubly-Connected Edge Lists (DCELs)):
Show how a DCEL can be used to visit all edges incident to a vertex v in cyclic order.

(5 points)

Exercise 3 (Triangulation):

a) Triangulate the polygon shown in Figure 1 using the algorithms from the lecture.

b) Give an algorithm that triangulates a polygon with holes in $O(n \log n)$.

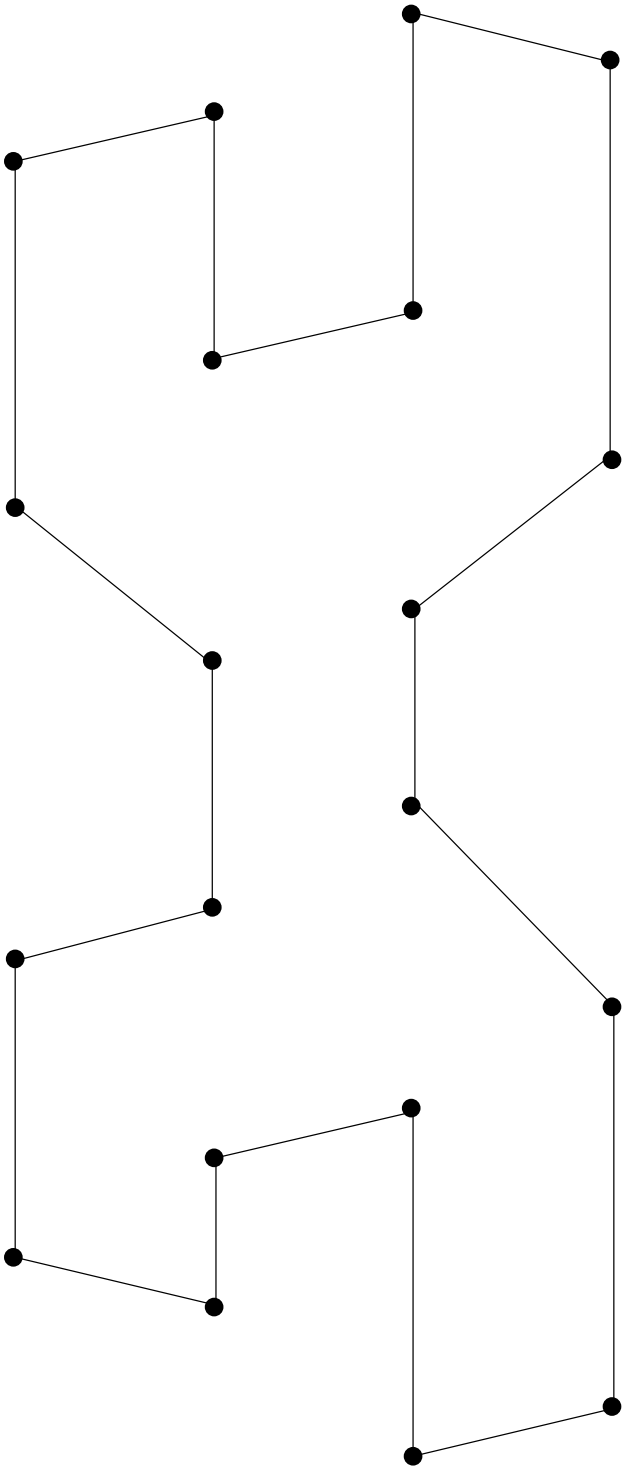


Figure 1: A Polygon.

(10+10 points)

Exercise 4 (Monotonicity II.):

a) Given a simple polygon P and a line g.

Give an algorithm that tests in $O(n)$ steps whether P is monotone with respect to g.

You may assume P to be given either as a Doubly-Connected Edge List (DCEL) or simply as a list of vertices and edges.

Hint: You may assume that no edge of the polygon is perpendicular to g.

b) Given a simple polygon P.

Give an algorithm that decides in $O(n)$ steps whether there exists a line g, such that P is monotone with respect to g.

Hint: Consider the interior angles at potential saddle points.

Of course it is possible/allowed to present an algorithm that solves both problems.

(10+10 points)