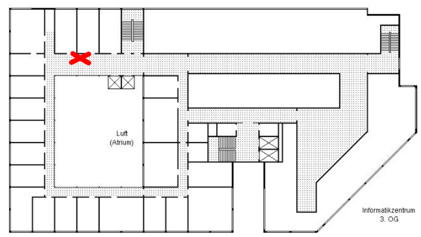
Abteilung Algorithmik
Institut für Betriebssysteme
und Rechnerverbund
TU Braunschweig

Dr. Michael Hemmer
Sebastian Morr

WS 14/15

Computational Geometry
Homework Set 5, 13.01.2014

Solutions are due Tuesday, January 20, 2014, until 9:45 in the mailbox for homework sheets or at the beginning of the lecture. **Please put your name on all pages!**



Exercise 1 (Voronoi Diagrams):

a) Is it possible to construct a point set with three sites whose Voronoi vertex is exterior to the triangle determined by the sites?

b) Can a Voronoi cell consist of a single point?

c) Can a Voronoi edge run through a site?

b) Is a Voronoi diagram like Figure 1 possible?

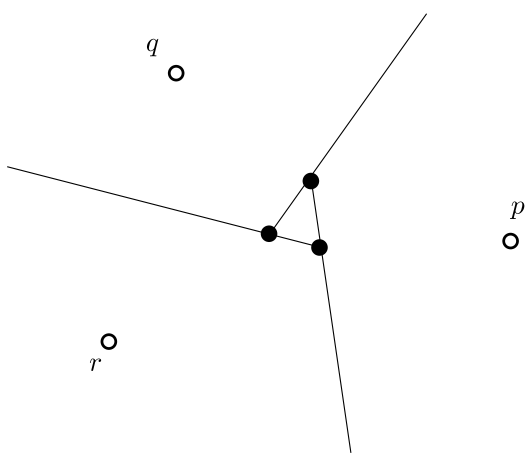


Figure 1: Is this possible?

(5+5+5+5 points)

Exercise 2 (Voronoi Diagrams II):
Which of the following statements are true?

a) The only way in which an existing arc can disappear from the beach line is through a circle event.

b) The only way in which an existing arc can disappear from the beach line is through a site event.

c) $O(n^3)$ circle events are processed.

d) $O(n)$ circle events are processed.

e) In the worst case, the beach line can consist of $2n - 1$ parabolic arcs.

(1+1+1+1+1 points)

Exercise 3 (Delaunay triangulation):
Show that each minimum spanning tree of a point set S is a subgraph of the Delaunay triangulation of S.

(10 points)

Exercise 4 (Lower Bound for Edge Flips):
Show that for each n, there is a set of n points and a triangulation of these points that requires $\Omega(n^2)$ edge flips to transform it into a Delaunay triangulation.

(15 points)

Exercise 5 (Lower Bound for Computation of VD):
Prove that there is no algorithm that can compute the Voronoi diagram of n sites faster than $\Omega(n \log n)$ in the worst case.
Hint: Show that you could use this algorithm to sort n numbers faster than $\Omega(n \log n)$.

(15 points)