Abteilung Algorithmik
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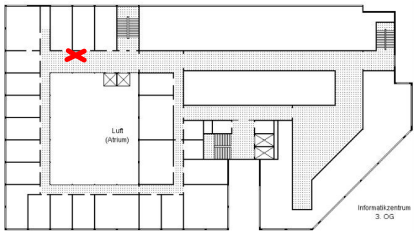
WS 12/13

Computational Geometry
Homework Set 5, 09. 01. 2012

Solutions are due Wednesday, January 23rd, 2013, until 11:25 in the cupboard for handing in practice sheets. **Please put your name on all pages!**



Exercise 1 (Lower Bound for Voronoi):
Assume that an algorithm ALG is able to compute the Voronoi diagram of a point set P with $|P| = n$ in
$O(f(n))$ with $f(n) \in o(n \log n)$ (that is, faster than $O(n \log n)$).
Prove that this is not possible by showing that you could use ALG to sort n numbers in $O(n + f(n))$.

(15 Punkte)

Exercise 2 (Voronoi Lookup):
Given: A point set P with $n \in \mathbb{N}$ points and its Voronoi diagram $Vor(P)$.

Give a method for the construction of a data structure that allows finding the nearest site for an arbitrary point $q \in \mathbb{R}^2$ (that is, to determine in which cell q lies).

Generating the data structure can be arbitrarily complex; once it is established, it should allow finding the next site for arbitrary q in time $O(\log n)$. Explain why your method complies with a lookup time of $O(\log n)$.

Hint: In case q is located on a Voronoi edge or a Voronoi vertex, the next site is not uniquely defined. Your lookup should simply give one of those next sites.

(15 Punkte)

Exercise 3 (Triangulations and the Convex Hull):
A triangulation of a planar point set S is a subdivision of the plane determined by a *maximal* set of noncrossing edges whose vertex set is S.

Show: The edges of the convex hull of a point set S will be in every triangulation of S.

(15 Punkte)

Exercise 4 (Gift Wrapping for the Convex Hull):
Consider the Gift Wrapping algorithm presented in the tutorial. Prove that the point forming the largest angle to the previous edge must be a hull point.

(15 Punkte)