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Computational Geometry — Homework 2 — HS12

URL: http://www.ti.inf.ethz.ch/ew/courses/CG12/

Exercise 1 (15 points)

Describe and analyze an algorithm for computing the convex hull of n *random* points in the plane. By random points we mean that each of the n points is chosen independently and uniformly at random from either the unit square, or the unit disk.

Your algorithm should in both cases have expected runtime $O(n)$, where the expectation is over the random choice of the input point set and (possibly) internal random choices of the algorithm.

Hint: Use randomized incremental construction! You may assume the following results (see e.g. http://arxiv.org/abs/1111.5340): The convex hull of n points chosen independently and uniformly at random has an expected number of

(i) $O(\log n)$ vertices, if the points are chosen from the unit square, and

(ii) $O(\sqrt[3]{n})$ vertices, if the points are chosen from the unit disk.

Exercise 2 (15 points)

Let $P = \{p_1, p_2, \ldots, p_n\}$ be a set of points in the plane (not all of them on the same line). Prove that there is a triangulation of the vertices of the convex hull $\mathrm{conv}(P)$ with the property that the circumcircle of every triangle contains the whole set P.

Exercise 3 (30 points)

Prepare a short presentation (between 4 and 6 minutes) of the survey you did in the previous homework. You will have an opportunity to give a trial talk in an exercise session. This trial talk will *not* be graded and gives you a chance to receive feedback from the assistant and your fellow students. In the following exercise session, you will then give the talk once more in front of a larger audience and your performance will be graded.

General guidelines. This exercise has two goals. Firstly, you should learn how to put together an interesting presentation. This means that you must do some research. Get an overview about the topic at hand: What is it all about, and why is it interesting? (You have already done this in the last homework.) Furthermore you have to develop an idea of what to present and how to present it, which brings us to the second goal: Your audience should learn something worthwhile by attending your presentation. You should seriously think about what you want this to be. Talks that have not been prepared with this goal in mind can be very painful to endure and this will reflect in the grading.

Preparation. *Use electronic slides!* It doesn't matter whether you use Powerpoint, Keynote, Slitex, Beamer, or anything else. These days, the only serious alternative to electronic slides are pure blackboard talks, but since your talk will be 4-6 minutes, giving a blackboard talk is probably not a good idea. Well-prepared slides guide you through your talk almost automatically. Choose suitable colors as some combinations (e.g. green colors on white background) are either invisible or hurt the eye on some projectors. It is a good idea to test your presentation on the projector before giving the graded talk to make sure the colors show up as expected. You will have a chance to do this during the trial talk.

Show many figures! It is difficult for the audience to understand even simple definitions without an illustration. You will have prepared your presentation well and (hopefully) know it by heart, but the audience hears it for the first time. Pictures add redundancy, so they allow the audience to cross-check whether their understanding of the previous formal definition was correct. Explaining pictures also slows down the presentation and gives people the time necessary to absorb the material. Depending on your topic, you should consider having a picture on (almost) every slide.

Use a large font, and show one thing at a time! A slide only helps if it corresponds to what the speaker is telling at the very moment. Slides that stay on for minutes while the speaker is simply droning on makes the audience lose attention. There may be technical slides (that explain an algorithm, say) which are necessarily somewhat denser, but these should be exceptions. Every slide should focus on just one issue.

Practice your presentation! It's not easy to judge the length of a presentation without actually giving it. Once you have practised it a few times you'll now how much time you need to explain each part and can be sure that you stay within the allotted time. This is also a good way to become more confident and less nervous. You can practice with an audience (e.g. with a trial talk in the exercise session) but also without one.

Content. The essential rule here is: keep it simple, but do the simple things well. We expect you to stay within the allotted time of 4-6 minutes and there is only so much you can say in such a short time. So it makes sense to prefer simple over complicated material. The time will not allow you to explain the topic comprehensively. You may pick the most interesting results or one interesting direction to present. Be prepared to answer questions about your topic, in particular about any terms you mention on your slides.

Due date: 15.11.2012