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Computational Geometry Exercise Set 3 HS08

URL: http://www.ti.inf.ethz.ch/ew/courses/CG08/

Exercise 1

Let $P = (p_0, \ldots, p_{n-1})$ be a sequence of n points in $\mathbb{R}^2$. Someone claims that you can check by means of the following algorithm whether or not P describes the boundary of a convex polygon in counter clockwise order:

```
bool is_convex(p_0, ..., p_{n-1}) {
    for (int i = 0; i <= n - 1; i = i + 1)
        if (rightturn(p_i, p_{(i+1) mod n}, p_{(i+2) mod n}))
            return false;
    return true;
}
```

Disprove his claim and describe a correct algorithm for the solution of the problem.

Exercise 2

Let S be a set of n segments that are either horizontal or vertical. Describe an $O(n \log n)$ time and $O(n)$ space algorithm that counts the number of pairs in $\binom{S}{2}$ that intersect.

Exercise 3

You are given n axis–parallel rectangles in $\mathbb{R}^2$ with their bottom sides lying on the x–axis. Construct their union in $O(n \log n)$ time.

Exercise 4

Consider k convex polygons $P_1, \ldots P_k$, for some constant $k \in \mathbb{N}$, where each polygon is given as a list of its vertices in counterclockwise orientation. Show how to construct the convex hull of $P_1 \cup \ldots \cup P_k$ in $O(n)$ time, where $n = \sum_{i=1}^{k} n_i$ and n_i is the number of vertices of P_i, for $1 \leq i \leq k$.