**Eric Berberich, Michael Kerber** **WS 2013**

# Excercises
# Computational Geometry

http://www.mpi-inf.mpg.de/departments/d1/teaching/ws13/ComputationalGeometry/

## Sheet 11 Deadline: 14.01.2014, 10:00am

**Rules:** Until the end of the semester you have to reach 50% of the achievable points to be admitted to the exam. 40 points correspond to 100%; you can get up to 10 bonus points.

**Exercise 1** (*10 pts*)
What is the largest representable number as a `double`, the smallest positive number, the smallest normalized positive number?

**Exercise 2** (*10 pts*)
Let $a, b \in \mathbb{F}$ with $\frac{1}{2} \leq \frac{a}{b} \leq 2$. Show that $a \ominus b = a - b$. This was first observed by Sterbenz.

**Exercise 3** (*10 pts*)
Assume that point coordinates are `doubles` in $[\frac{1}{2}, 1]$. Show for three given points $p, q, r$

a) $\mathrm{orientation}(p, q, r) = 0$ implies $\mathrm{float\_orientation}(p, q, r) = 0$

b) $\mathrm{float\_orientation}(p, q, r) \neq 0$ implies $\mathrm{float\_orientation}(p, q, r) = \mathrm{orientation}(p, q, r)$

c) What does this mean for the geometry of $\mathrm{float\_orientation}$?

d) Can you find examples that make the foating point implementation of the convex hull algorithm crash when point coordinates are restricted to doubles in $[\frac{1}{2}, 1]$?

**Exercise 4** (*10 pts*)
Given real numbers $x, y, z$. Derive (floating point) error bounds for the decision if the expression $xy - z$ is larger or smaller than zero.

**Exercise 5** (*10 pts*)
Analyse the computational overhead of guarding predicates with (a) forward error analysis and (b) interval arithmetic.

**Exercise 6** (*10pts*) Simulation of Simplicity: Argue why $\varepsilon(i, j) = \varepsilon^{i \cdot \delta + j}$ and $\varepsilon(i, j) = (i \cdot \delta + j) \cdot \varepsilon$ are no suitable choices for successful simulated perturbations of a matrix predicate.