Computational Geometry **Winter term 2023**
TU Braunschweig, Algorithms Division

Prof. Dr. Sándor Fekete
Peter Kramer
Tobias Wallner

Question Sheet 1

Submit in your solutions, in a properly formatted, single, PDF file, to `https://nextcloud.ibr.cs.tu-bs.de/s/p5pNRkgYMJE9F5Z`. The deadline is December 21, 2023. Please additionally note the following data: Full name, field of study, and matriculation number. Please name the file as follows: `[your_full_name]_[your_matriculation_number]`.pdf

---

We consider these problems in the two-dimensional variant. Please explain your answers.

Question 1 (Convex hull): **(3 Points points)**

a) Provide a definition of the convex hull of a set of points in the plane.

b) What is the fastest feasible runtime guarantee of an algorithm which computes it?

c) What is your favorite algorithm that computes the convex hull? Explain why!

Question 2 (Closest pair): **(3 Points points)**

a) Explain the basic idea of the divide-and-conquer algorithm for computing the closest pair of a set of points.

b) What is the key observation in the merging step of Bentley's and Shamos' algorithm?

c) Is it possible for the closest pair to lie on the convex hull of the point set? Why?

Question 3 (Voronoi diagram): **(4 Points points)**

a) In your own words, what is the intuitive idea of a Voronoi diagram?

b) Explain the relationship between Voronoi cells, Voronoi vertices, and Voronoi edges.

c) Is there a relationship between the convex hull of a point set and its Voronoi diagram?

d) What is your favorite property of a Voronoi diagram? Why?

Question 4 (Miscellaneous): **(3 Points points)**

a) What does it mean for an algorithm to be output-sensitive? Describe a scenario in which such an algorithm may be preferable over another with better runtime bounds.

b) What is a randomized algorithm? Do you know any? Explain its idea.

c) How and how fast can we compute the median of a set of n integers? And of a set of n points in the plane?