Algorithms Group **Summer '14**
Departement of Computer Science - IBR
TU Braunschweig

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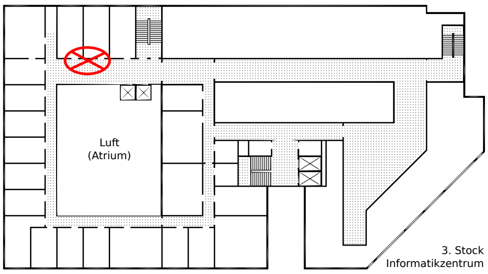
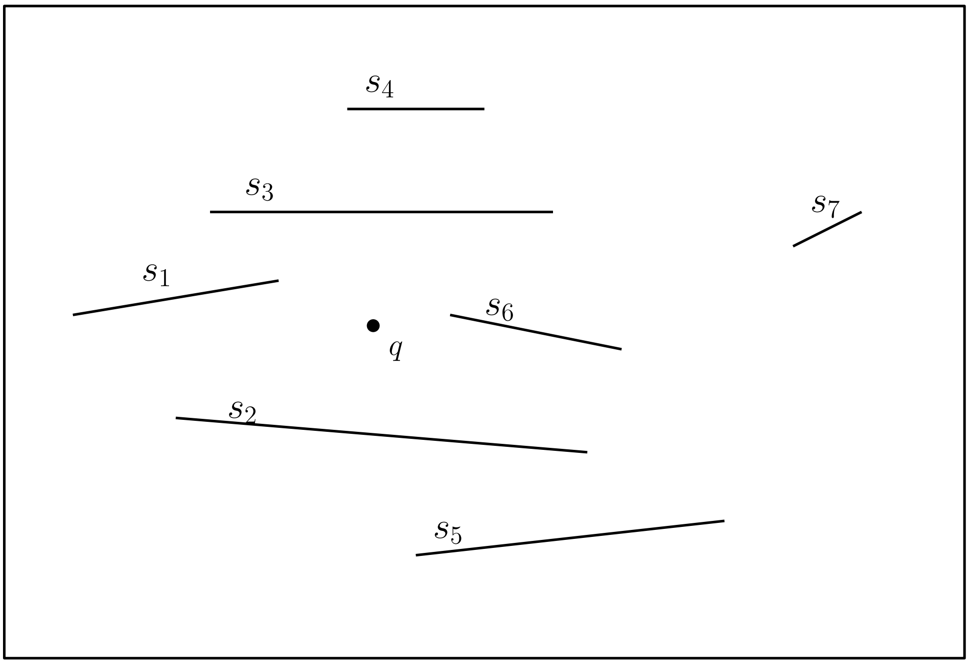
Geometric Algorithms
Exercise 4
June 11, 2014



This sheet is comprised of several exercise. Most of them are theoretical but some are also applied, i.e., coding tasks. The solutions should be handed in by **June 17**. This can be done either at the beginning of the lecture or by placing them in the appropriate box of the exercise locker, see floor plan on the right. Applied exercises should be handed in via email to `hemmer@ibr.cs.tu-bs.de`. Please mark those exercises that you would like to present during the tutorial.
In order to achieve the *"Studienleistung"*, you must have presented at least three exercises until the end of the term. Moreover, you must pass the midterm exam at the beginning of June.

Exercise T1 (Planar Point Location - Trapezoidal Map):

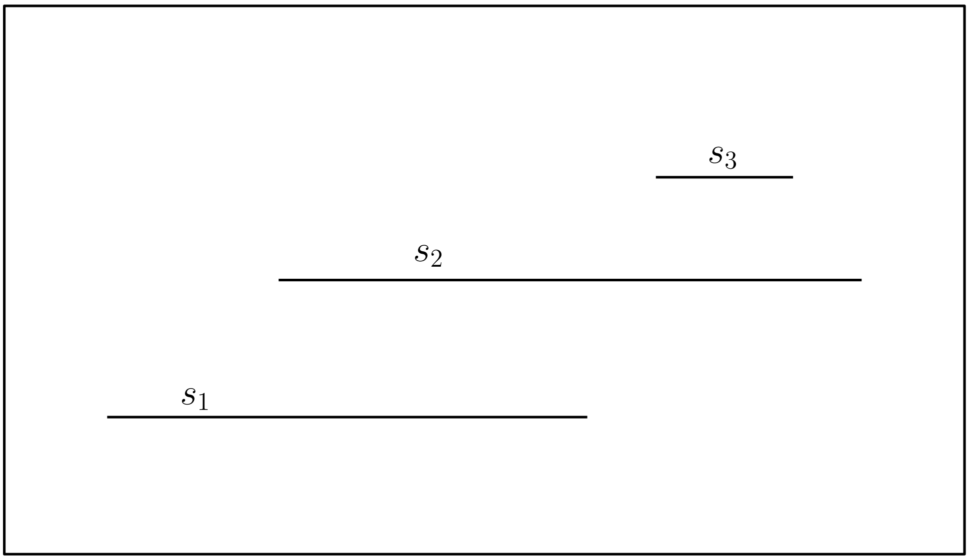


a) Draw the final trapezoidal decomposition that is induced by the segments above.

b) Give an insertion order of the segments such that the query path to q is minimal.

c) Give an insertion order of the segments such that the query path to q is maximal.

Exercise T2 (Planar Point Location - Trapezoidal Map):



Insert the segments according to sequence $[s_1, s_2, s_3]$.

a) Draw $T(S_i)$ and $D(S_i)$ for $i \in \{1, 2, 3\}$ separately.

Now observe that not all paths in $D(S_3)$ are actually valid search paths. Let $\mathcal{D}$ be the maximal length of all paths in $D(S)$ and $\mathcal{L}$ be the maximal length of all valid search paths.

b) Indicate a path of length $\mathcal{D}$ in $D(S_3)$.

c) Indicate a valid search path of length $\mathcal{L}$ in $D(S_3)$.

Exercise T3 (HARD: Planar Point Location - Trapezoidal Map):

Let n be a square, that is, $n = k^2$ for some $k \in \mathbb{N}$. Sketch a set of segments S of cardinality n and give an insertion order such that the length of the longest path in $D(S)$ is $O(n)$ whereas the length of the longest search path is in $O(\sqrt{n})$.

Exercise T4 (HARD: Planar Point Location - Trapezoidal Map):

Let n be a power of 2, that is, $n = 2^k$ for some $k \in \mathbb{N}$. Sketch a set of segments S of cardinality n and give an insertion order such that the length of the longest path in $D(S)$ is $O(n)$ whereas the length of the longest search path is in $O(\log n)$.