Computer Science Lecture
SS2015 Selected Topics in Algorithmics
Sample Questions

1. Define the conflict list for an interval, describe the randomized incremental version of Quick-Sort, and analyze the expected time complexity.

2. Prove that given a set N of n line segments with total k intersections and an i-element subset N^i of N, the expected number of trapezoids in the vertical trapezoidal decomposition $H(N^i)$ of N^i is $O(i + ki^2/n^2)$.

3. Define conflict relations between a newly inserted segment and the current trapezoidal decomposition $H(N^i)$, and describe how to insert a new segment.

4. Analyze the expected time of inserting a line segment into $H(N^i)$, and the total expected time for constructing the vertical trapezoidal decomposition.

5. Describe how to use a history graph to develop an on-line algorithm for the vertical trapezoidal decomposition and analyze the expected time complexity.

6. Please compare conflict graphs and history graphs.

7. Regarding the paper "Kenneth L. Clarkson, Kurt Mehlhorn, and Raimund Seidel Four, Results on Randomized Incremental Construction," define a configuration, conflict relations, and history, and give one example, e.g., vertical trapezoidal decomposition.

8. Please define the Voronoi diagram and the Delaunay triangulation and explain the duality between them.

9. Please explain how to insert a new site when we compute the Voronoi diagram incrementally as well as the update of conflict list.

10. What is the backward analysis for the randomized incremental construction? Please give an example.

11. What is the central concept of random sampling? Given a set of n points in the real line, how does an r-element random sample partition those n points?

12. What is a configuration space? What is the bounded degree property? What is the bounded valence? Given n objects, how does an r-element random sample partitions the configuration space?

13. What is high probability complexity? Consider n elements, and flip a coin for each element such that the tail will remove the element. Continuously flip the coin until no element exists. Please give a high probability complexity for the number of flips.

14. What is the top-down sampling? Please explain how to adopt it to build search structure through a simple example.

15. What is the bottom-up sampling? Please explain how to adopt it to build search structure through a simple example.

16. Please analyze the number of levels for the bottom-up sampling (the expected value and the high probability bound).

17. Please compare the top-down sampling and the bottom-up sampling regarding the construction of the search structure for the arrangement.