1. (12 points) Ex. 10.8, page 240.

A careful description of the data structure, in words, suffices; pseudocode is not needed. (If it helps, augment your discussion with appropriate figures.) Be sure to justify the correctness of your method and to analyse its performance (space and query time).

Limit your answer to 3 pages.

2. (12 points) Let $S$ be a set of $n$ points in the plane. In class we discussed how to preprocess $S$ in $O(n \log n)$ time into a layered (i.e., fractional-cascaded) 2D range tree of size $O(n \log n)$ so that the $k$ points that are contained in a query rectangle $q = [x_1, x_2] \times [y_1, y_2]$ can be reported in $O(\log n + k)$ time.

It is possible to achieve the same bounds using a (relatively) simpler data structure: a 1D range tree where each node stores a suitable associated structure (different from a 1D range tree). Describe how to build and query the overall data structure and analyse its performance (space and query time). You may describe the construction and query algorithms in words, but please be clear and precise. (Again, augment your discussion with appropriate figures if needed.)

Limit your answer to 2 pages.

3. (12 points) This question pertains to the paper “Computational Geometry: Generalized (or colored) intersection searching”, by P. Gupta, S. Rahul, M. Smid, and yours truly, which can be downloaded from the class web page. The paper is a recent survey of a general class of query-retrieval problems that has attracted widespread interest in recent years.

The paper describes several techniques that have been designed over the years to address such problems. Please read the paper carefully and describe any two of the methods (your choice) in detail. Your answer should be in your own words and should show that you have really understood the methods; do not just recite from the paper. You are welcome to refer to any of the papers cited in the survey, if needed.

Limit your answer to 2 pages.

p.s. You may find it fun to think on your own of other new problems that can be formulated in this setting.