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Advanced Data Structures

Spring Semester 2018

Exercise Set 6

Exercise 1:
Show an explicit construction of persistent segment trees, with each query and each update taking $\mathcal{O}(\log n)$ worst-case time.

Exercise 2:
(Dominance Query) For two points, $p = (x_p, y_p)$ and $q = (x_q, y_q)$, p is said to *dominate* q if $x_q \leq x_p$ and $y_q \leq y_p$. Consider a set S of n points in the plane. Show that S can be preprocessed in $\mathcal{O}(n \log n)$ time, such that for a query point $p = (x_p, y_p)$, the points in S that are dominated by p can be reported in $\mathcal{O}(\log n + k)$ time, where k is the output size.

Hint:

- For each point $q \in S$, project an upward ray from q.
- Project a leftward ray l from the query point p and find all the upward rays intersected by l, from which the points dominated by p can be obtained.
- Move a vertical line from left to right, and store the vertical order.

Exercise 3:
Consider a set S of n disjoint axis-parallel rectangles. Show that S can be preprocessed in $\mathcal{O}(n \log n)$ time, such that for a query vertical line segment l, the rectangles in S intersected by l can be reported in $\mathcal{O}(\log n + k)$ time, where k is the output size.
Hint: Use the segment tree and the plane sweep paradigm.