FTP_Alg_Week 7: Exercises

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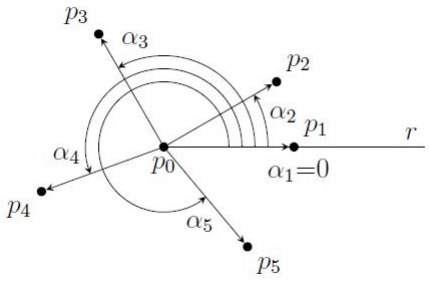
Exercise 1 *The polar angle of a point p_i with respect of an origin p_0 is the angle from the semi horizontal straight line r (see picture below) and the vector $p_0\vec{p}_i$. The positive direction of the angle is the counterclockwise one. Furthermore angle amplitude are taken in the interval $[0, 2\pi)$. In the picture below you find some examples of polar angle.*



Write a pseudocode, which orders n points $q_1, \ldots, q_n$ according their polar angles, in increasing order. The algorithm should have $O(n \log n)$ running time.

Exercise 2 *(*)Given two segments a and b that are comparable at x, show how to determine in $O(1)$ time which of $a \succcurlyeq_x b$ or $b \succcurlyeq_x a$ holds. Assume that neither segment is vertical. (Hint: If a and b do not intersect, you can just use cross products. If a and b intersect—which you can of course determine using only cross products—you can still use only addition, subtraction, and multiplication, avoiding division. Of course, in the application of the $\succcurlyeq_x$ relation used here, if a and b intersect, we can just stop and declare that we have found an intersection.)*

Exercise 3 *Argue that ANY-SEGMENTS-INTERSECT works correctly even if three or more segments intersect at the same point.*

Exercise 4 *Show that ANY-SEGMENTS-INTERSECT works correctly in the presence of vertical segments if we treat the bottom endpoint of a vertical segment as if it were a left endpoint and the top endpoint as if it were a right endpoint. How does your answer to above Exercise 3 change if we allow vertical segments?*