K Closest points — Heaps

Given N points in $\mathbb{R}^2$, return the K closest points to (0,0)

Naive : sort points accordy to distance

Pick the first K

$O(N \log N)$

Heap : Build and maintain a max heap ↑ size K as follows

scan each point P

If heapsize < K, insert point into heap

elif point P further then max-heap's max-point, M

throw point P away

else

pop max point M from heap
insert point P

return points from max heap.

$N \times O(\log K) = O(N \log K)$

↑ no. of times

↑ complexity of each

insertion

Follow up: ∃ median-of-medians algorithm which returns the K^{th} smallest elt in an unsorted array of size N in O(N) time. Using this, can you give a better solution?

Find K^{th} smallest elt $\alpha \leftarrow O(N)$

O(N) {
- Scan array and pick all $\beta \leq \alpha \rightarrow$ (L)
- Return first K elements of L

so overall O(N)