Project: closest pair problem vs data stream

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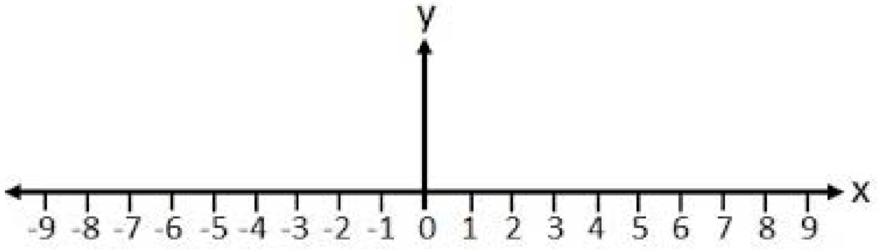
Simplify

If we can solve the closest pair problem, we can solve the problem “find minimum difference between any two elements in an unsorted array”.

Method: just let the elements in the array have y-axis value 0.

Then the distance of the closest pair is the minimum difference.



Hardness proof

Claim: A 1-pass deterministic algorithm to the minimum difference problem (and closest pair problem) can’t have space complexity under $\Omega(n)$.

Proof:similar to the indexing problem.

Alice is the input, Bob is the program.

Alice send n distinct number + 1 repeat number to Bob.

Bob would answer the index(1~n) of the repeated number.

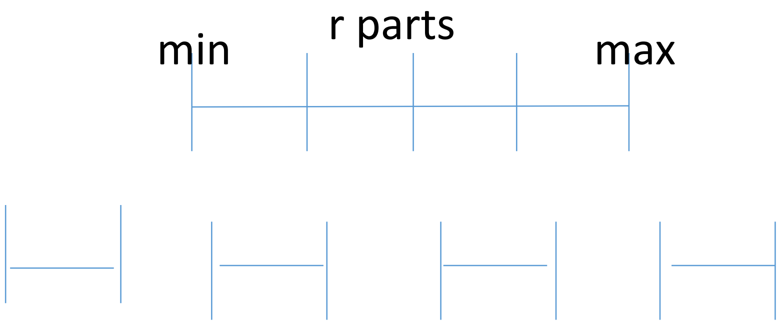
Bob must use at least $\Omega(n)$ space before he know the repeat number.

approximate of minimum difference problem

Find r points:$\frac{n}{r+1}$-th, $\frac{2n}{r+1}$-th,…, $\frac{rn}{r+1}$-th largest number by using find k-th number in streaming model.

Then at least a difference of two point less than $\frac{max-min}{r}$can be found.

$O(r)$ pass, $O(rn^{\frac{1}{r}}\log n)$ space.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