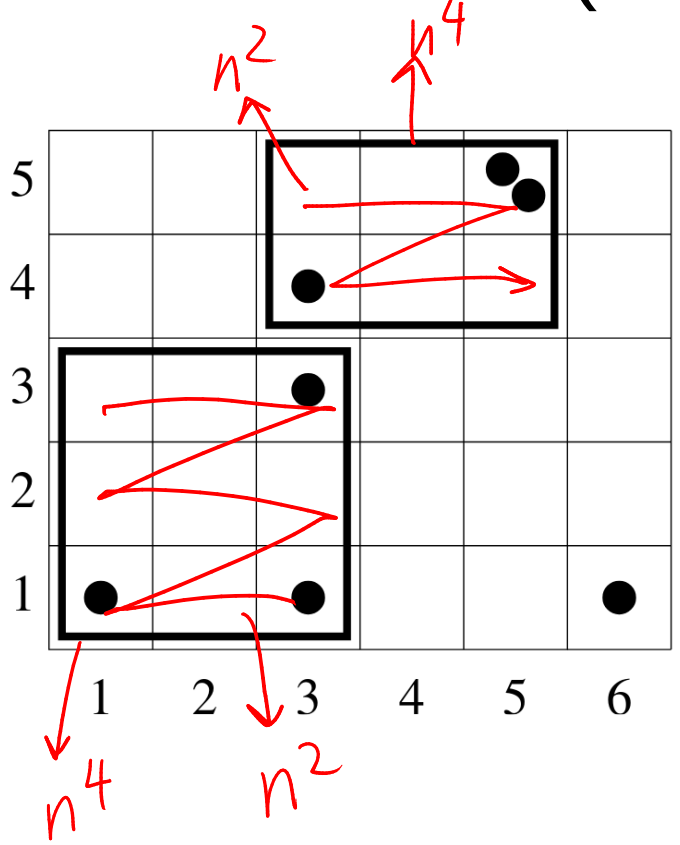
Joint Problem Session

April Camp 2022

Problem 1 – Garden (IOI 2005)



K=3

- Do not intersect
- Sum of perimeters is minimised

Garden: O(n^10)

Try every possible pair of rectangles

If both criteria hold, record their perimeters

FInally, take the smallest possible amongst these pairs

$$n^4 \times n^4 \times (n^2 + n^2) = O(n^{10})$$

Garden: O(n^8)

Using prefix sum

$O(n^2) \longrightarrow O(1)$ counting

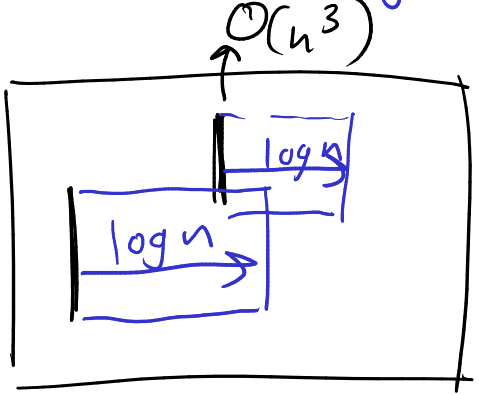
$O(n^2)$ overhead

Garden: O(n^~~8~~ 6) $\log^2 n$

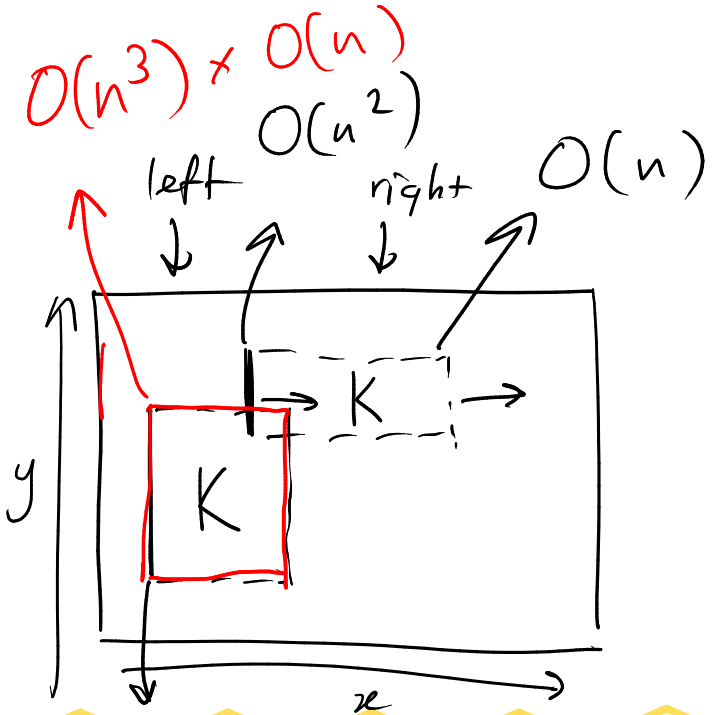
Binary search on width of final rectangle

because K is fixed

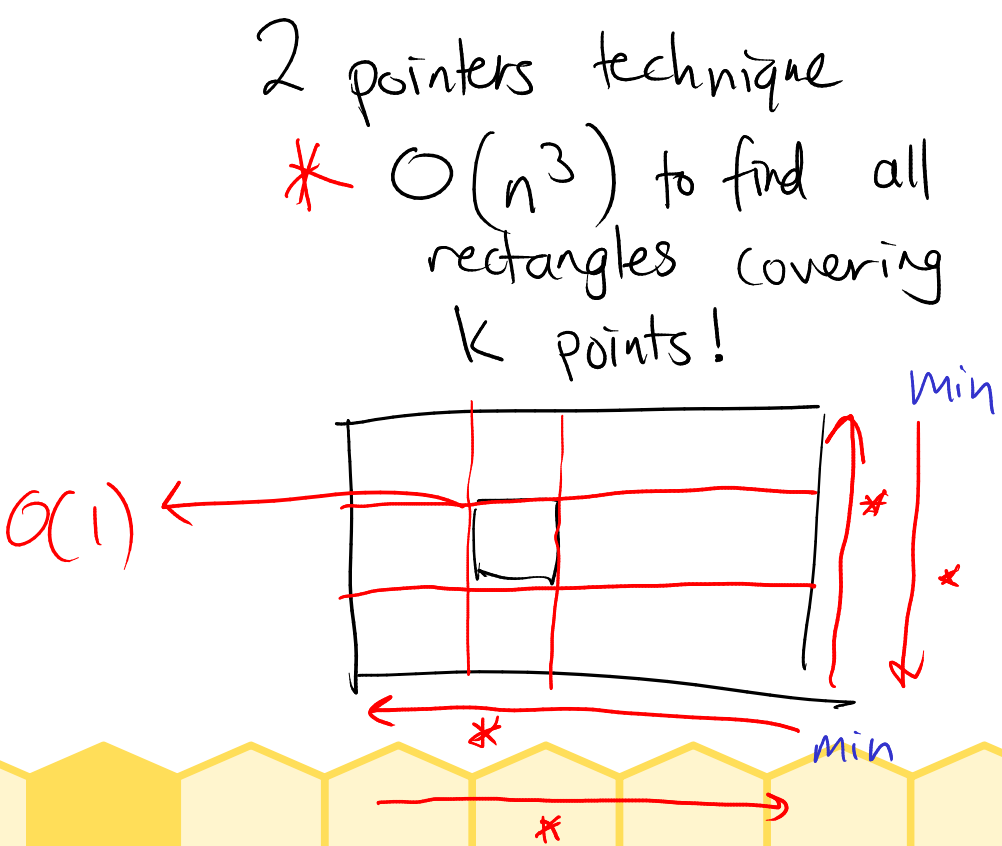
$O(n^4) \rightarrow O(n^3 \log n)$

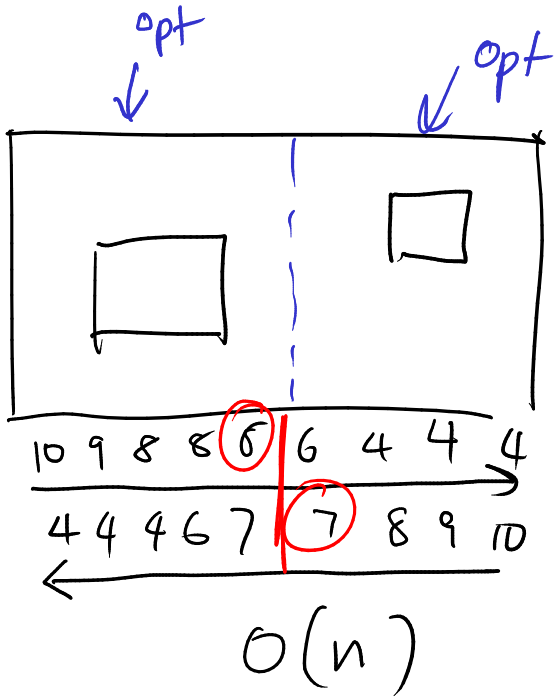


Garden: O(n^4)



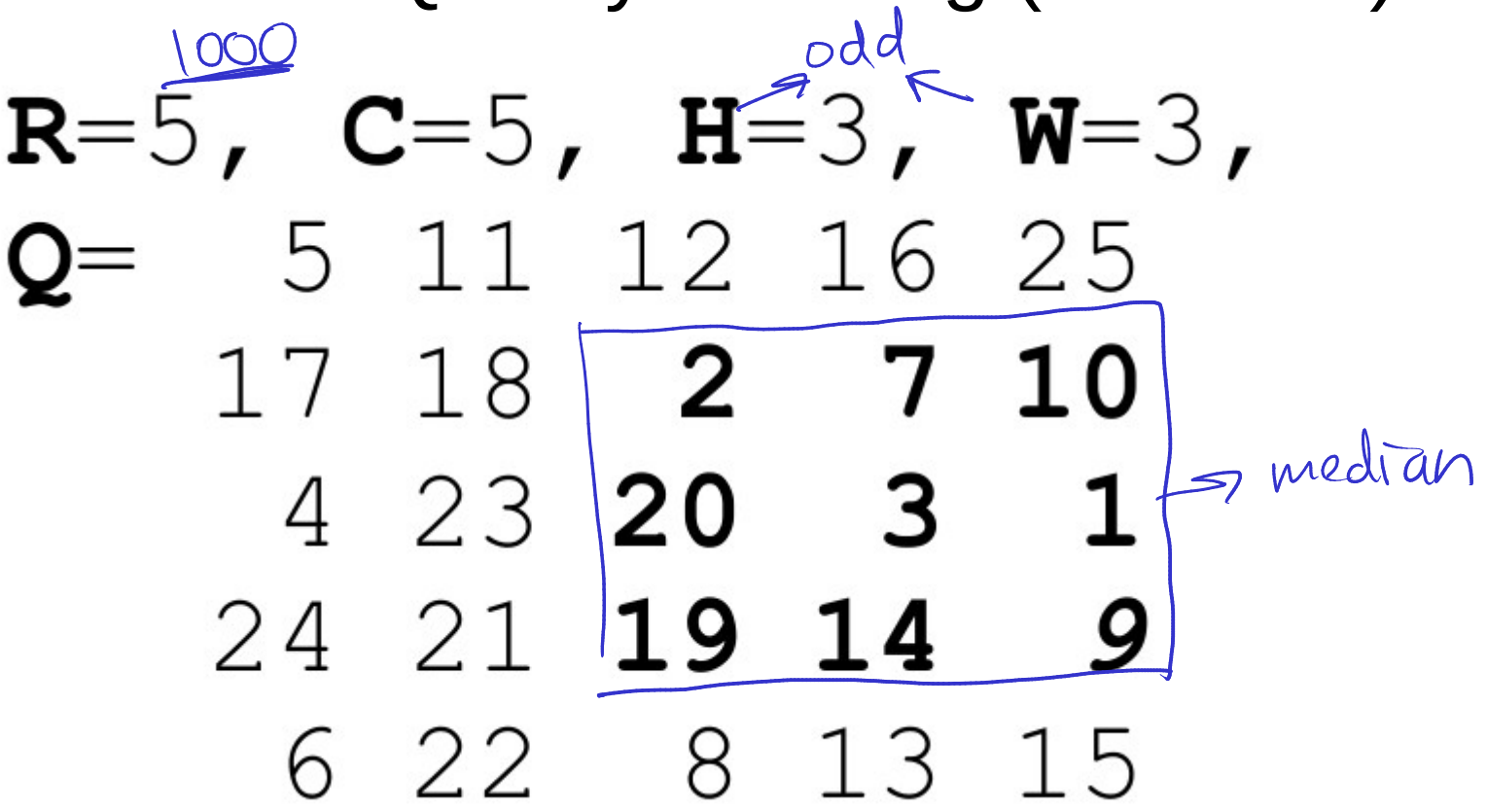
Garden: O(n^3)





The minimum perimeter of any K-rectangle in the associated part of the grid

Problem 2 – Quality of Living (IOI 2010)



QoL: O(n^4)

Calculating median for all subrectangles

$O(n^2)$ subrectangles

$O(n^2)$ calculating the median

$\Rightarrow O(n^4)$ in total.

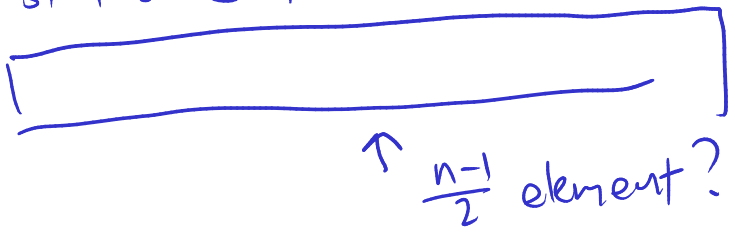
QoL: O(n^3) log n

DS to calculate median

→ 2 sets "balanced sets"

O(log n)

→ Order statistic tree

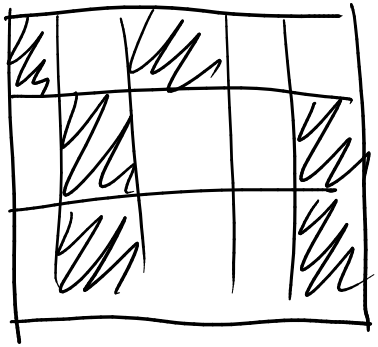


O(log n)

QoL: O(n^2 log n)

Binary search the answer (is best median $\leq x$?)

- Prefix sum to count # elements $> x$ in a subgrid
- YES if any subgrid exists with < half of elements set to 1



Set 0 for less

Set 1 for greater

Looking for slightly less than half of elements greater and slightly more than half of elements less.