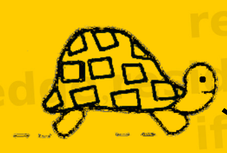
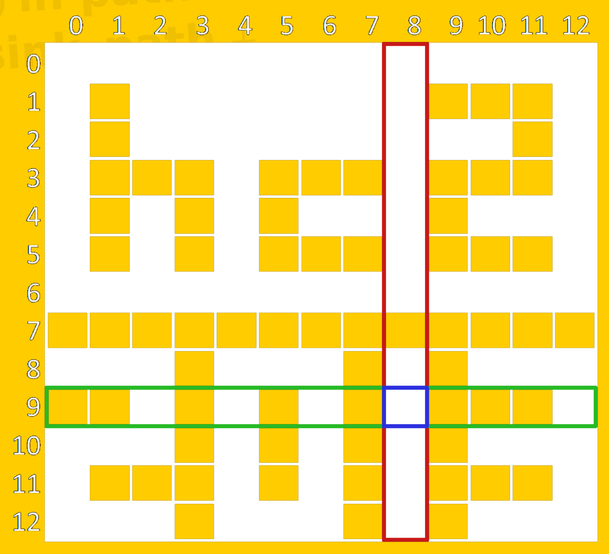
Quarantine

Christian Kauth

Easy: How many white pixels in row r / column c?

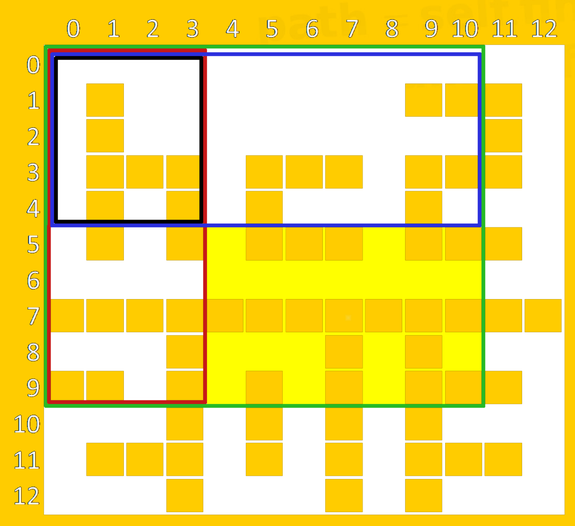


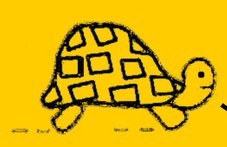
Count pixels for each query
⇒ O(N·Q)



Count pixels once for each row and column!
Answer: row[r] + column[c] - pixel[r][c]
⇒ O(N² + Q)

Medium: How many white pixels in a rectangle?





Count pixels for each query
⇒ O(N²·Q)

Count once the pixels for each rectangle [0..r]×[0..c]
Answer: rect[r2][c2] - rect[r2][c1-1]
- rect[r1-1][c2] + rect[r1-1][c1-1]
⇒ O(N² + Q)

Hard: Is pixel (r, c) white after a series of toggles?

Simply simulate all toggles... ⇒ O(N²·Q)

Replace each toggle with four toggles of rectangles rooted at the origin.
Use a fancy data structure to keep track of toggles :-)

- 2D Binary Indexed Tree
- Quad Tree
- 2D Interval Tree

Answer: count(r2,c2) - count(r2,c1-1) - count(r1-1,c2) + count(r1-1,c1-1)
⇒ O(Q · log² N)