Line Sweep

CS 491 – Competitive Programming

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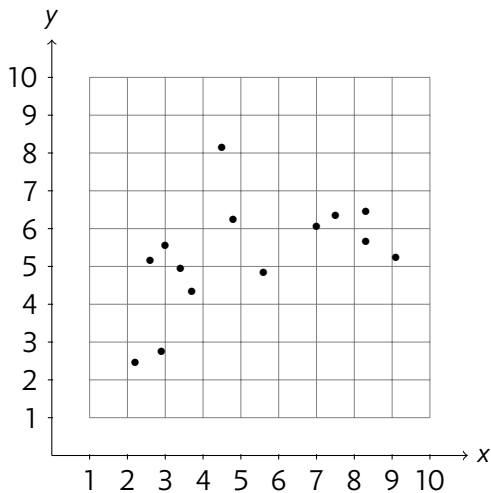Spring 2024

Objectives

Use the Line Sweep method to …

- ▶ compute the convex hull
- ▶ compute the area of overlapping rectangles
- ▶ find the closest two points

Another Convex Hull Technique

The algorithm

```
sort points by x value
push p[0], p[1], p[2] onto stack
while stack has >= 3 entries:
    if s[-2:0] bends counterclockwise:
        pop s[-1]
    push next p onto stack
stack has upper perimeter
clear stack
push p[0], p[1], p[2] onto stack
while stack has >= 3 entries:
    if s[-2:0] bends clockwise:
        pop s[-1]
    push next p onto stack
stack has lower perimeter
```
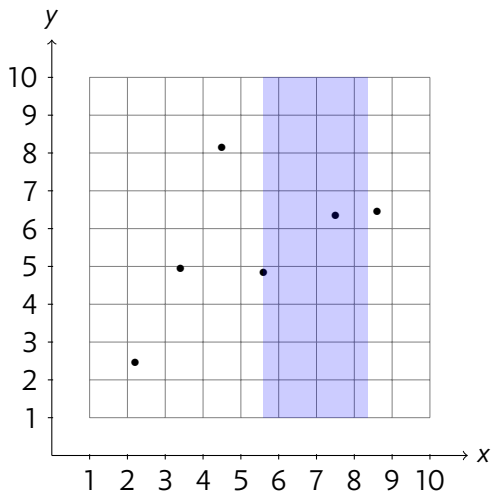
Area of Rectangles
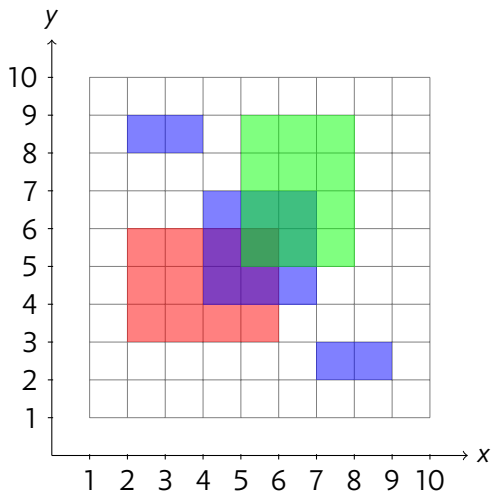
Algorithm

- ▶ Make two copies of the rectangles.
    - ▶ Sort one by "entry" x coordinate.
    - ▶ Sort other by "exit" x coordinate.
- ▶ Use a segment tree to mark y ranges.
    - ▶ Update +1 when entering a rectangle.
    - ▶ Update -1 when exiting.
- ▶ Conceptually simple, but can be tedious to code.
    - ▶ You did save your segment tree code, right?

Closest Points

Algorithm

- ▶ Sort points by x coordinate.
- ▶ Distance between first two points becomes δ.
- ▶ Advance line to next point p.
    - ▶ Add all points q where $x_q - x_p < \delta$ to set s.
    - ▶ Check all points in s where $|y_q - y_p| < \delta$.
    - ▶ New candidate? Update δ.
- ▶ Remove points from s when the sweep line passes them.