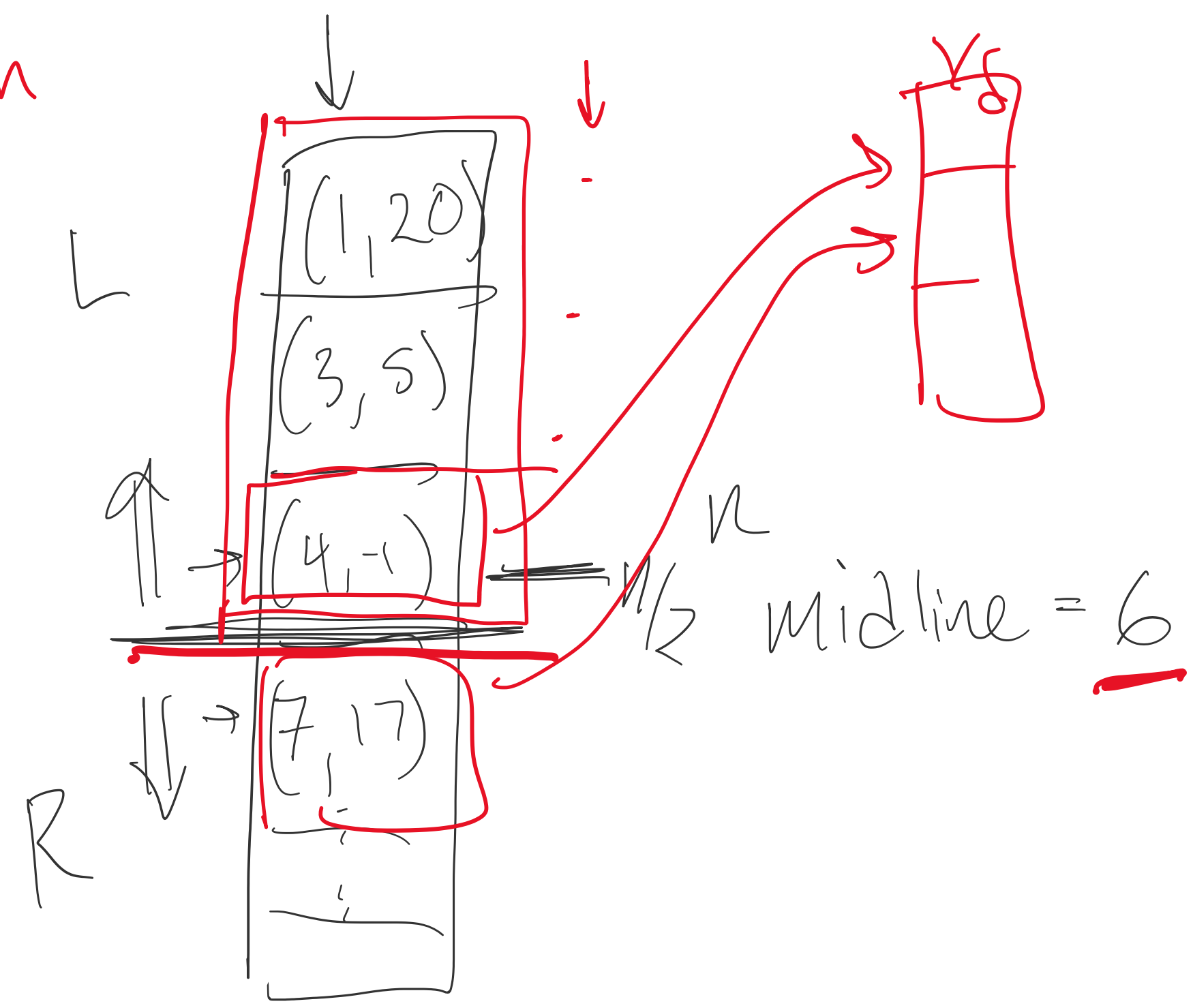


Goals:

1. Analyze runtime of Closest Points

$\text{CloPt}(P)$ $\xleftarrow{n \text{ pts}}$ $T(n) = \text{runtime on } n \text{ pts}$

- $O(1)$ 1. If $n \leq 3$, brute force
- $O(n \log n)$ 2. Sort P by x -coordinate \leftarrow
- $O(n)$ 3. Divide into L, R maybe $O(1)$
- $2T(n/2)$ 4. $S = \min\{\text{CloPt}(L), \text{CloPt}(R)\} + O(1)$
- $O(n)$ 5. Create Y_S



- $O(n \log n)$ 6. Sort Y_S by y -coordinate
- $O(n)$ 7. For $p \in Y_S$:
- $O(n)$ 8. For $i = 1$ to 7:
- $O(n)$ 9. $S' = \text{dist}(p, p+i^{\text{th}})$
- $O(n)$ 10. If $S' < S$, then $S \leftarrow S'$
- $O(1)$ 11. Return S

$\{O(1)\} \{O(1)\} \{O(n)\}$

$\log n = O(n^\epsilon)$

Group: $T(n) = \begin{cases} O(1) & \text{if } n \leq 3 \\ 2T(n/2) + O(n \log n) \end{cases} \Rightarrow O(n^{1.001})$

\rightarrow Runtime?
 \rightarrow Improve? What is slowing us down

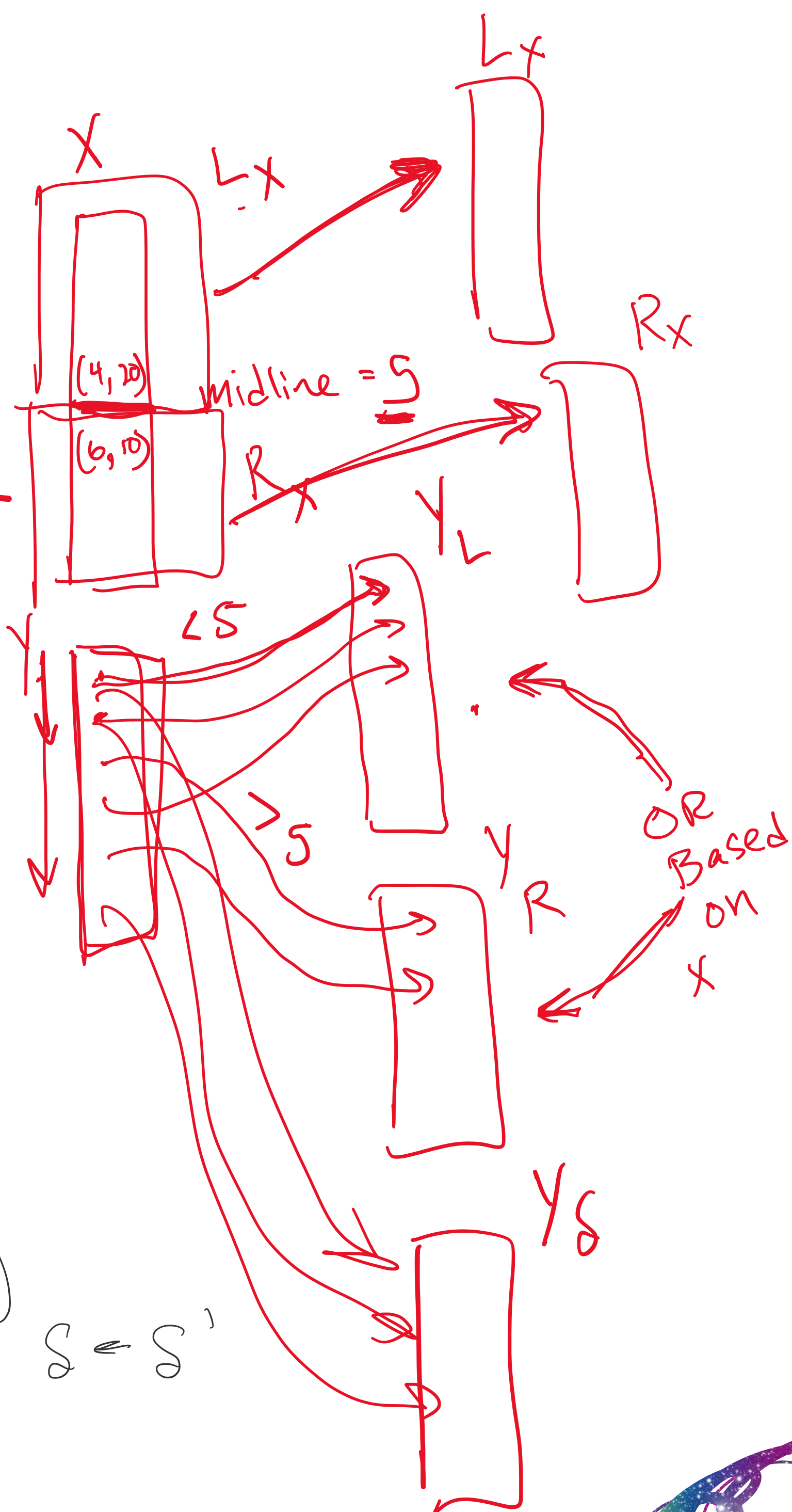
$\log n = O(n^{0.001})$

PreSort $P(P)$

$X = P$ sorted by x $O(n \log n)$
 $Y = P$ sorted by y $O(n \log n)$

$\text{CloPt}(X, Y)$

- $O(1)$ • If $n \leq 3$, brute force
- ~~Sort P by x -coordinate~~
- $O(n)$ • Divide into L, R
- $2T(n/2)$ • $S = \min\{\text{CloPt}(L), \text{CloPt}(R)\}$ R_x, R_y
- $O(n)$ • Create Y_S (from Y)
- ~~Sort Y_S by y -coordinate~~
- $O(n)$ • For $p \in Y_S$:
- $O(n)$ • For $i = 1$ to 7:
- $O(n)$ • $S' = \text{dist}(p, p+i^{\text{th}})$
- $O(n)$ • If $S' < S$, then $S \leftarrow S'$
- $O(1)$ • Return S



$T(n) = \begin{cases} O(1) & \text{if } n \leq 3 \\ 2T(n/2) + O(n) \end{cases} \Rightarrow T(n) = O(n \log n)$