



Quiz tomorrow

want

{ 3 }

use

[3, 2, 1, 3]

↙

[2, 1, 3]

1. sorted

2. root is black

3. red only has black children

4. all root-leaf paths
have same # of black

black height

black height = h

B
 $|$
 B
 $|$
 $B \dots X$

$\left. \vphantom{\begin{matrix} B \\ | \\ B \\ | \\ B \end{matrix}} \right\} h$

$B - R - B - R - B - \dots - X$

$\underbrace{\hspace{10em}}_{2h-1}$

$\downarrow$
 $[h, 2h)$

$d \in \Theta(h)$

$$h I \triangleleft I^{2h}$$

$$\text{WTS } d \in O(\log(n))$$

$$2^h \quad 2^{2h} \quad \xrightarrow{\log_2} \quad h \quad 2^h$$

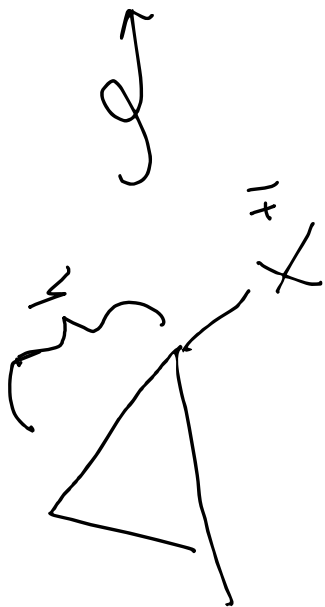
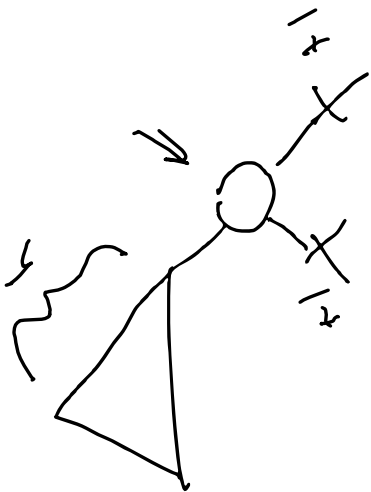
$$n \in O(2^{2h})$$

$$O(h) = O(2^h)$$

$$d \in O(h)$$

$$O(\sqrt{n}) : O(n)$$

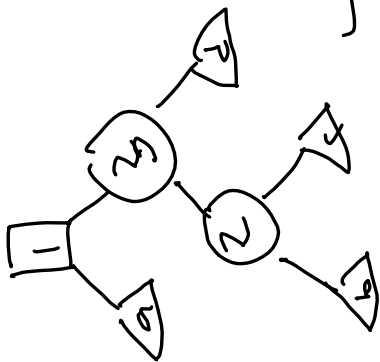
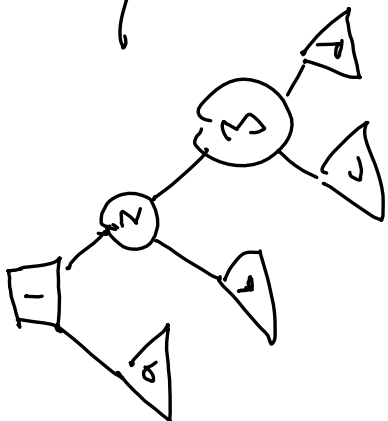
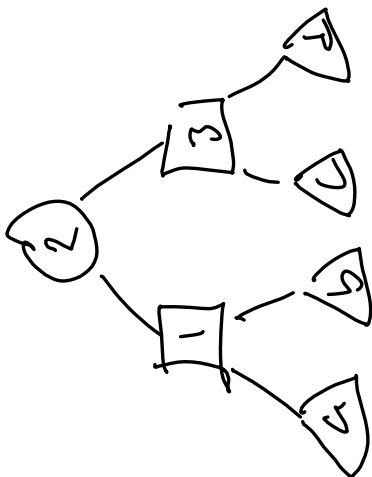
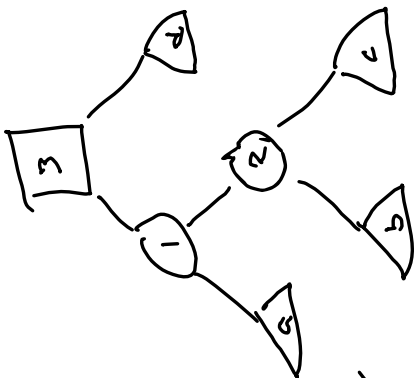
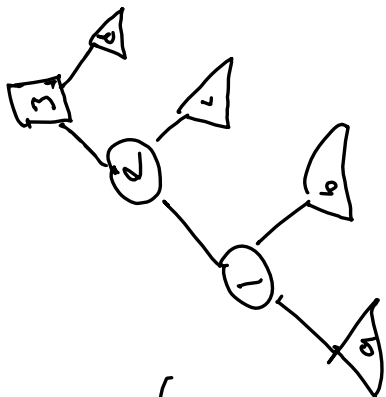
$$\in O(\log(n))$$

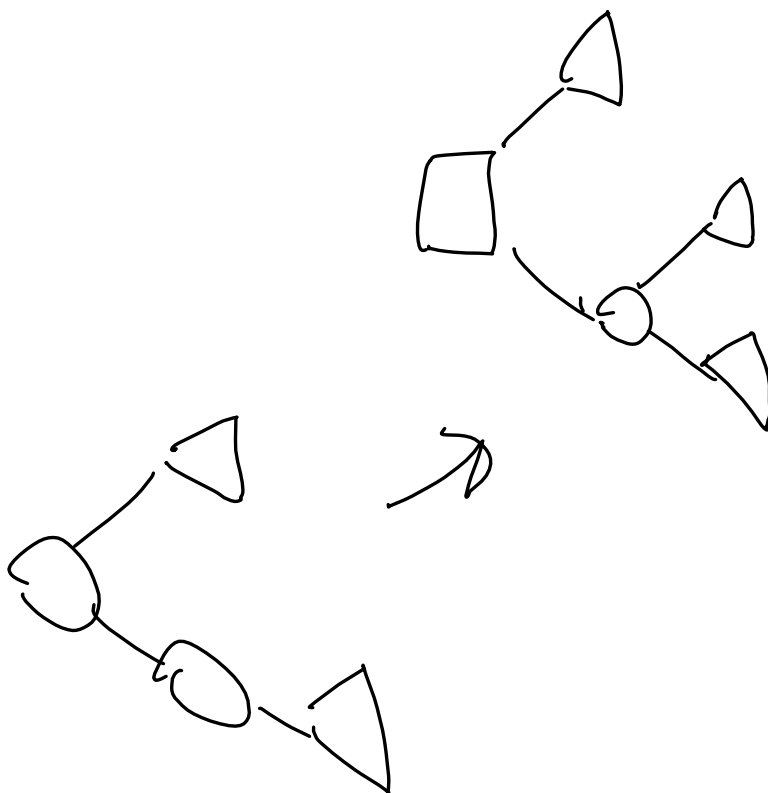


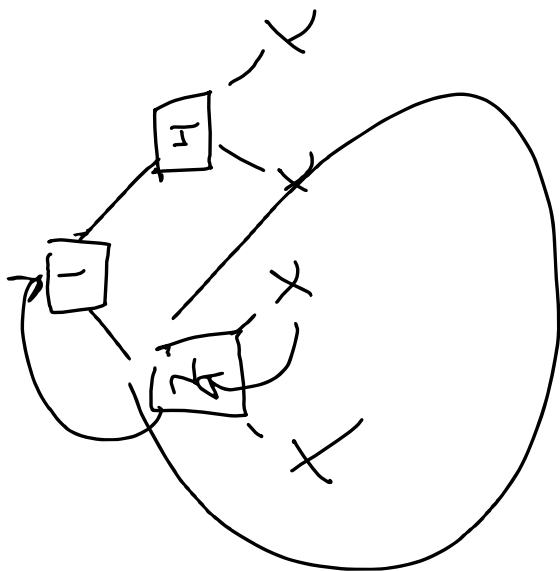
1. binary search
if you find it
then return
put red @ bottom

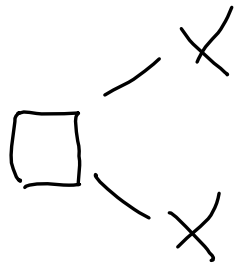
2. fix on way up to root
child

3. blacken root

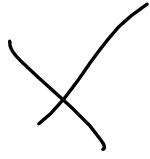
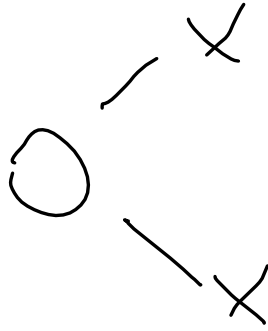




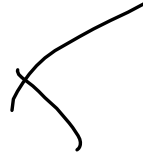




diff



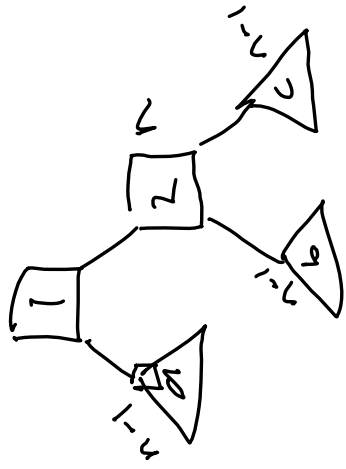
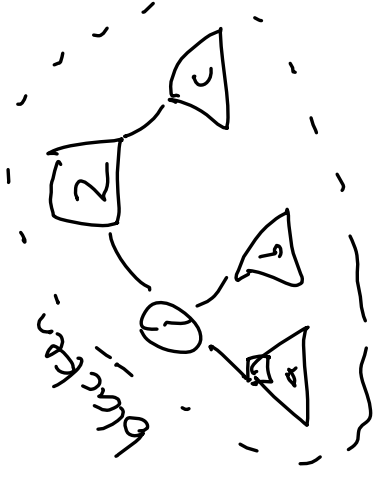
Same



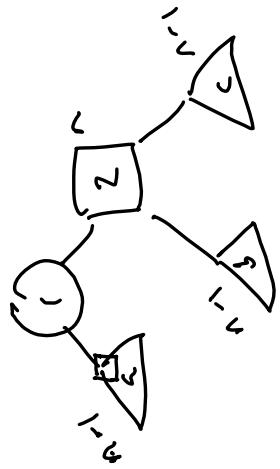
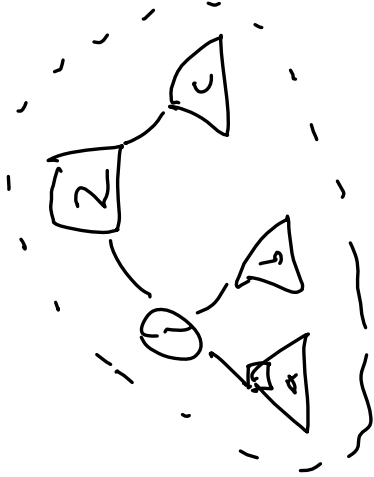
Same

effect - same

no effect - diff



same



same

