

17 -  $\hat{J}^2$

$$\frac{1}{1 - \gamma_{\text{LR}}}$$

→  $\text{Mg}^{2+}$  +  $\text{H}_2\text{O}$  →  $\text{Mg(OH)}_2$  (s)  $\rightleftharpoons$   $\text{Mg(OH)}_2$  (aq)

→ n → m → p → e → s → d →

`succ-d[x] = " " → new [Copy it in] size[?]`

$\rightarrow$   ~~$\rightarrow$~~   $\rightarrow$   $\rightarrow$   $\rightarrow$   $\rightarrow$   $\rightarrow$

دکتر مختار رئیس هیئت مدیره سازمان اسناد و کتابخانه ملی

1. right [x]
  2. left [x]
  3. p [x]
  4. key [x]
  5. colour [x]
  6. succ [x]
  7. d-succ [x]
  8. pre d [x]

## BUILD(S)

Sort S from small to large  
by quick sort and save at S<sub>1</sub>

for i=0 to size[S<sub>1</sub>]

  succ[i[S<sub>1</sub>]] ← NULL

  if i+d <= size[S<sub>1</sub>]

    succ[i[S<sub>1</sub>]] = S<sub>1</sub>[i+d]

    pred[S<sub>1</sub>[i]] ← S<sub>1</sub>[i-1]

    succ[S<sub>1</sub>[i]] ← S<sub>1</sub>[i+1]

REINSERT(S<sub>1</sub>)

Time complexity for S given n is O(n lg n)

Time complexity for pred and succ

O(n lg n) = 3n lg n

Since S → sorted is O(n lg n)

pred and succ are O(n lg n), so O(n lg n)

pred, succ and insertion are O(n lg n)

Time complexity for pred and succ

O(n lg n) = 3n lg n

Time complexity for pred and succ

O(n lg n) = 3n lg n

$O(n \lg n)$

$\approx 3n \lg n$

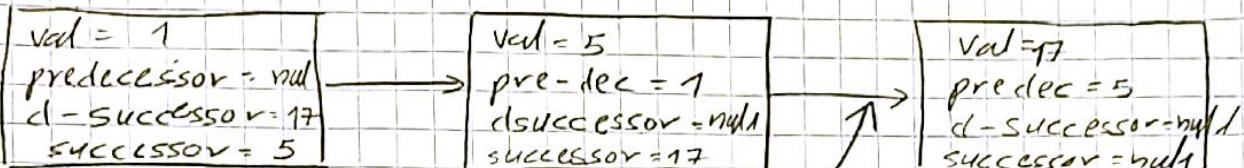
## - INSERT -

list is empty

new node is root = true

new node is inserted at index 3 in array

(append new node)



d-9

copy value y

current node is set to y

new node is set to y

new node is inserted at index 3 in array

new node is inserted at index 3 in array

y. predecessor 1

y. successor 2

y. dSuccessor 3

original pointer d is set to y

d. successor null y se

INSERT ( $S, k$ )

$y \leftarrow \text{NIL}[S]$

$x \leftarrow \text{root}[S]$

while  $x \neq \text{NIL}[S]$

do  $y \leftarrow x$

if  $\text{key}[k] < \text{key}[x]$

then  $x \leftarrow \text{left}[x]$

else  $x \leftarrow \text{right}[x]$

$\text{parent}[y] \leftarrow x$

if  $y = \text{NIL}[S]$

then  $\text{root}[S] \leftarrow k$

else if  $\text{key}[k] < \text{key}[y]$

then  $\text{left}[y] \leftarrow k$

$\text{successor}[k] \leftarrow y$

$\text{predecessor}[k] \leftarrow \text{predecessor}[y]$

$\text{successor}[\text{predecessor}[y]] \leftarrow k$

$\text{predecessor}[y] \leftarrow k$

UPDATE-D-SUCCESSOR( $k$ )

else  $\text{right}[y] \leftarrow k$

$\text{predecessor}[k] \leftarrow y$

$\text{successor}[k] \leftarrow \text{successor}[y]$

$\text{successor}[\text{predecessor}[y]] \leftarrow k$

$\text{successor}[y] \leftarrow k$

UPDATE-B-SUCCESSOR( $k$ )

$\text{left}[-k] \leftarrow \text{NIL}[T]$

$\text{right}[k] \leftarrow \text{NIL}[T]$

$\text{color}[k] \leftarrow \text{RED}$

RB-INVERT-FIX( $S, k$ )

## UPDATE - D - SUCCESSOR (1c)

$x = l_c$ :

for  $i = 1$  to  $d$

$d\text{-successor}[x] = d\text{-successor}[\text{predecessor}[x]]$

$x = \text{predecessor}[x]$

$d\text{-successor}[x] \leftarrow l_c$

$\rightarrow S \rightarrow S \rightarrow \dots \rightarrow \text{DELETE} \rightarrow \dots$

INSERT

$(l_c \leftarrow l_c \leftarrow \dots \rightarrow \text{DELETE} \rightarrow \dots \rightarrow x \leftarrow \dots \rightarrow \dots \rightarrow \dots)$

$x.\text{presuccessor} \leftarrow x.\text{successor}$        $x.\text{successor} \leftarrow x.\text{presuccessor}$

$\rightarrow \dots \rightarrow \text{DELETE} \rightarrow \dots \rightarrow \dots \rightarrow \dots \rightarrow \dots$

$\text{successor}[\text{presuccessor}[x]] = \text{successor}[x]$

$\text{presuccessor}[\text{successor}[x]] = \text{presuccessor}[x]$

DELETE ( $S, l_c$ )

$\rightarrow \dots \rightarrow \dots$

RB-DELETE ( $S, l_c$ )

▷ after line 13 in RB-DELETE

$\text{successor}[\text{presuccessor}[l_c]] = \text{successor}[l_c]$

$\text{presuccessor}[\text{successor}[l_c]] = \text{presuccessor}[l_c]$

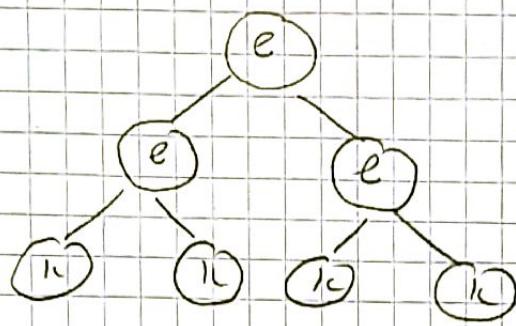
! UPDATE - D - SUCCESSOR (1c)

▷ continue with RB-DELETE

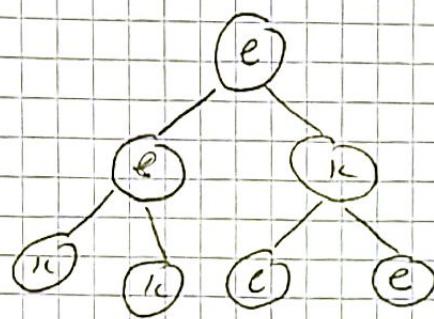
$O(1) \rightarrow$  ~~3~~  $\rightarrow$  D-successors, P  $\rightarrow$  read  
Successor  $\rightarrow$  sole entry  $\rightarrow$

2 - Tree

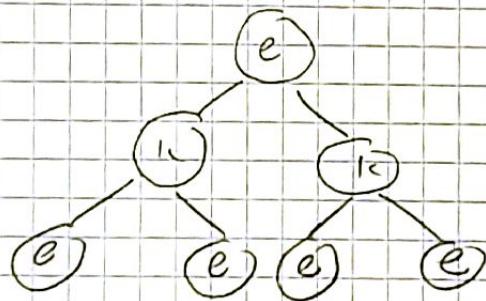
inorder      pre-order      post-order      level-order

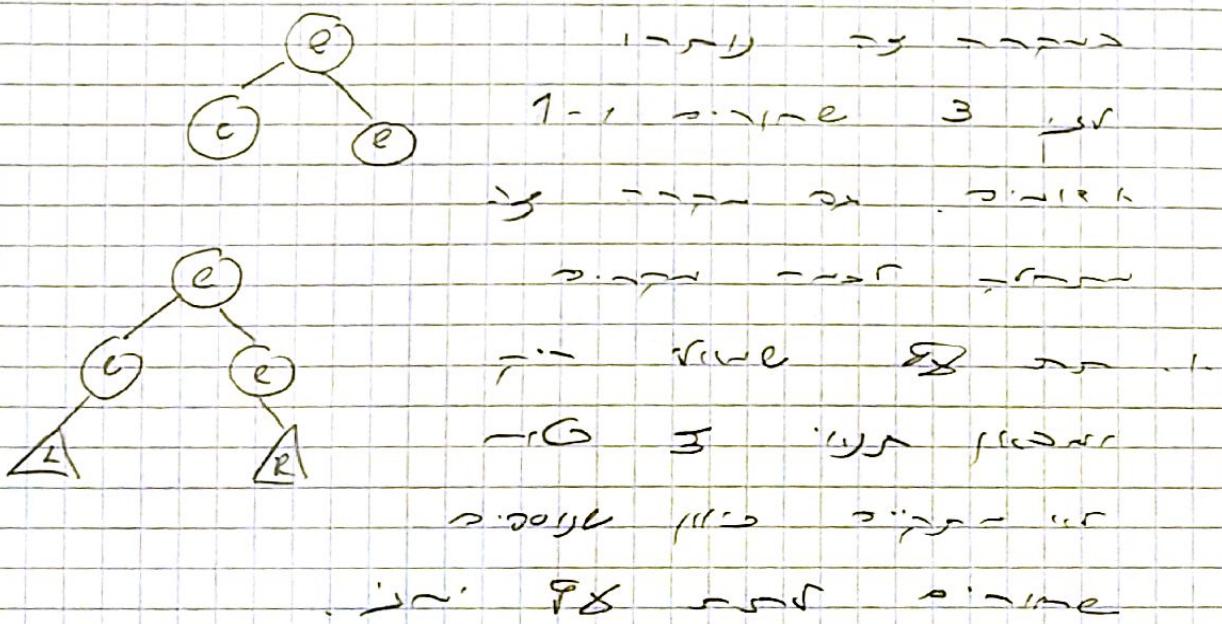
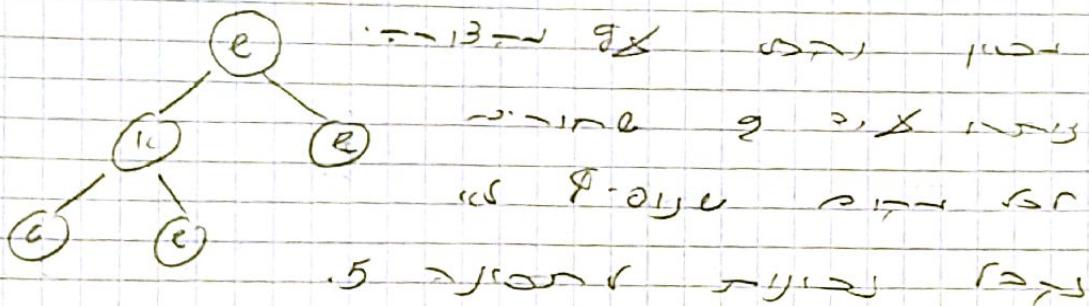
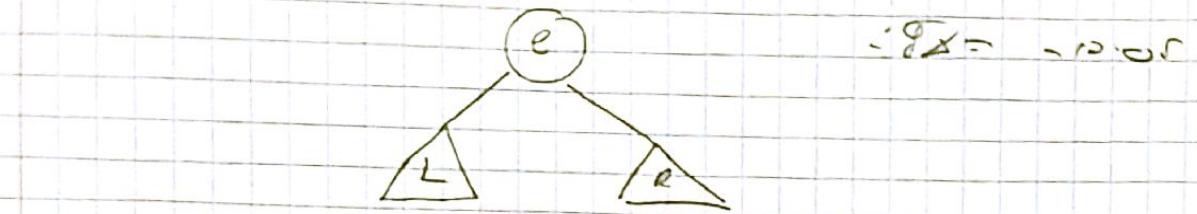


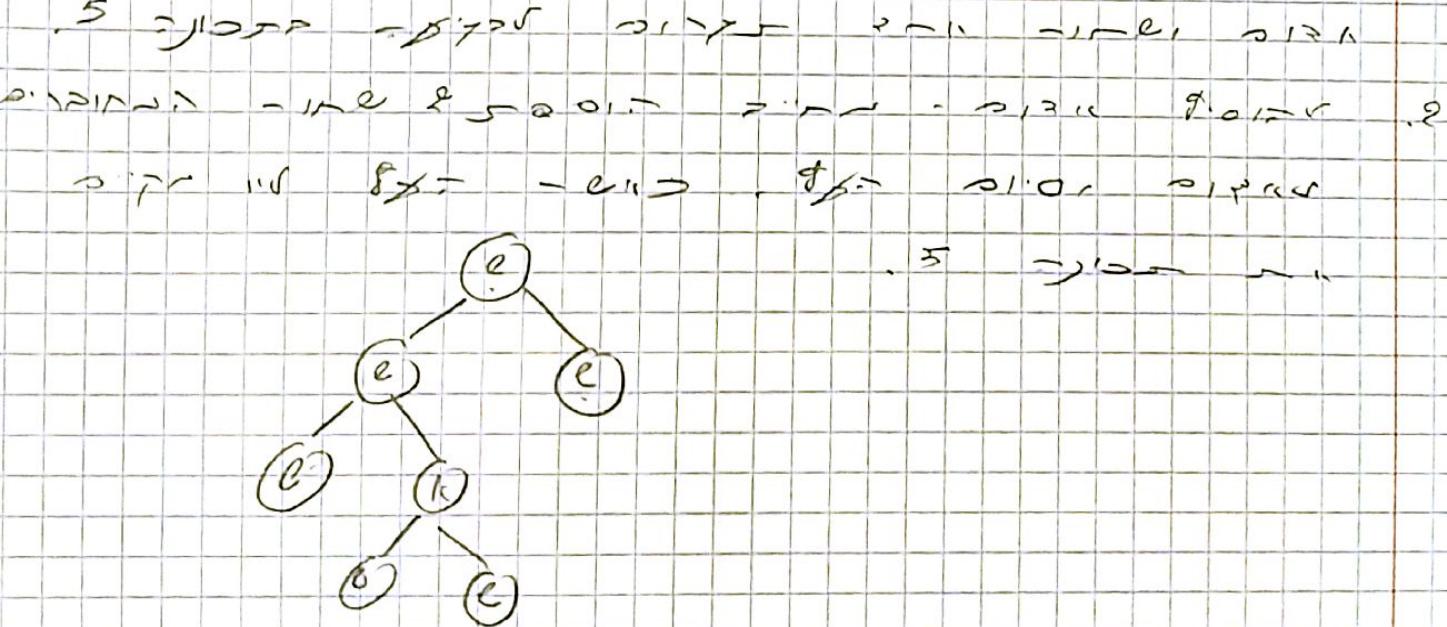
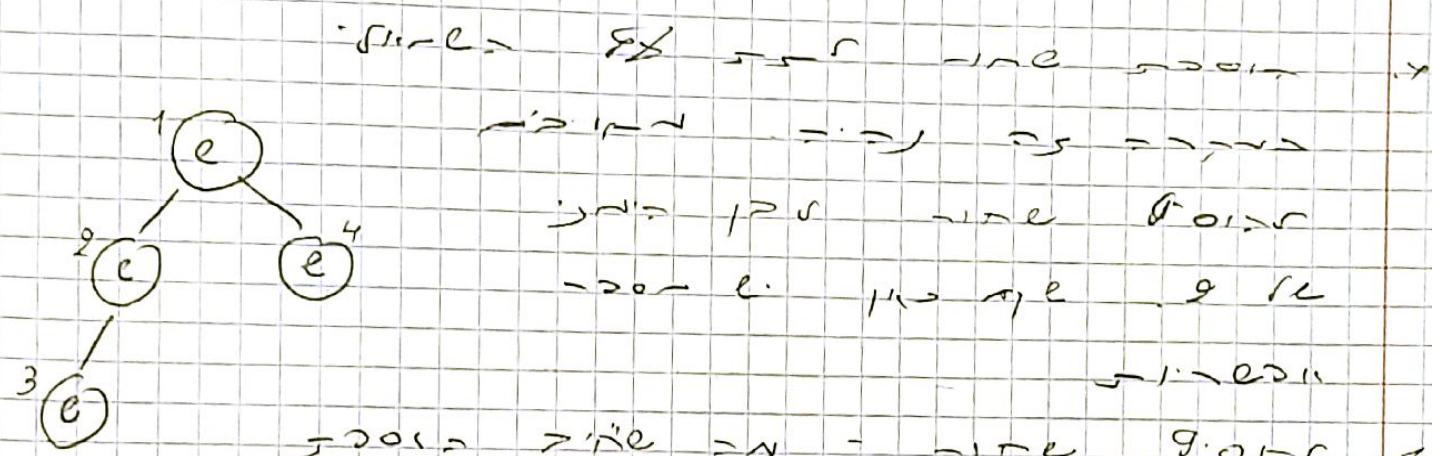
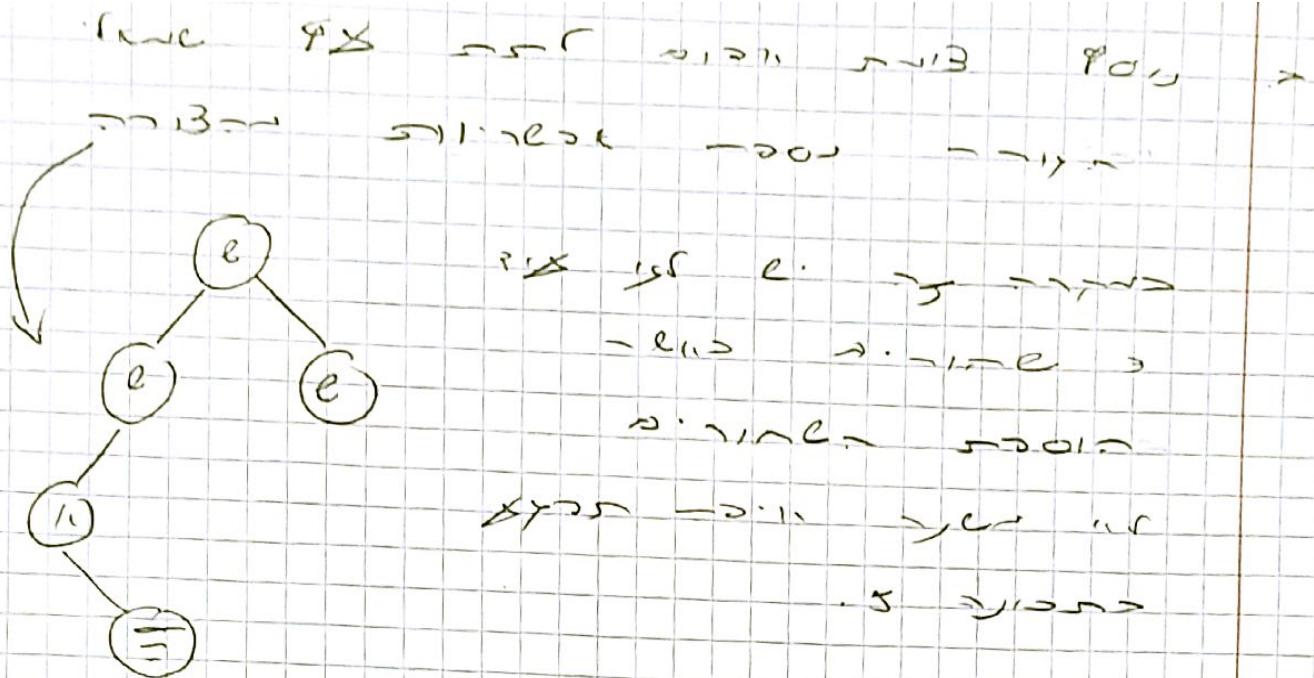
inorder      pre-order      post-order      level-order



inorder      pre-order      post-order      level-order







संग्रहीत सिलेक्शन बे योजना प्राप्त  
निर्वाचन द्वारा

— १५०१/ जप्तवात् यजूर् लः इमान्ति  
प्रकार विभाग उप- ग्रन्थ वा  
विभाग यजूर्

3 = tree

22-12 line  $\rightarrow$  1210 98 > empty

50 re node = 12 > 50-12

13 50 12 > 12 > 75 50

112-12 225 12 > INSERT 1210 112 1

71 1210 12 > 12 line 1210 2 12

sum 1210 12 > 12 1210 112 12

.size 1210

: 1210 12 > 12

y curr 1210 12 > 12 1210 112 1

10 12 - INSERT 1210 2 12 & 12

: 1210 12 > 12

12 1210 12 > 12 1210 12 > 12 =

sum[x] = sum[x] + y

- 1210 12 > 12 1210 12 > 12 1210 12

LEFT-ROTATE 1210 12 > 12 1210 12 > 12 RB-INSERT-FIX

1210 12 > 12 1210 12 > 12 1210 12 > 12

1210 12 > 12 1210 12 > 12 LEFT-ROTATE 1210 12 > 12

sum[x]  $\leftarrow$  sum[left[x]] + sum[right[Tx]] - left[x] - right[x].

sum[y]  $\leftarrow$  sum[left[y]] + sum[right[y]] - left[y] - right[y]

$O(n \lg n)$   $\rightarrow$   $n^2$ ,  $\sim 17 - 18$

→ 17-1 985

10-5 C.6 -11.1 8.1 1.1 1.3 1.4

1. Find the area of a triangle with base 12 cm and height 8 cm.

$$-0.51 \text{ g} \times 7.115 = 3.6 - 2.8 \approx 0.8$$

$\rightarrow B \rightarrow \gamma \rightarrow \pi$

zrc - rank IP  $\Rightarrow$  5-13 7-11 ?

$$-1 - 0 \approx 1 \quad 8 \approx 1 \quad 7 \approx 1 \approx 1 = 1$$

17. de gres

۱۰ - روزهای میتوانند

$\approx 11$   $\mu$   $10$   $\approx 6$   $\approx 11$   $13 \text{ m}$

-0.5158 = 77.115 - R

for  $\sim$  15 days.  $\rightarrow$  "  $\rightarrow$   $\rightarrow$

-5-11 - 1-13 = ~~24~~ > 7.85 = 11.85

$\rightarrow \text{right} - B \rightarrow \text{left} \rightarrow 1 \rightarrow \text{right} \rightarrow 3 \rightarrow$

277-1 J-2 cont'd in 8.04 T-2

June 2135

جیزیں جنگ اسلامیہ کے درباریں

• 'יְמִינֵי יְמִינֵי כָּל־עַמּוֹד

— 13C, — 14C, — 15N, — 16O, — 17F, — 18O, — 19F, — 20Ne, — 21Ne, — 22Ne, — 23Ne, — 24Ne.

مودودی مکالمہ

LEFT-Rotate

rc

$\text{sum}[x] \leftarrow \text{sum}[\text{left}[\text{left}[x]]] + \text{sum}[\text{right}[\text{left}[x]] + \text{left}[\text{right}[x]]]$

$\text{sum}[y] \leftarrow \text{sum}[\text{left}[\text{left}[y]]] + \text{sum}[\text{left}[\text{right}[y]] + \text{right}[\text{left}[y]]]$

c.  $\rightarrow c$

RIGHT-Rotate

rc

$y \leftarrow x$  if  $\text{sum} - = \text{sum}$  else  $\leftarrow \beta$

: / \ \ \ \ - PAIN-DIFF 3

$\text{sum} > \text{sum} - \text{sum}$   $\text{sum} - \text{sum}$   $\text{sum} - \text{sum}$   $\text{sum} - \text{sum}$   $\text{sum} - \text{sum}$

$\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$   $\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

$\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$   $\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

$\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$   $\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

.  
.

$\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$   $\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

$j=2 - 1$   $i=1$   $\text{sum} - \text{sum}$   $j=1$   $i$

$d \leftarrow \text{arr}[j] - \text{arr}[i]$   $\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

$\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$   $\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

$j=3 - j=2$   $\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

$\text{sum} - \text{sum} \leftarrow \text{sum} - \text{sum}$

PAIN-DIFF ( $\leq, d$ )

create arr with sort element  
using inorder tree walk on S

$j \leftarrow 1$

$j \leftarrow 2$

for  $i \leftarrow 1$  to  $\text{length}[\text{arr}]$

if  $(\text{arr}[j] - \text{arr}[i] \geq d)$

$$i \leftarrow i - 1$$

else if (arr[j] - arr[i] < d)

$$J \leftarrow J + 1$$

else if (arr[j] - arr[i]) == d

print(i,j);

1

$O(n)$   $\rightarrow$   $\exists \forall n$   $\sim$

$\omega_1 \circ \eta$   $\omega_2 \circ \eta$   $\omega_3 \circ \eta$

$O(n)$      $\leftarrow$  ~~for~~  $i = 1$     ~~to~~  $n - 1$      $\leftarrow$  ~~do~~  $j = i + 1$

$$\rightarrow \rightarrow \text{comes} \sum (S_1, S_2, S_3) = S_{\text{sum}}$$

$\text{sym}[x] = x$  if  $x \geq 0$

$\rightarrow$   $\sqrt{4} = \pm 2$   $\rightarrow$   $x = 1$

$x = -13$  re  $7x$ .

• ८५ • - २५१

0.61240 0.1710 0.0000 0.0000 0.0000 0.0000

versus  $\sim$  one  $\sim$

دیگر اینجا نمایند و میراند.

resp = 0 time log = 1

$$res = res_1 - res_2 \Rightarrow e_f$$

$\text{sum}(S, \mathbf{l}_{\mathbf{c}_1}, \mathbf{l}_{\mathbf{c}_2})$

$\text{res1} \leftarrow \text{SUM}(s_1, c_1)$

`res2 ← sum(s, 1q)`

return res1 - res2

res1 = 1 res2 = 100  
 $\leftarrow$  13 = 100 13  $\rightarrow$  100 = 112  
 $\leftarrow$  100 = 100 100 = 100  
 $\leftarrow$  100 = 100 100 = 100

sum(s, i)

$\text{sum} \leftarrow 0$   
 $x \in \text{root}[s]$

while  $x \neq \text{null}$

if  $\text{left}[x] > \text{lc}$

$\text{sum} \leftarrow \text{sum} + \text{sum}[\text{left}[x]] - x$

$x \leftarrow \text{left}[x]$

if  $x \leq \text{lc}$

$x \leftarrow \text{right}[x]$

return sum

time  $O(\log n) = O(n \cdot \log n)$   
 SUM  $\rightarrow 100 \rightarrow 0 \rightarrow 100 \rightarrow 100 \rightarrow 100$   
 98  $\rightarrow 100 \rightarrow 0 \rightarrow 100 \rightarrow 100 \rightarrow 100$   
 Tr  $\rightarrow 0 \rightarrow 100 \rightarrow 100 \rightarrow 100 \rightarrow 100$   
 time  $\rightarrow 100$

4  $\rightarrow$  tree

PS  $\leftrightarrow$  tree min-heap & w/ file tree  
min-heap  $\rightarrow$  min & max = max

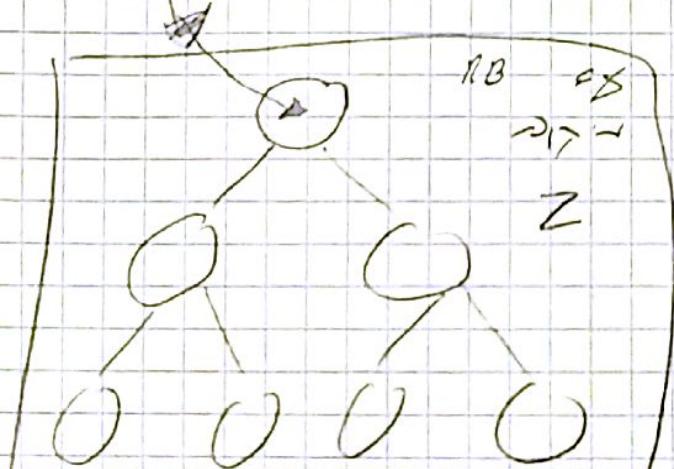
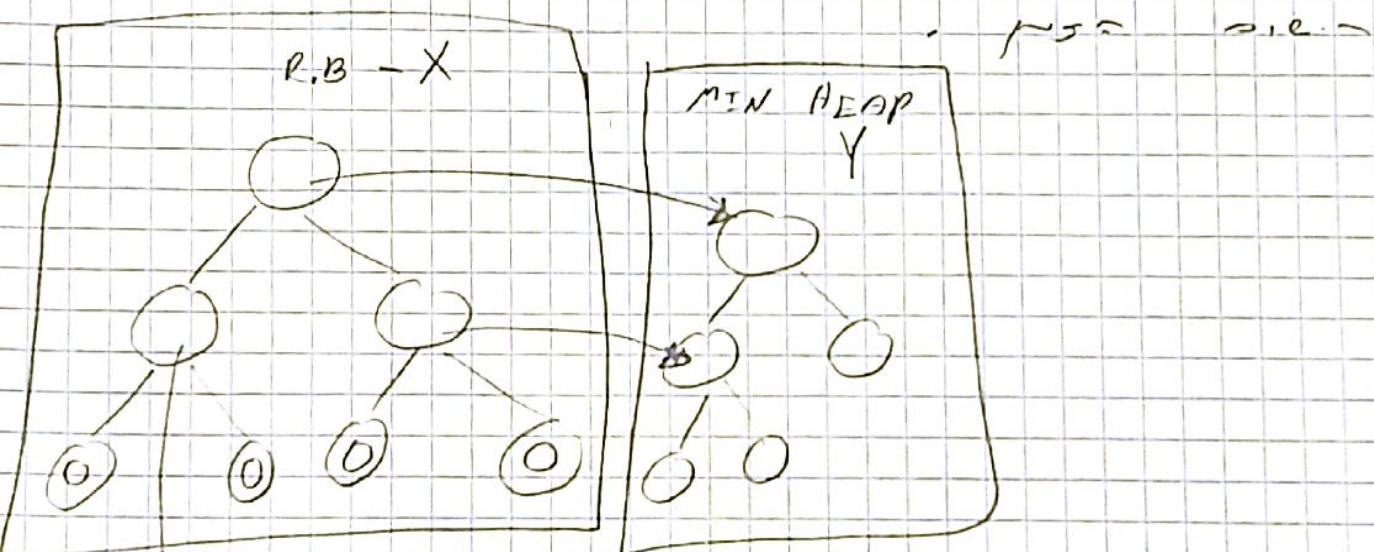
MOPE is  $O(1)$   $\rightarrow$  3.1 ms  $\rightarrow$  1000 > 1000  
order  $\rightarrow$  current insertion

insertion in file time  $\rightarrow$  1000 ms

B will return first element Q

insertion only for minimum - node

like merge min-heap  $\rightarrow$  1.23-1



$\rightarrow$  tree  $\rightarrow$  3  $\rightarrow$  we search in tree ..

above (one min step)  $\times \approx$  elem

$\Rightarrow$  3  $\rightarrow$  1  $\rightarrow$  k times  $\rightarrow$   $O(n)$

$O(\lg n)$   $\rightarrow$

~~tree~~  $\rightarrow$  tree  $\rightarrow$  3  $\rightarrow$  - INSERT step?

apis  $\rightarrow$  3c  $\times$  RB tree  $\rightarrow$  3  $\rightarrow$ .

$O(\lg n)$

insert - 0  $\rightarrow$  2 apis tree  $\rightarrow$  3  $\rightarrow$

apis  $\rightarrow$  2 apis tree  $\rightarrow$  3  $\rightarrow$ .

~~tree~~  $\rightarrow$  ~~tree~~  $\rightarrow$  ~~tree~~  $\rightarrow$  3  $\rightarrow$  3  $\rightarrow$

$S = 0$  .  $\rightarrow$   $\rightarrow$  ~~tree~~ re INSERT

$O(\lg n)$   $\rightarrow$  3  $\rightarrow$

$\rightarrow$  3  $\rightarrow$   $\rightarrow$   $\rightarrow$   $\rightarrow$   $\rightarrow$   $\rightarrow$ .

$O(\lg n)$

$\rightarrow$  0  $\rightarrow$  2  $\rightarrow$  3  $\rightarrow$  2  $\rightarrow$  1  $\rightarrow$   $\rightarrow$  DELETE(S, V)  $\rightarrow$

$\rightarrow$  3  $\rightarrow$   $\rightarrow$

$\rightarrow$  0  $\rightarrow$  1  $\rightarrow$  2  $\rightarrow$  3  $\rightarrow$  4  $\rightarrow$  V  $\rightarrow$

$\rightarrow$  3  $\rightarrow$  4  $\rightarrow$  0  $\rightarrow$  1  $\rightarrow$  2  $\rightarrow$  3  $\rightarrow$

RB-REMOVE

$\rightarrow$  0  $\rightarrow$  2  $\rightarrow$  3  $\rightarrow$  4  $\rightarrow$  5  $\rightarrow$

$\rightarrow$  0  $\rightarrow$  1  $\rightarrow$  2  $\rightarrow$  3  $\rightarrow$  4  $\rightarrow$

$\rightarrow$  3  $\rightarrow$  4  $\rightarrow$   $\rightarrow$  RB-REMOVE  $\rightarrow$

$\rightarrow$  0  $\rightarrow$  1  $\rightarrow$  2  $\rightarrow$  3  $\rightarrow$  4  $\rightarrow$

$\rightarrow$  2  $\rightarrow$  3  $\rightarrow$

o(bign) n't r-ont r-shts s-

↳ 1) MODE(S) / PAST - ic - MODE(S) ↳  
- ic BUT - e (ic) - Y like this - good

$$\text{root}[y] = \pm 1, \pm$$

It is also seen as a result of the increase in the number of species.

$$VC - 1e = \frac{2}{3} \cdot 50 = 33.33$$

$$1 \approx 1 \rightarrow 1 = 1 \approx 1$$

Z =  $\neg\neg X \rightarrow (\exists v \in V \neg L(v))$

$$O(1) \rightarrow r_1$$