

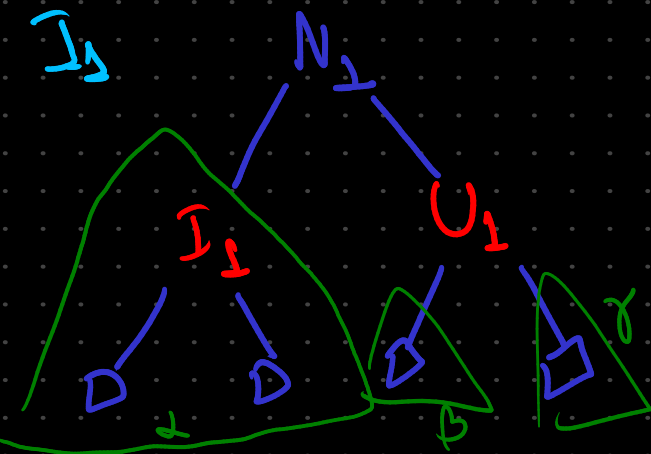
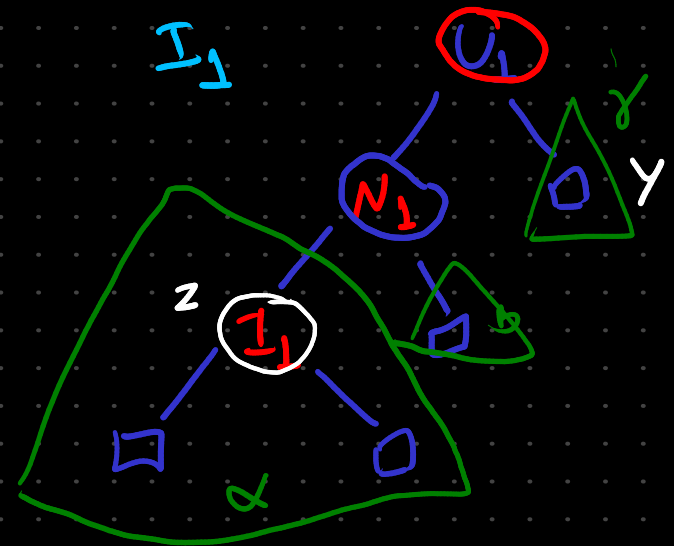
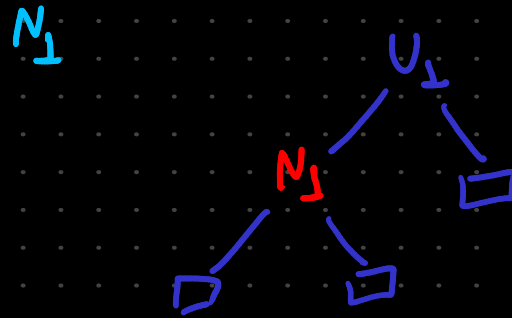
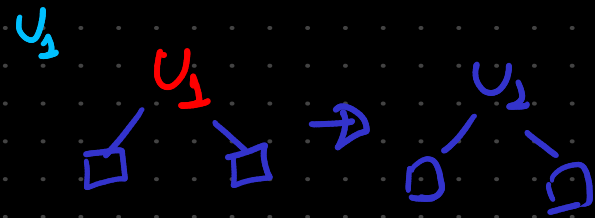
# UNIVERSIDADE FEDERAL RURAL DO RIO DE JANEIRO

1 1 1 1 1 2 1 1 2 2

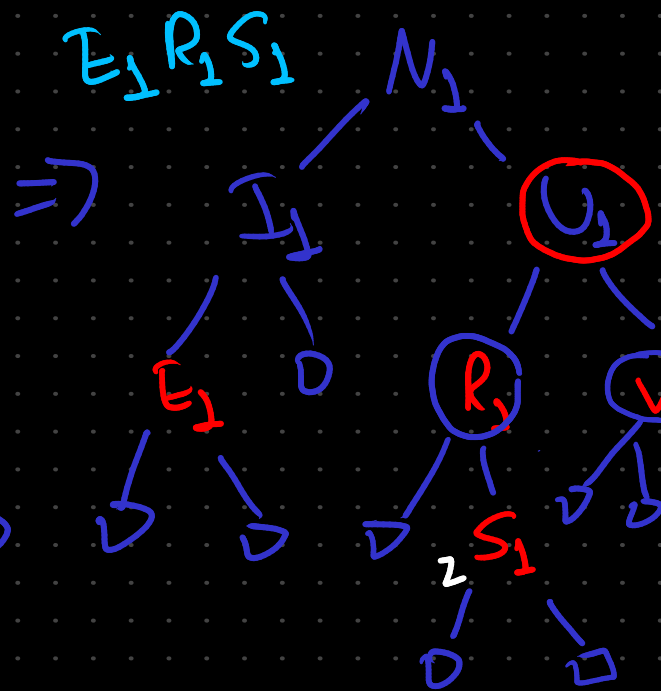
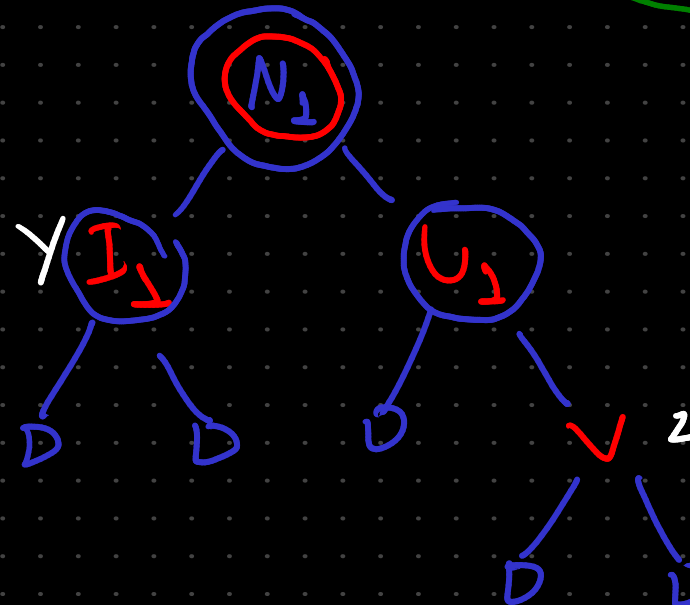
3 3 4 2 2 3 2 4 5

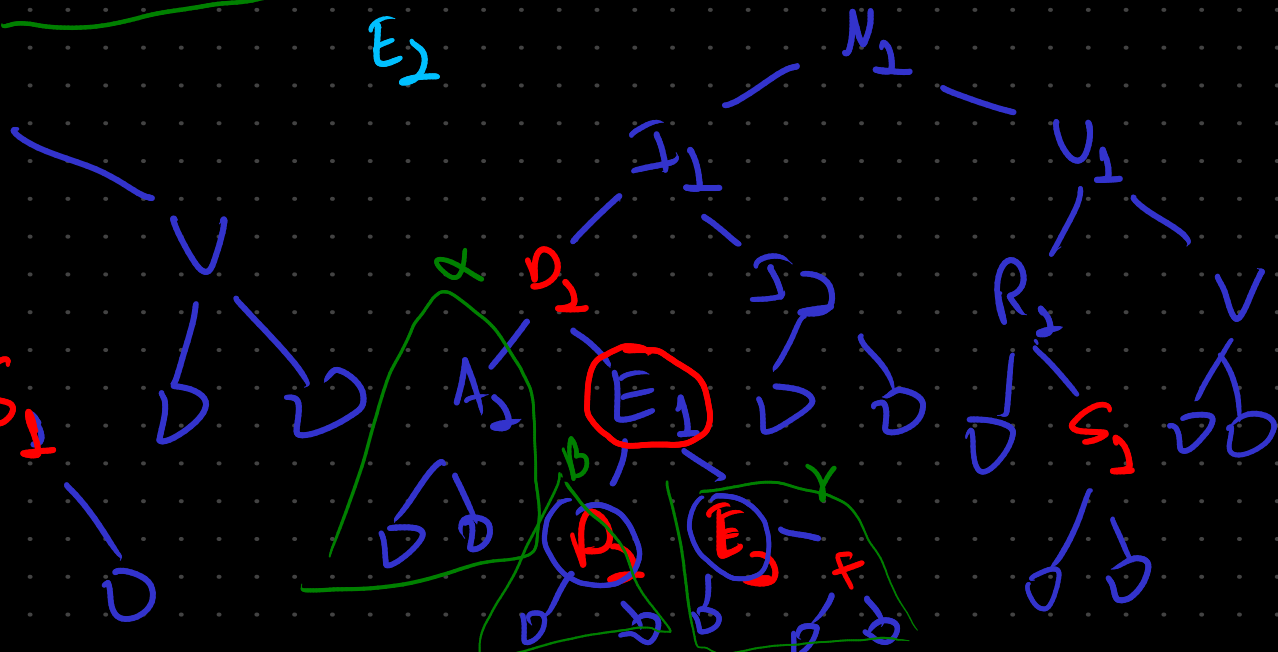
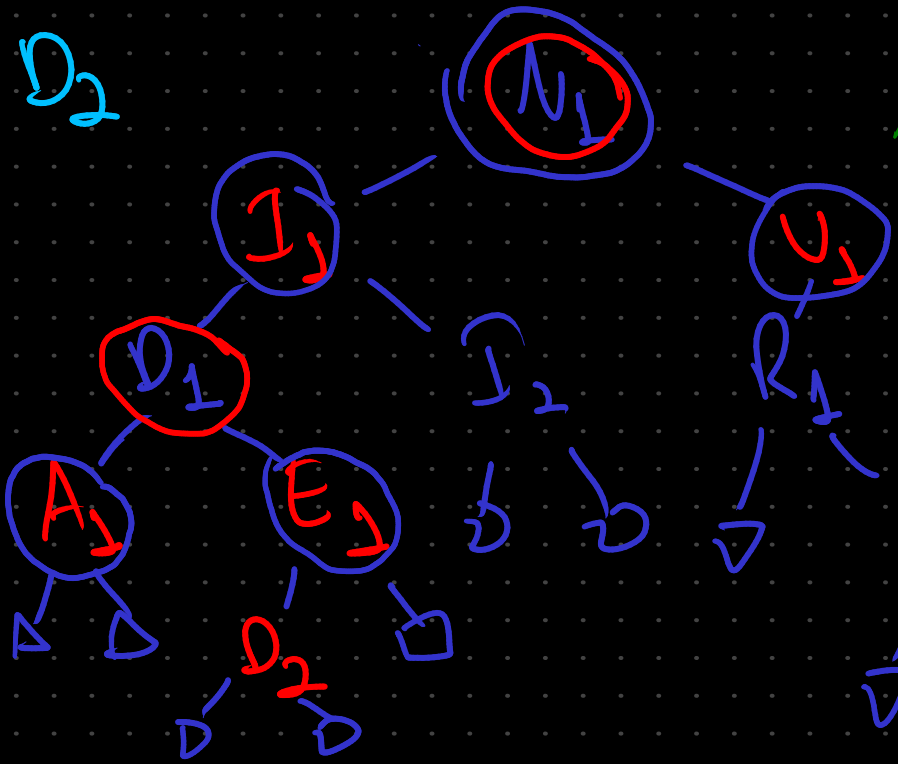
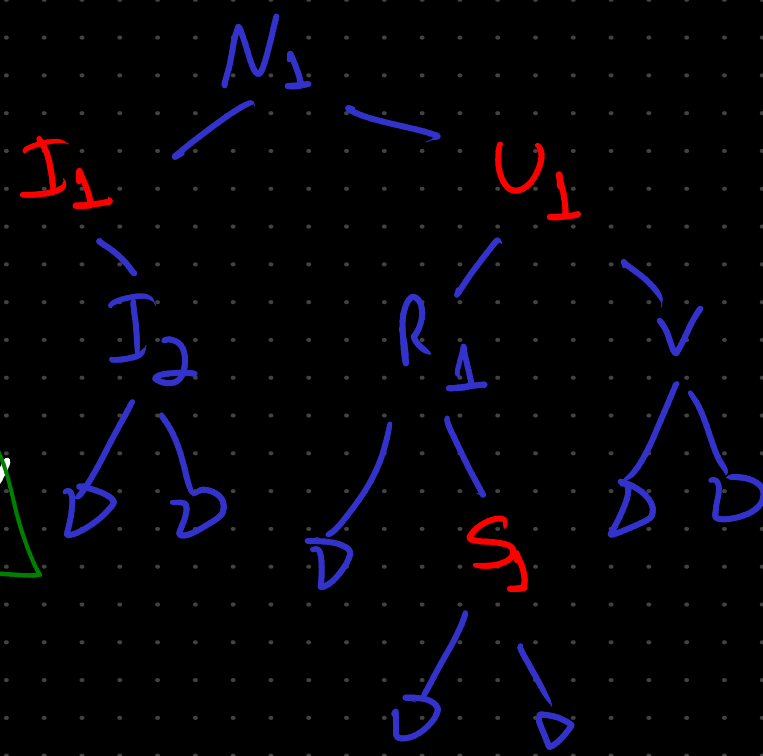
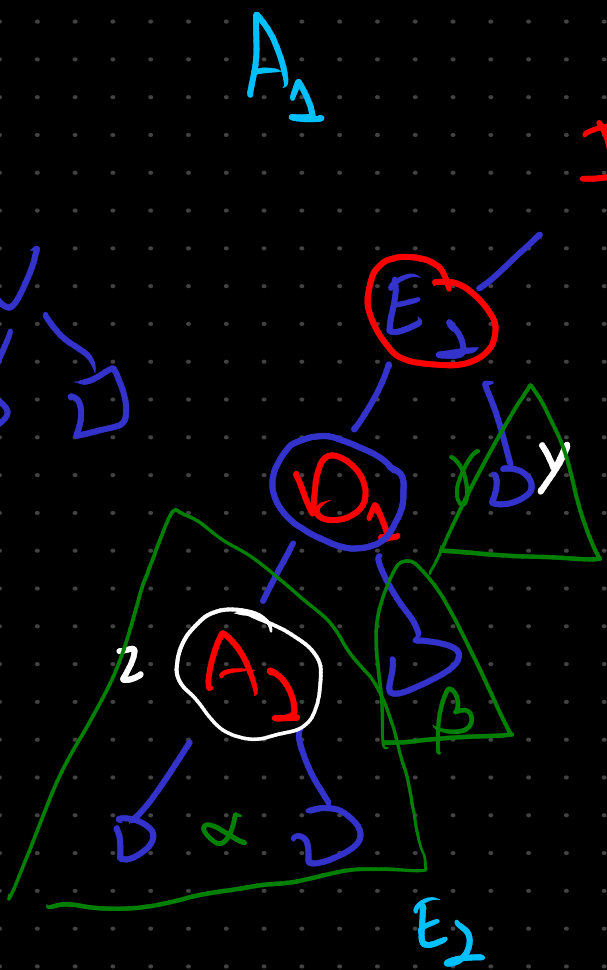
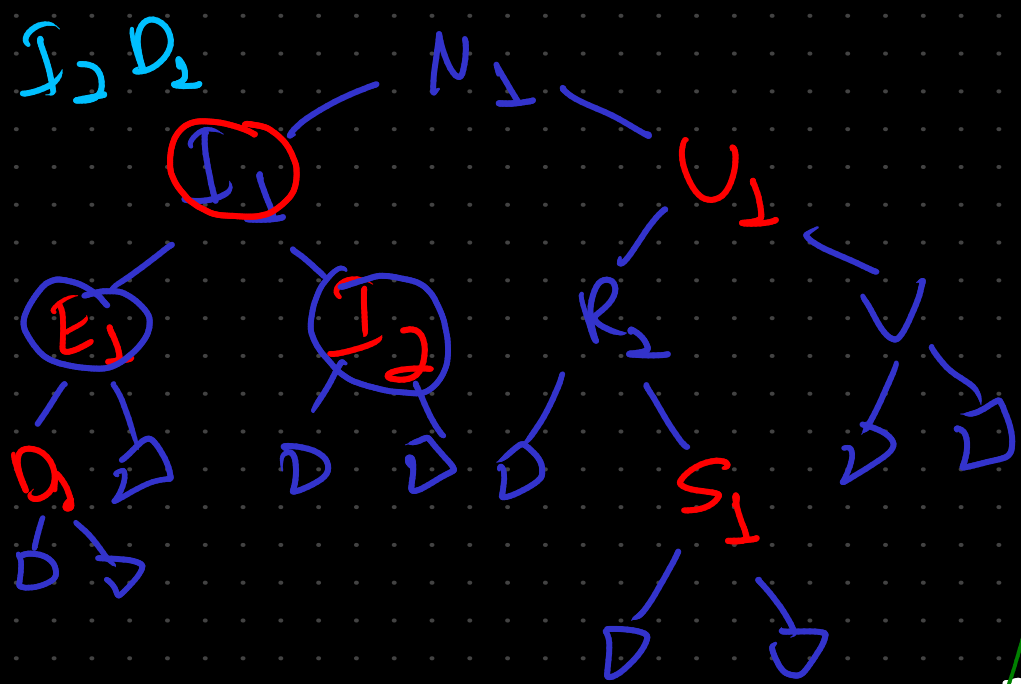
4 1 5 3 2 5

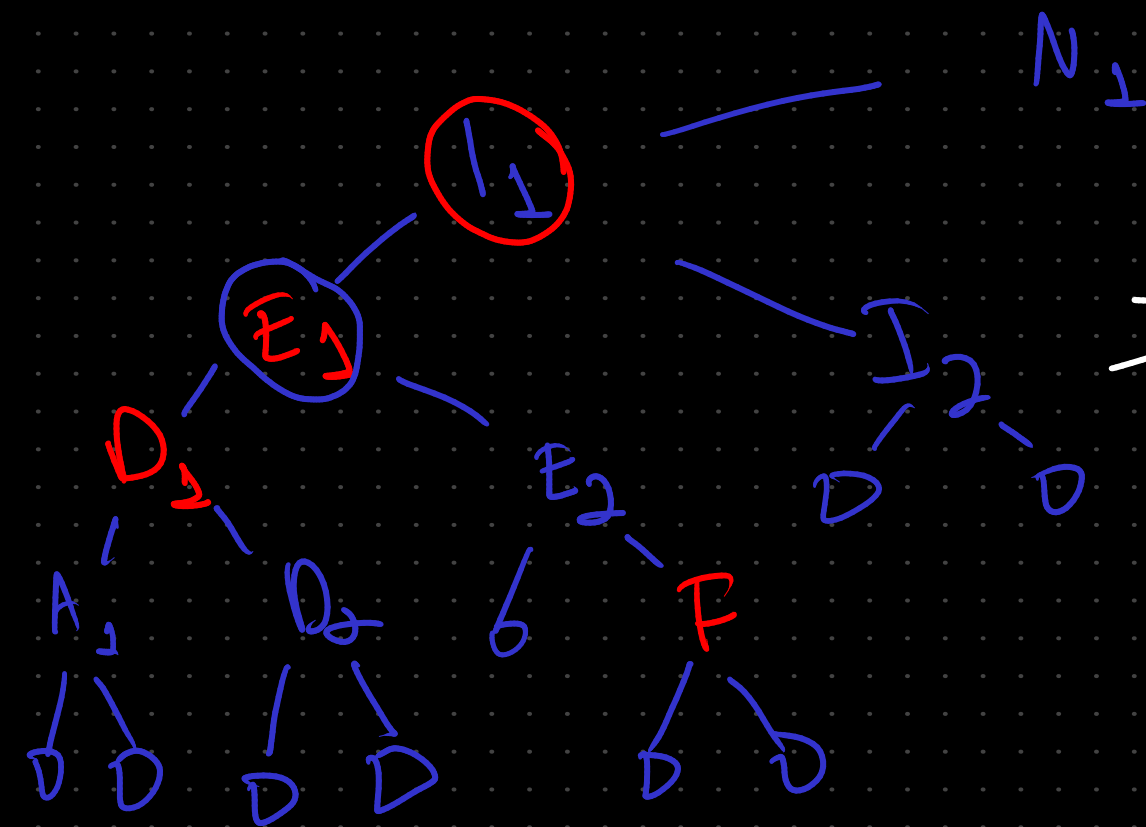
4 2 5 4 6 3



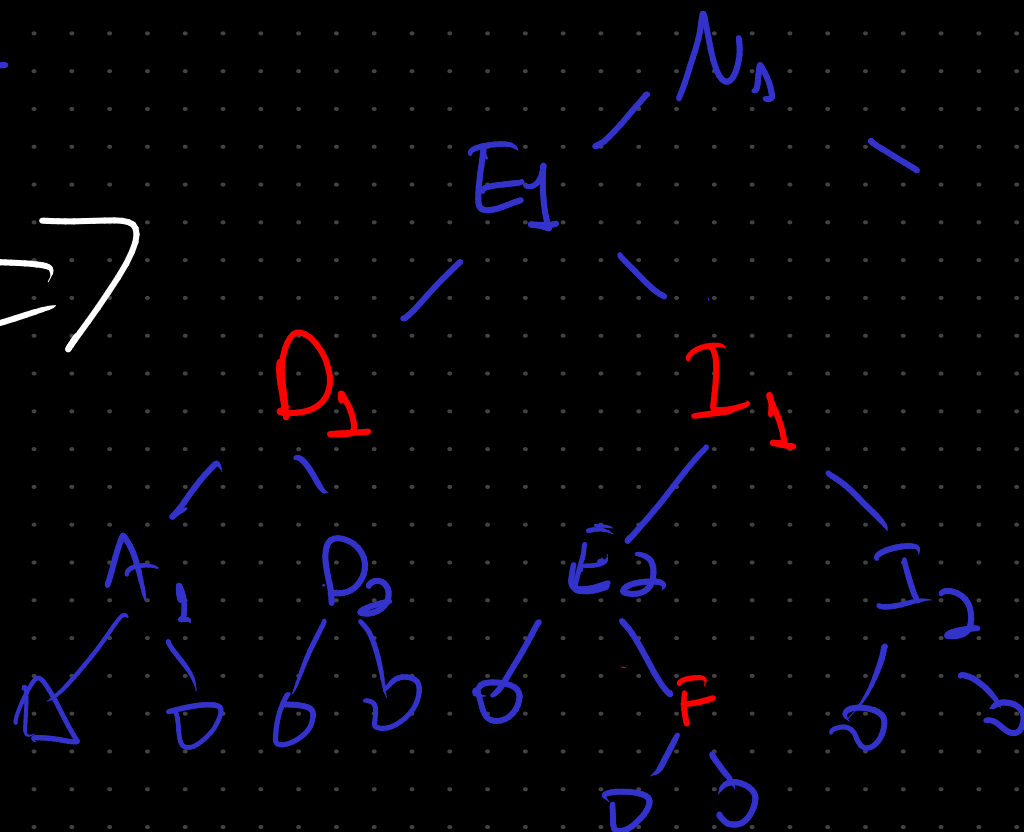
$V$







$\Rightarrow$



Algoritmo rotar-esquerda( $T, x$ )

$y \leftarrow x.$ <sup>dir</sup> $esq$

$x.$ <sup>esq</sup> $dir \leftarrow y.$ <sup>dir</sup> $esq$

se  $y.$ <sup>dir</sup> $esq \neq \text{NULO}$

$y.$ <sup>dir</sup> $esq.pai \leftarrow x$

$x.pai \leftarrow y.pai$

se  $x.pai = \text{NULO}$

$T.raiz = y$

senão se  $x = x.pai.$ <sup>dir</sup> $esq$

$x.pai.$ <sup>dir</sup> $esq \leftarrow y$

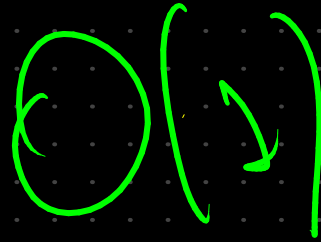
senão

$x.pai.$ <sup>esq</sup> $dir \leftarrow y$

$y.$ <sup>dir</sup> $esq \leftarrow x$

$x.pai \leftarrow y$

fin



struct nó {  
    esq  
    dir  
    pai  
    valor  
}

Algoritmo InserirRB( $T, z$ )

$y \leftarrow \text{NULO}$

$x \leftarrow T.\text{raiz}$

enquanto  $x \neq \text{NULO}$

$y \leftarrow x$

se  $z.\text{valor} < x.\text{valor}$  então

$x \leftarrow x.\text{esq}$

senão  $x \leftarrow x.\text{dir}$

fimenquanto

$z.\text{pai} \leftarrow y$

se  $y = \text{NULO}$

$T.\text{raiz} \leftarrow z$

senão se  $z.\text{valor} < x.\text{valor}$

$y.\text{esq} \leftarrow z$

senão  $y.\text{dir} \leftarrow z$

$z.\text{esq} \leftarrow \text{NULO}$

$z.\text{dir} \leftarrow \text{NULO}$

$z.\text{cor} \leftarrow \text{VERMELHO}$

fim RB-corrigir( $T, z$ )

$O(n)$

Algoritmo RB corrige (T, z)

enquanto z.pai.cor = VERMELHO fazer

se z.pai = z.pai.pai.esq então

y ← z.pai.pai.dir

se y.cor = VERMELHO

z.pai.cor ← PRETO

y.cor ← PRETO

z.pai.pai ← VERMELHO

z ← z.pai.pai

senão

se z = z.pai.dir então

z ← z.pai

rotasão-esquerda(T, z)

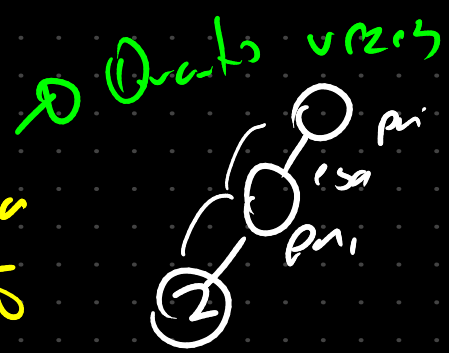
z.pai.cor ← PRETO

z.pai.pai.cor ← VERMELHO

rotasão-direita(T, z.pai.pai)

finse

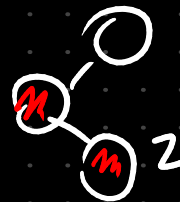
senão → Troca esq → dir



tipo de z

$$\frac{h}{2} = O(h)$$

$$h = O(\log n)$$



Insert

$$O(\log n)$$

T.pai  
PRETO

1) Gere a A.B.B com o seu nome

$R_1 A_1 F A_2 E_1 L$   
 $B E_2 N A R D O$   
 $T E_3 I X E_4 I R A$

