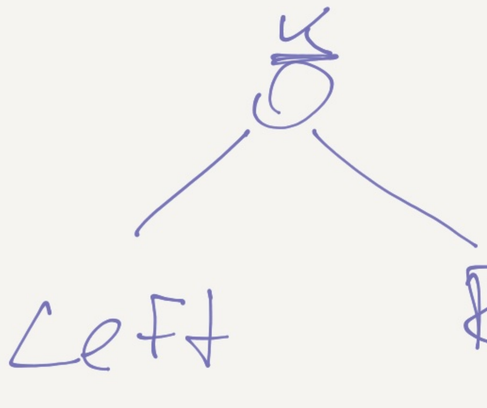


$\forall x \in Left: x \le k$

$\forall y \in Right: y > k$

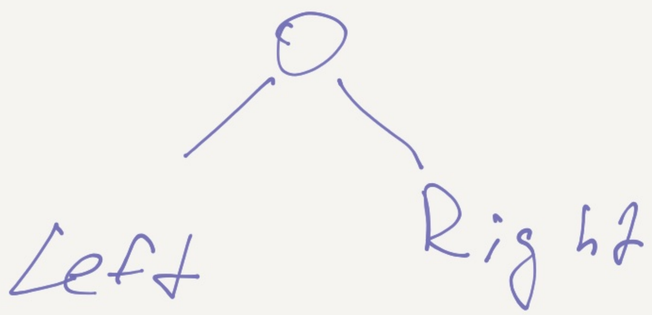
$\langle k, p \rangle$

k - key

p - priority

$\langle a, p \rangle$

$\langle key, priority \rangle$



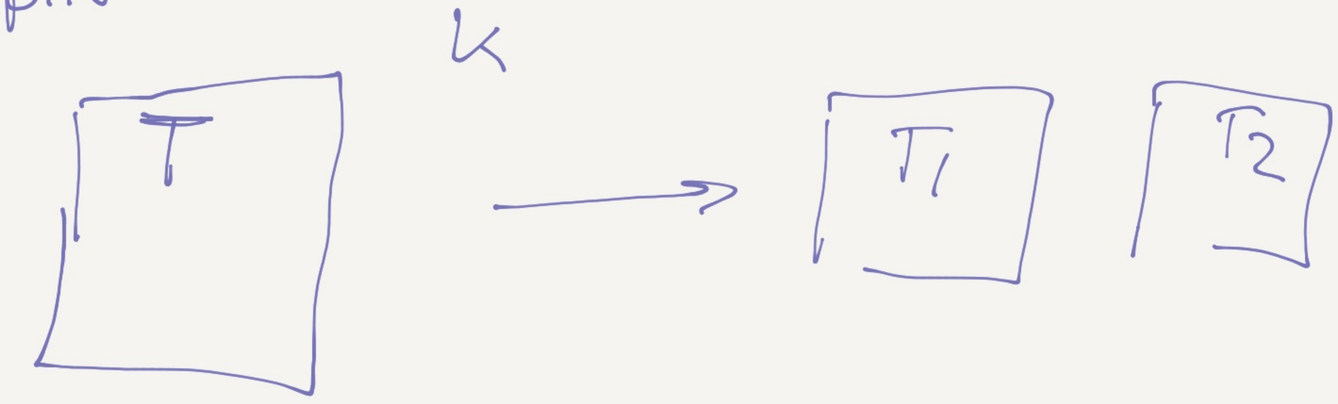
$\forall x \in Left:$

$x.key \le key$

$x.priority > priority$

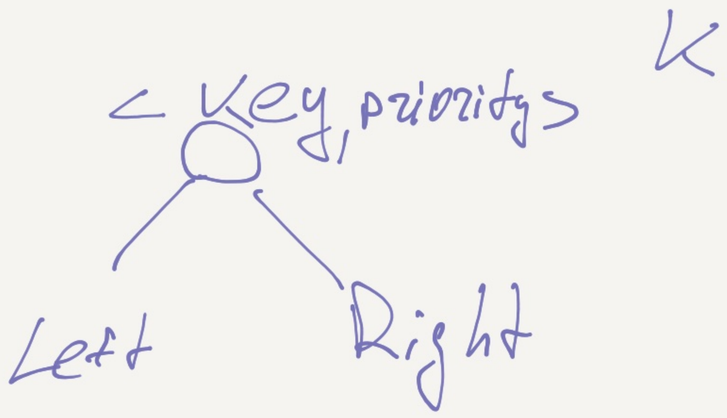
$\forall y \in Right: y.key > key, y.priority > priority$

Split



$\forall x \in T_1: x.key \le k$

$\forall y \in T_2: y.key > k$



k

1) key ≤ k

2) key > k

1) key ≤ k

≤ k

<key, priority>

Left

Right

Split (Right, k) → T_1' ; T_2'

≤ k > k

T_1

<key. priority>

Left

T_1'

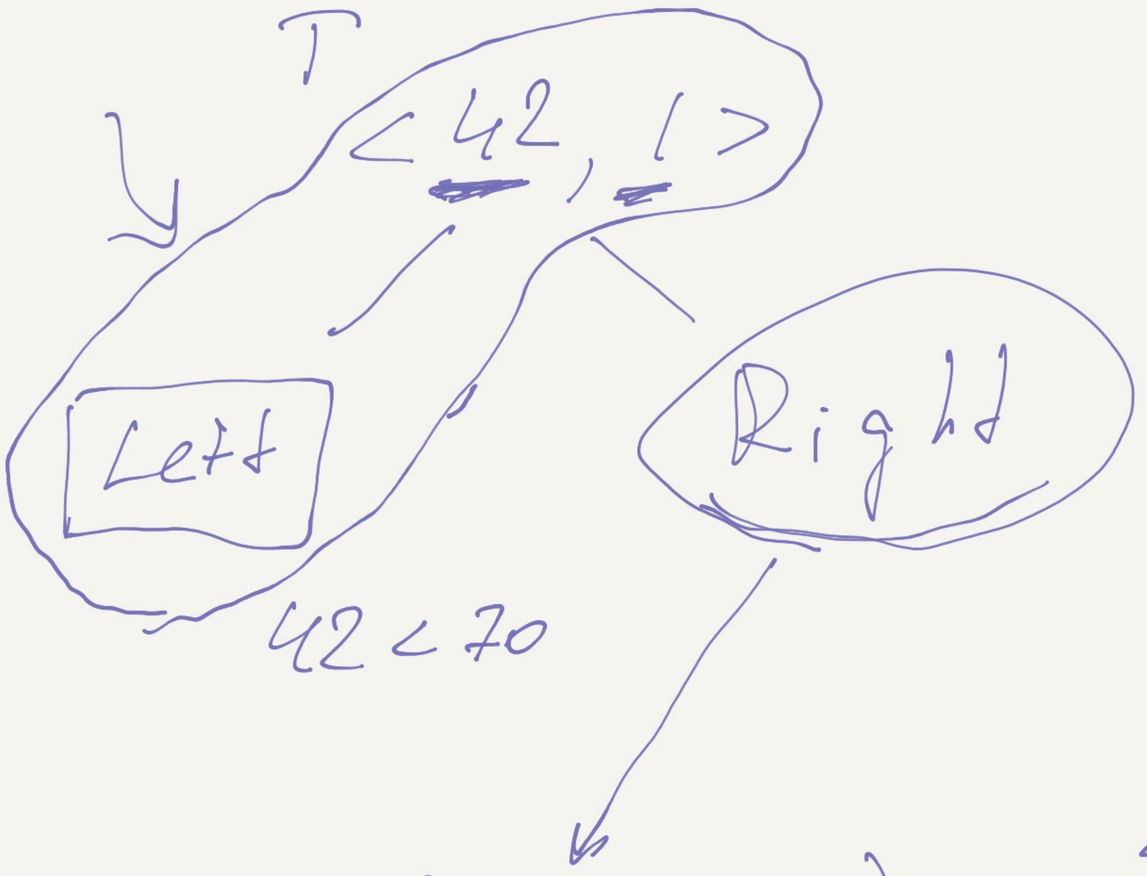
T_2

T_2'

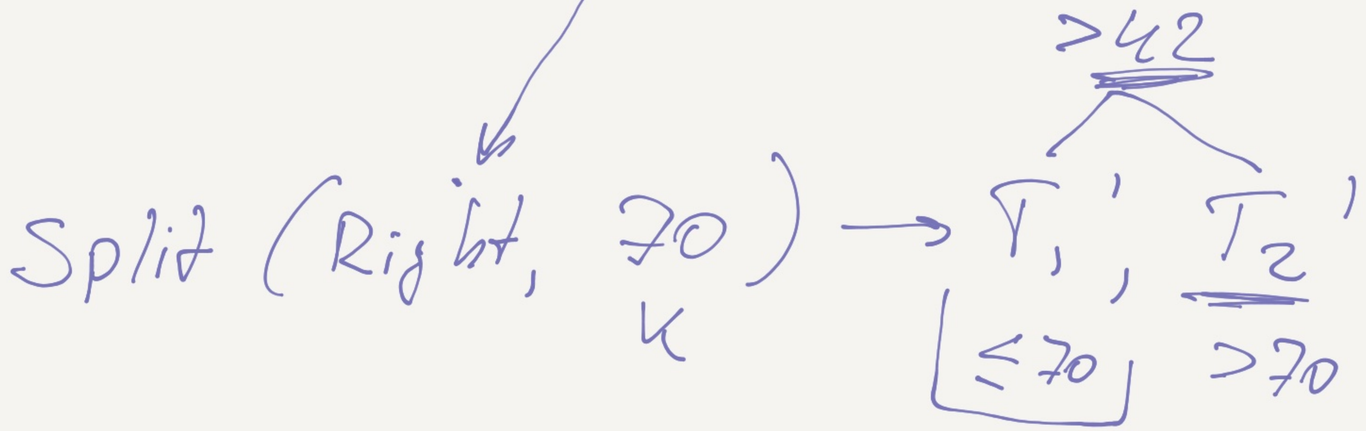
$k = 70$

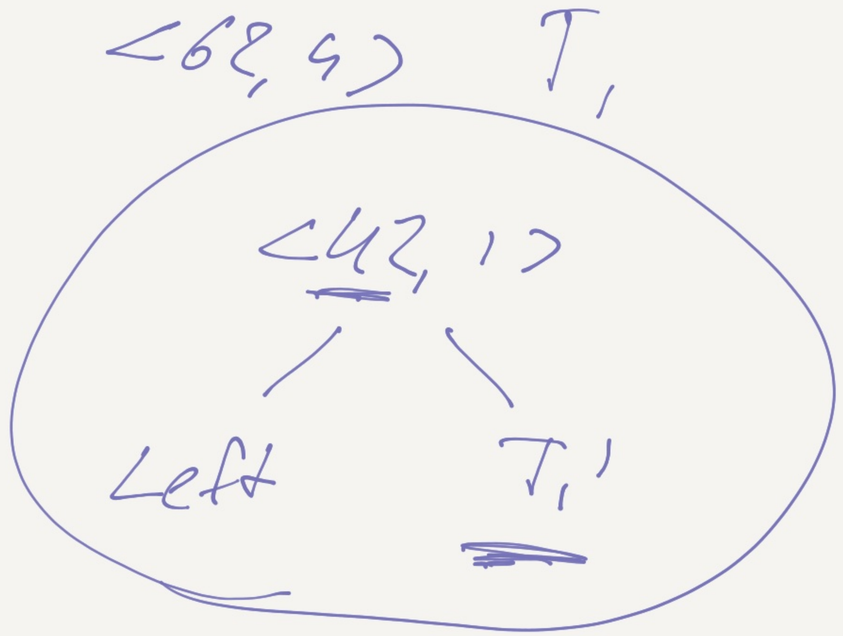
Split $(T, k) = (T_1, T_2)$

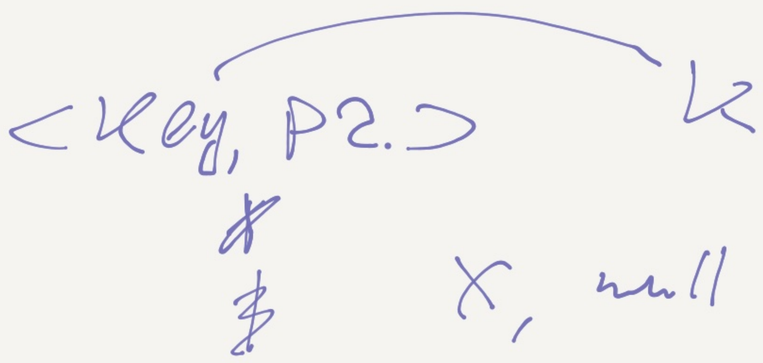
T_1: $\leq k$ ≤ 70 ; T_2: $> k$ > 70



<62, 2> ⇒ <93, 3>







null, X

$T_2' = T_2$

k

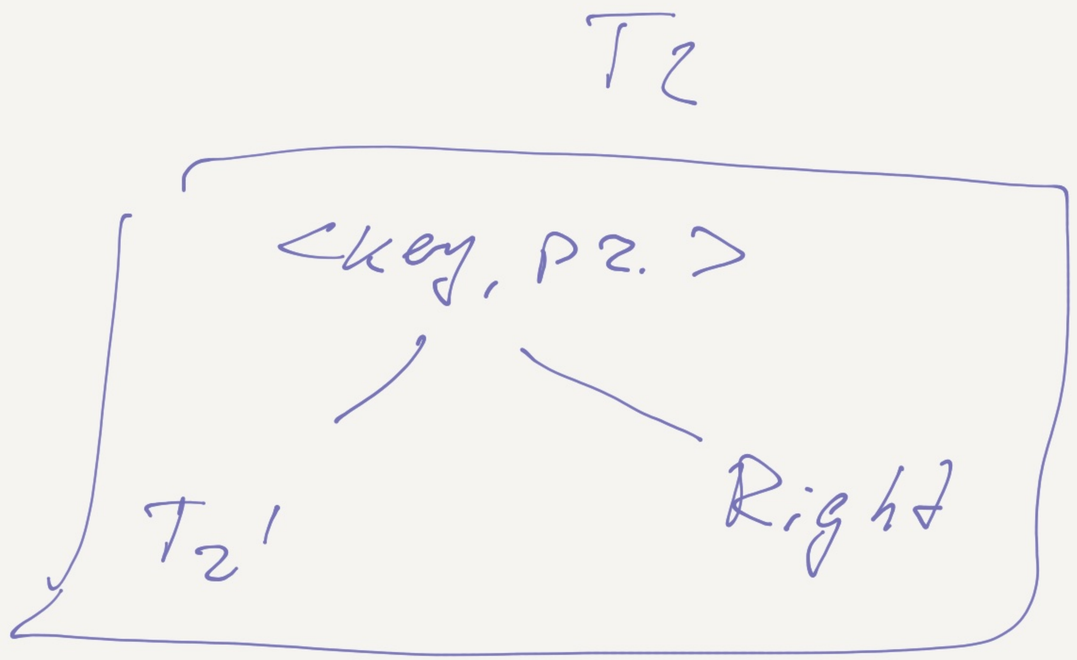
key >k

Split(left, k) → T_1', T_2'

≤k >k

$T_1' = T_1$

T_2



K = 61

<42, 1>

<26, 2>

<64, 3>

<13, 9>

<28, 4>

<10, 10>

<93, 4>

T1

<42, 1>

<26, 2>

<13, 9>

<28, 4>

<10, 10>

61

Split

<62, 3>

<10, 10>

<93, 4>

T2

<62, 3>

<93, 4>

T1 1

T2 1

T1' = <10, 10>

T2' = null

<62, 3>

null

<93, 4>

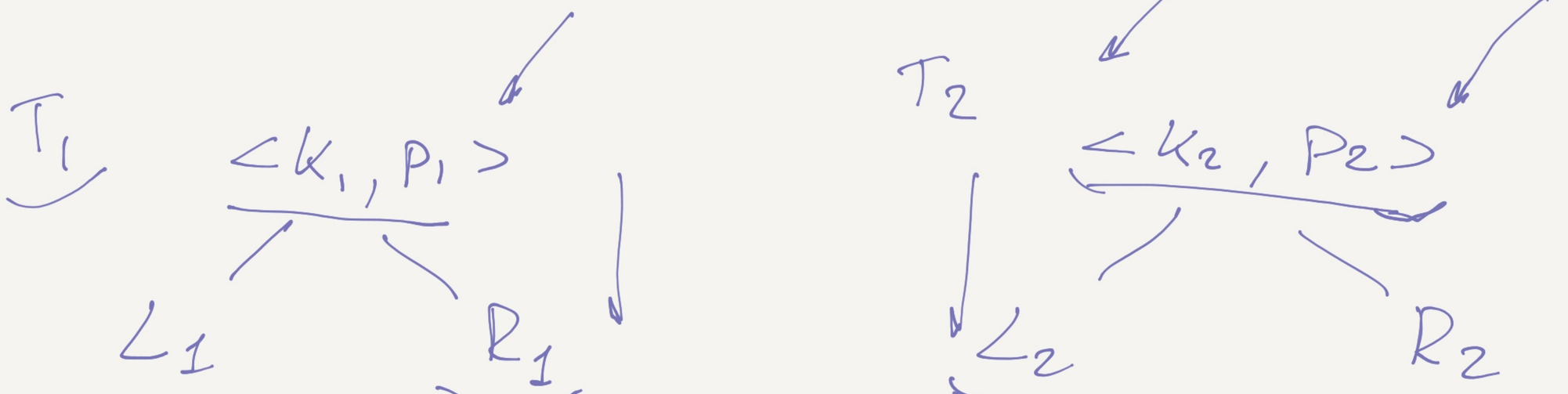
<10, 10>

null

null

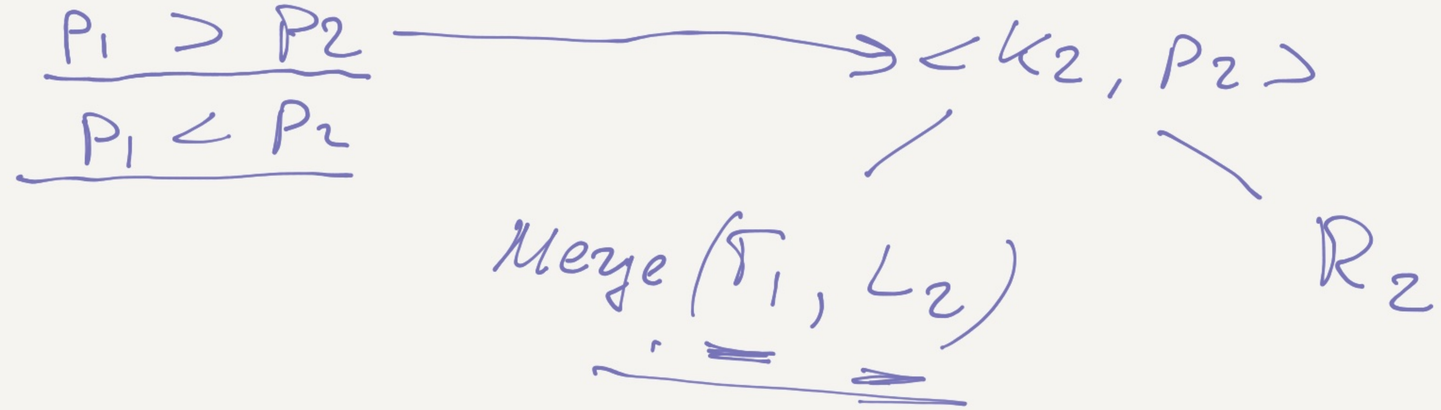
Merge $(T_1, T_2) \to T$

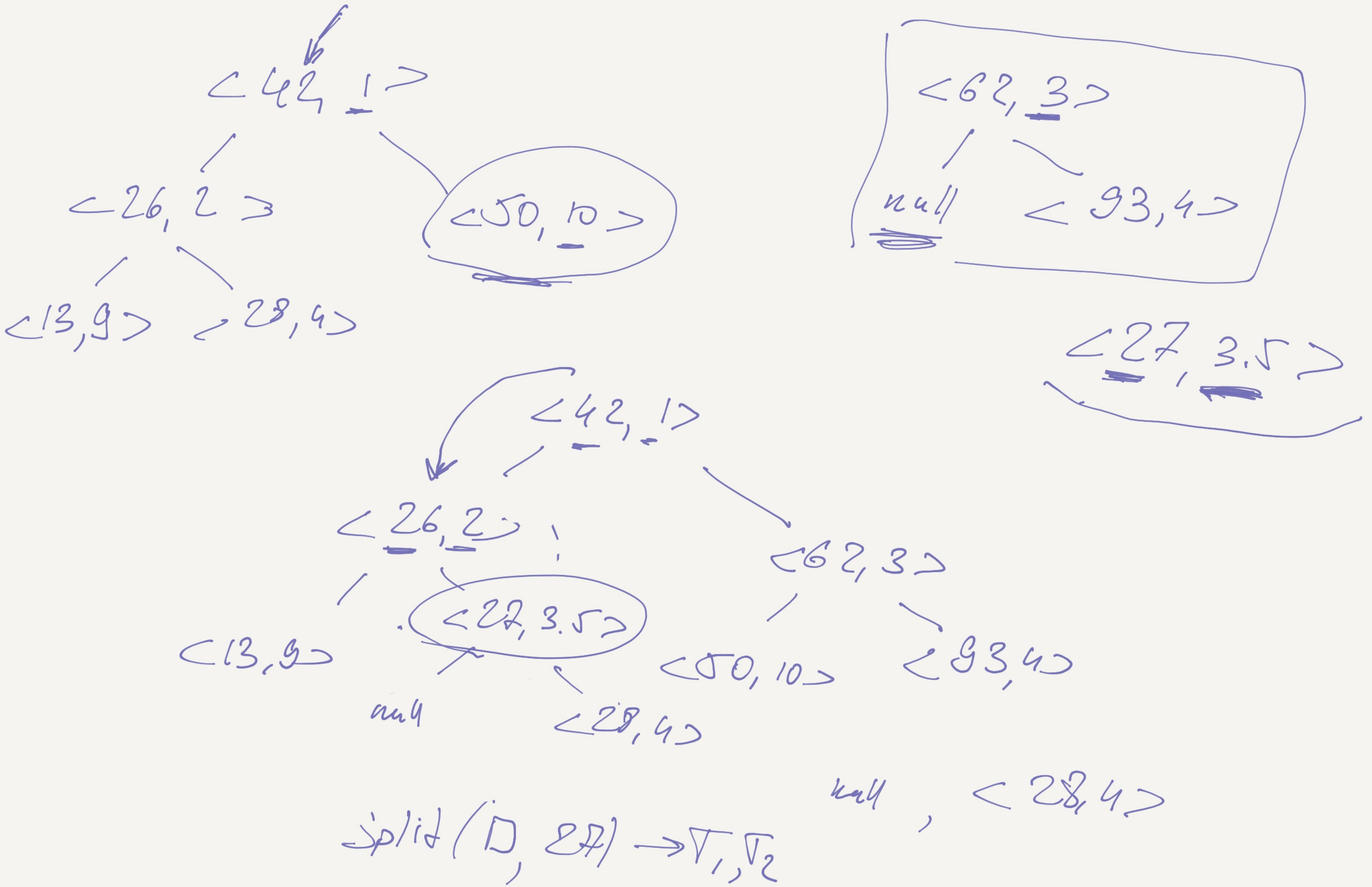
$\forall x \in T_1, \forall y \in T_2 : x.key < y.key$



$P_1 > P_2$

$P_1 < P_2$




<42, 1>
<26, 2>
<50, 10>
<13, 9>
<28, 4>
<62, 3>
null
<93, 4>
<27, 3.5>
<42, 17>
<26, 2>
<62, 3>
<27, 3.5>
<13, 9>
<50, 10>
<93, 4>
null
<28, 4>
null, <28, 4>
split(D, 27) → D1, D2

Insert

$T \leftarrow \boxed{\langle k, P \rangle}$

1) Split $(T, k) \rightarrow T_1, T_2$

$T_1: \leq k \quad T_2: > k$

2) Merge $(T_1, \langle k, P \rangle) \rightarrow T_1'$

$\leq k$

3) Merge $(T_1', T_2) \rightarrow T'$

Delete

$T \rightarrow \langle k, ? \rangle$

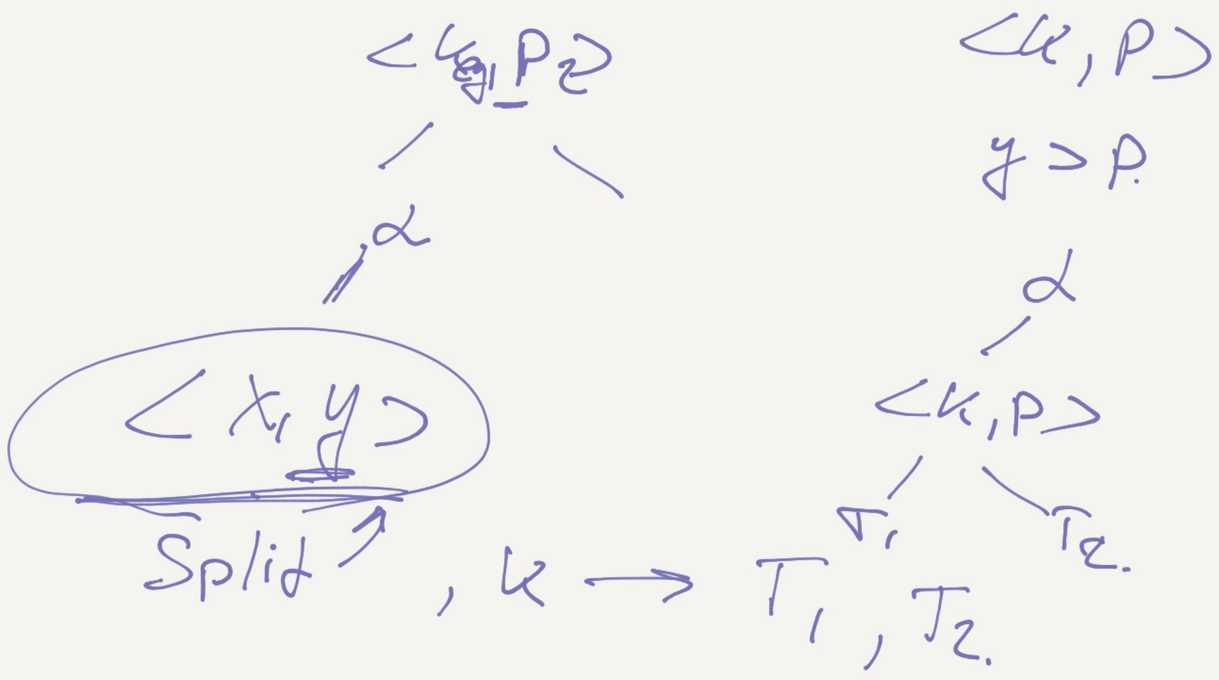
1) Split $(T, k) \rightarrow T_1, T_2$

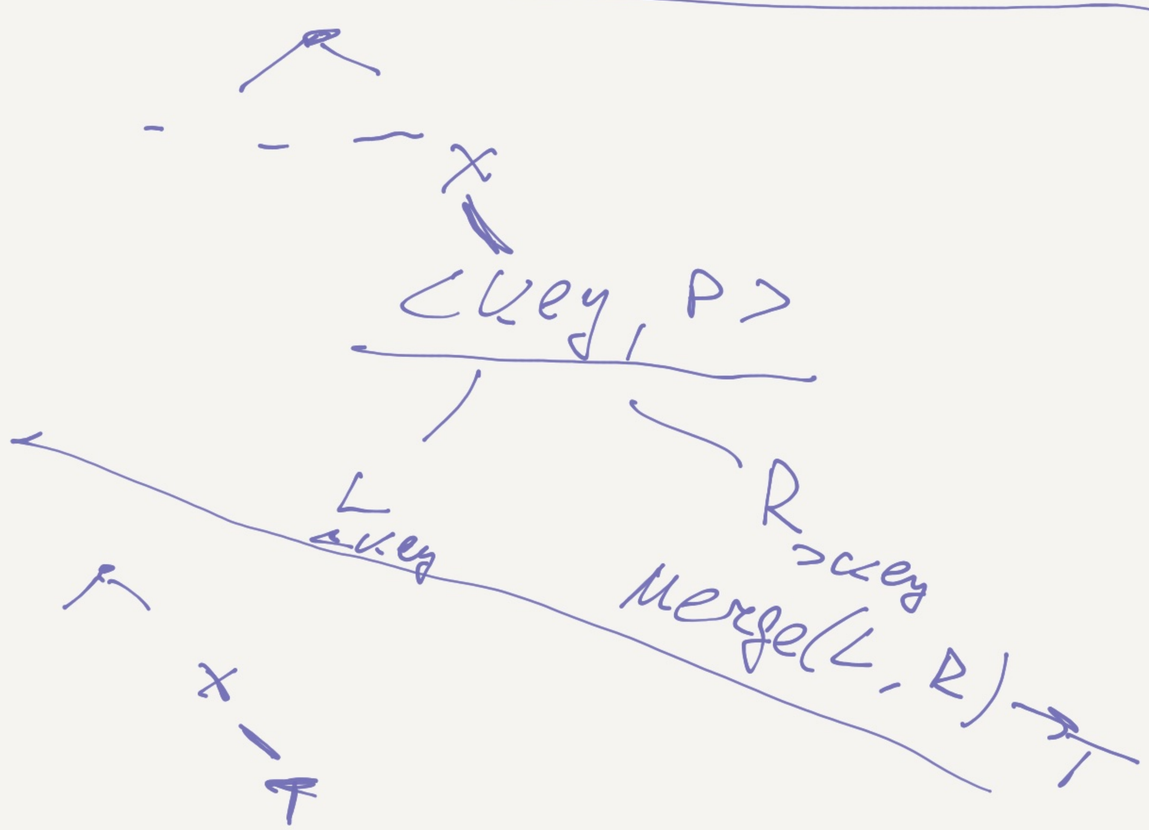
$T_1: \leq k \quad T_2: > k$

2) Split $(T_1, k - \varepsilon) \rightarrow T_1', T_1''$

$T_1': \leq k-\varepsilon \quad T_1'': > k-\varepsilon$

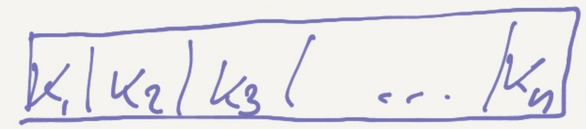
3) Merge $(T_1', T_2) \rightarrow T'$





B-дерево

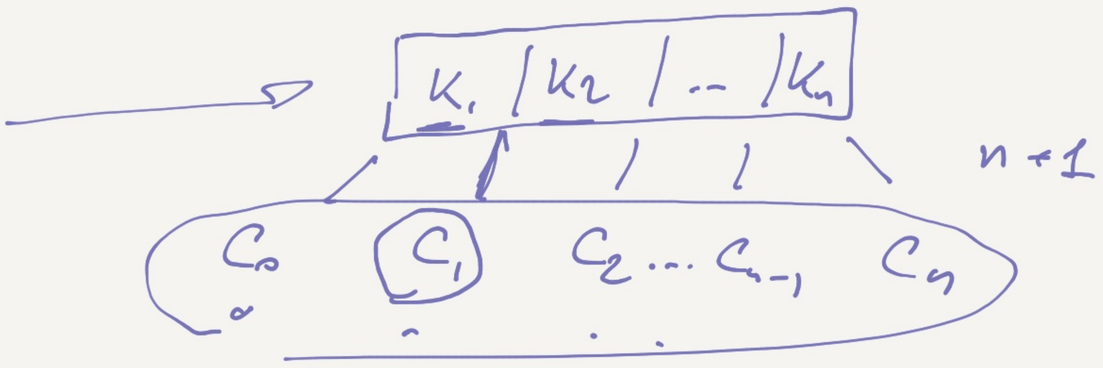
Кормен, гл. 18



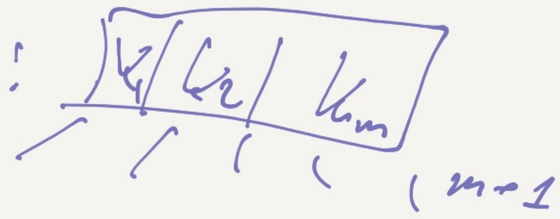
$t \geq 2$.

$t-1 \leq n \leq 2t-1$

$k_1 < k_2 < k_3 < \dots < k_n$



c_i :



$\forall x \in c_0 : x < k_1$

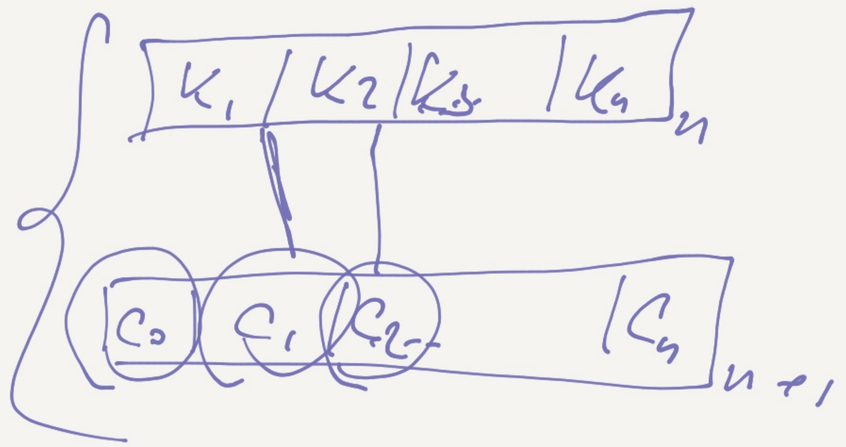
$\forall x \in c_1 : k_1 < x < k_2$

$\forall x \in c_2 : k_2 < x < k_3$

— — — —

$\forall x \in c_{n-1} : k_{n-1} < x < k_n$

$\forall x \in c_n : x > k_n$



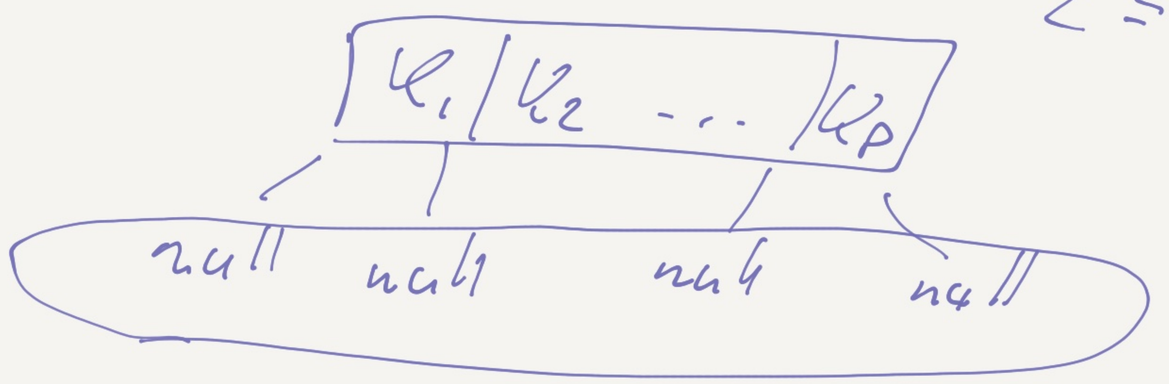
$t=2$

$1 \leq n \leq 3$

$2-3-4$.

$t=3$

$2 \leq n \leq 5$

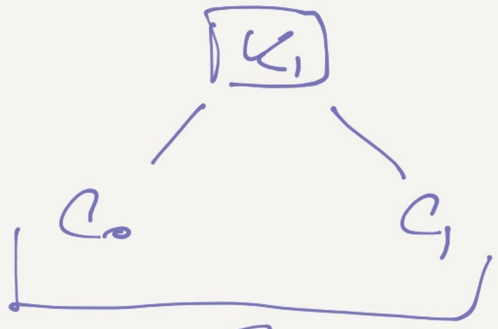


$t = 2$

$2 - 3 - 4 \longleftrightarrow$ RBT

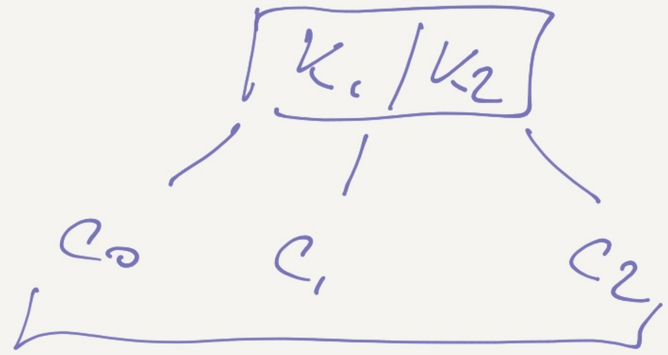
$1 \le n \le 3$

$n = 1$



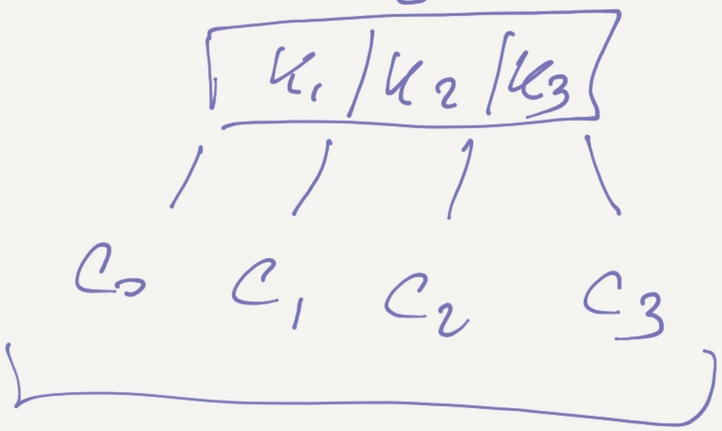
2-узел

$n = 2$

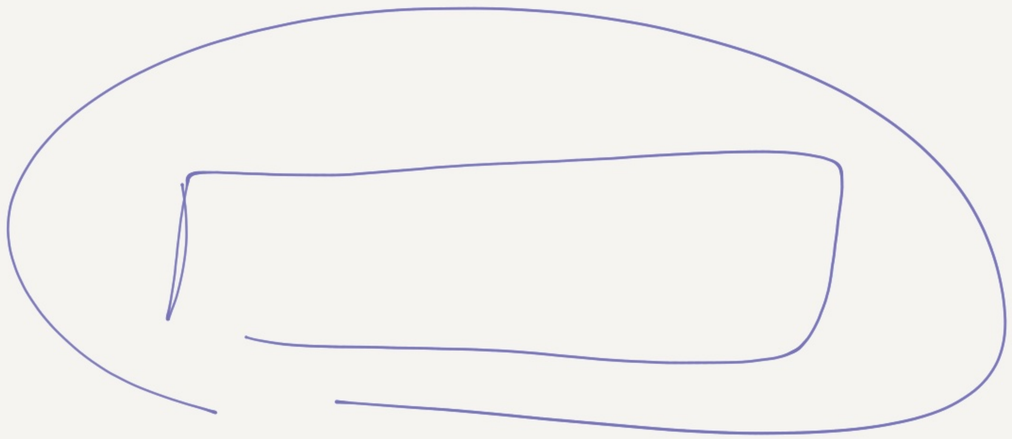


3-узел

$n = 3$

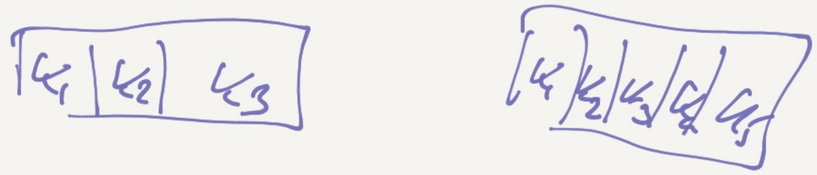


4-узел



t

$t = 3$ $\quad 2 \hookrightarrow 5$



$t - 1$ $\qquad$ $2t - 1$

$t-1 \dots 2t-1 \longrightarrow 1 \dots 2t-1$

$t = 2$

$1 \dots 3$

h

12 / 53

$-\infty$ | 50 | 100 | $+\infty$

10 | 60

0 | 1 | 2 | 12 | 51 | 52 | 70 | 80 | 90 | 150 | 250 | 350 | 450 | 500

$h \quad \log_t n \quad \log_2 n \quad \log_2 t$

200 | 300 | 400

B+

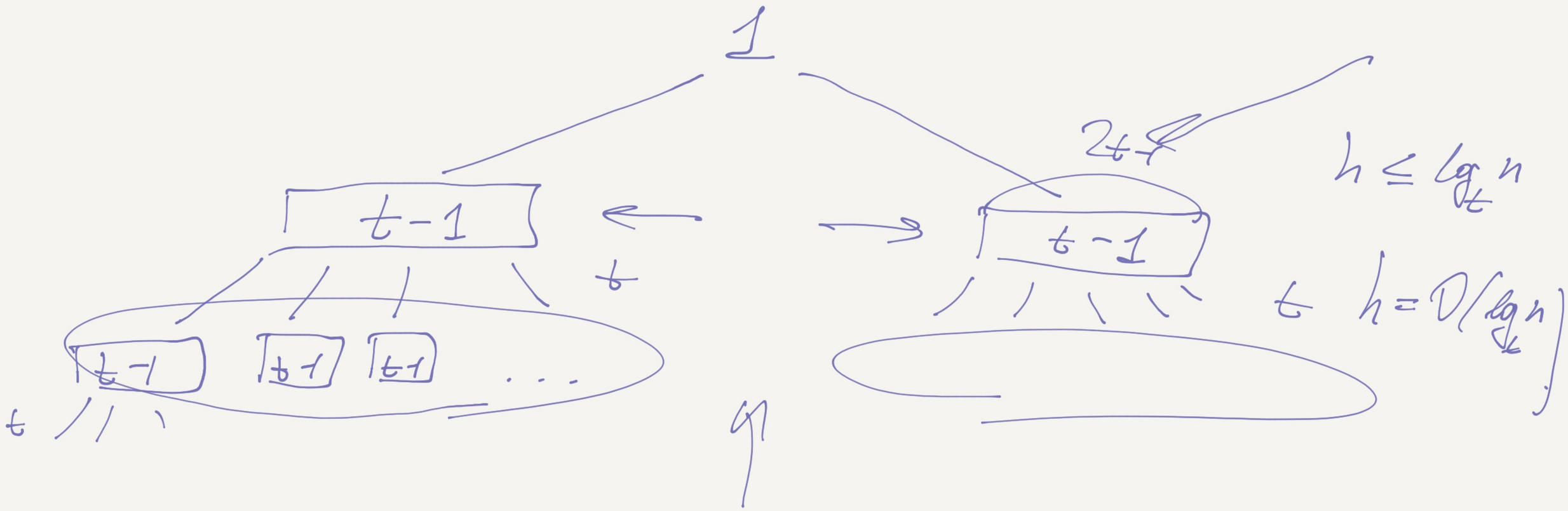
2-3

value value

$k_1 \mid k_2 \mid k_3 \mid k_4 \mid k_5$

$c_0 \quad c_1 \quad c_2 \quad c_3 \quad c_4 \quad c_5$

$r_1 \mid r_2 \mid \dots \mid r_m$



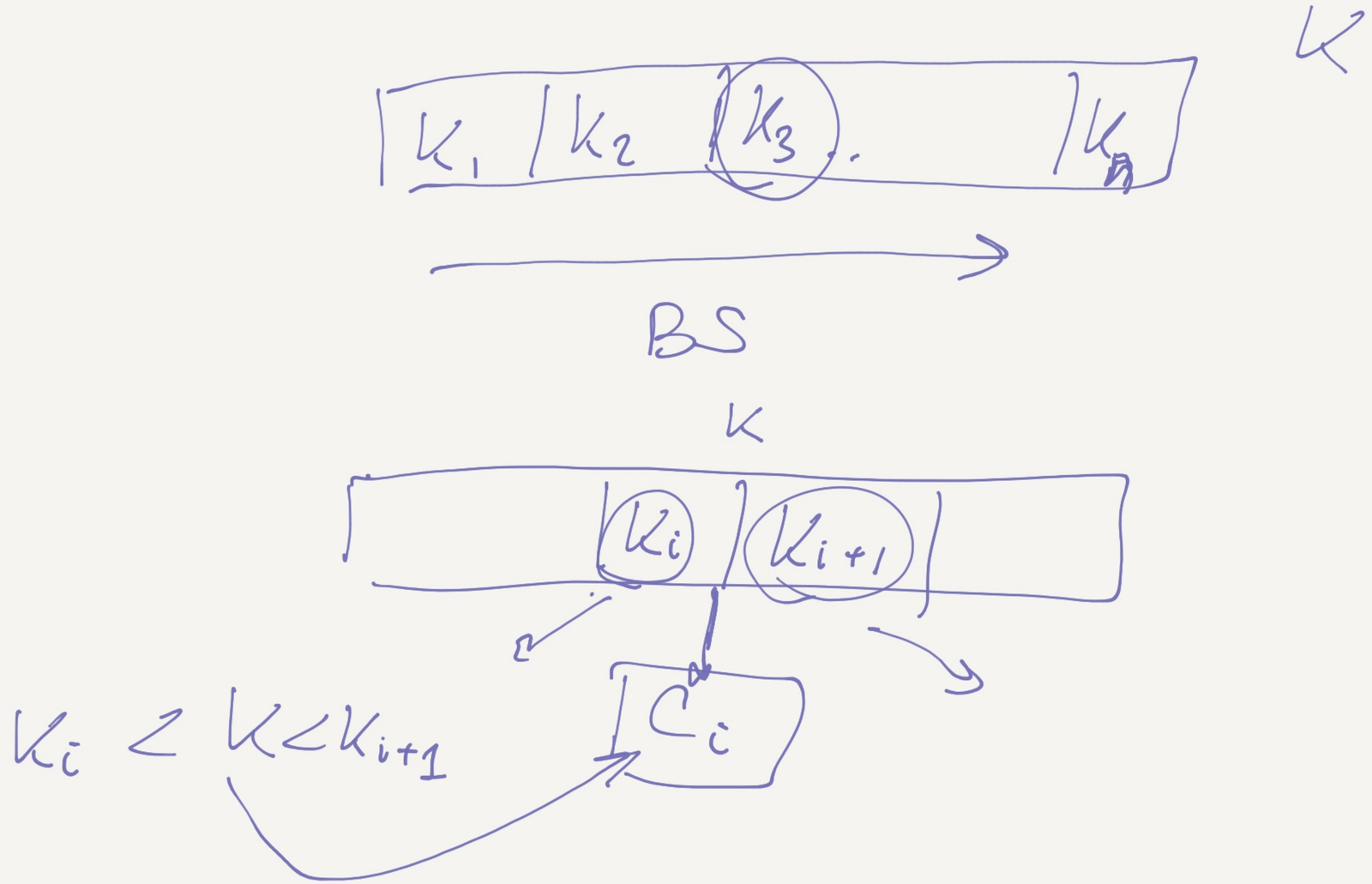
$$1 + 2(t-1) + 2\cdot(t-1)\cdot t + 2\cdot(t-1)\cdot t^2 + \dots \leq$$

$$\leq 1 + 2(t-1)\cdot\sum_{i=1}^{h} t^{i-1} = 1 + 2(t-1)\frac{t^h-1}{t-1} =$$

$$= 1 + 2(t^h-1) = n \qquad \frac{n-1}{2} = t^h - 1$$

$$1 + \frac{n-1}{2} = t^h \qquad h = \log_t\left(1 + \frac{n-1}{2}\right)$$

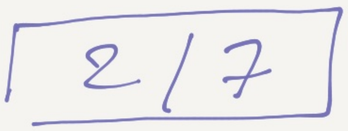
$$h \sim \log_t n$$

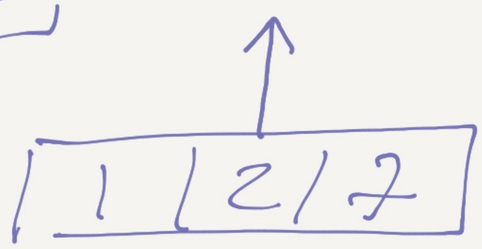

K
K1
K2
K3
Kn
BS
K
Ki
Ki+1
Ci
Ki < K < Ki+1

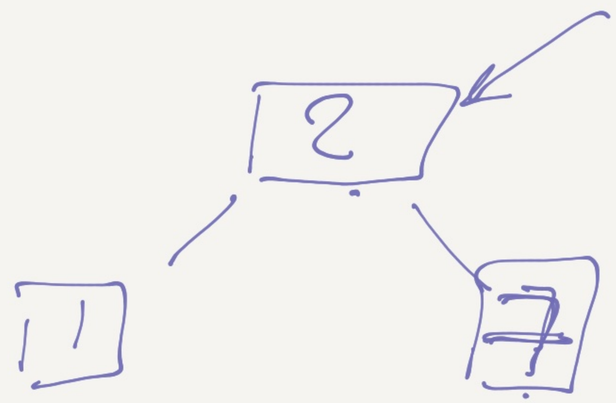
2 7 1 8 28 18 284 5 90 45

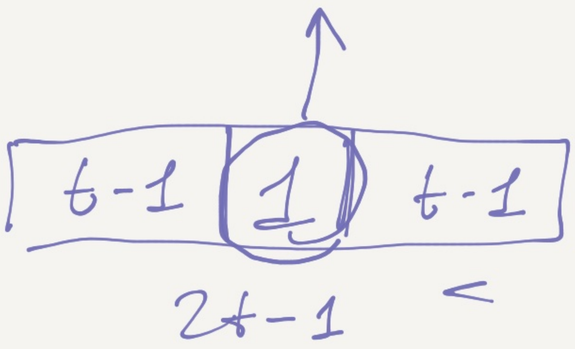
$t = 2$

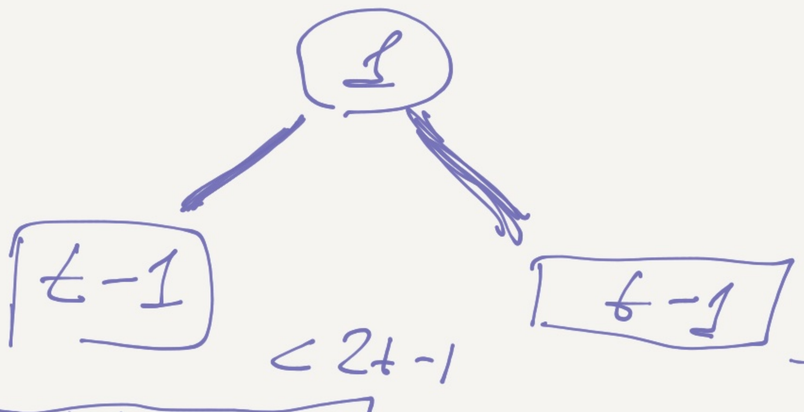
1 ... 3

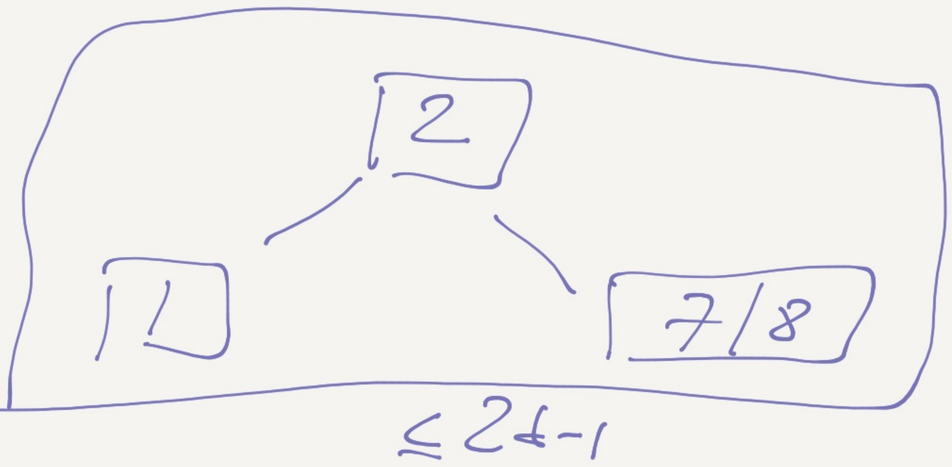


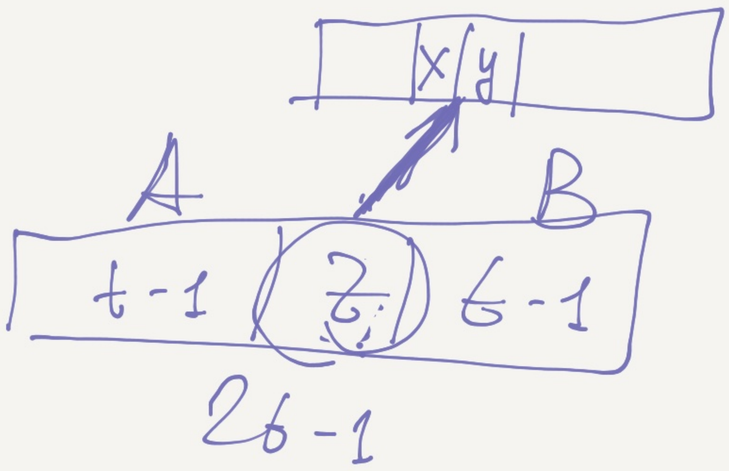


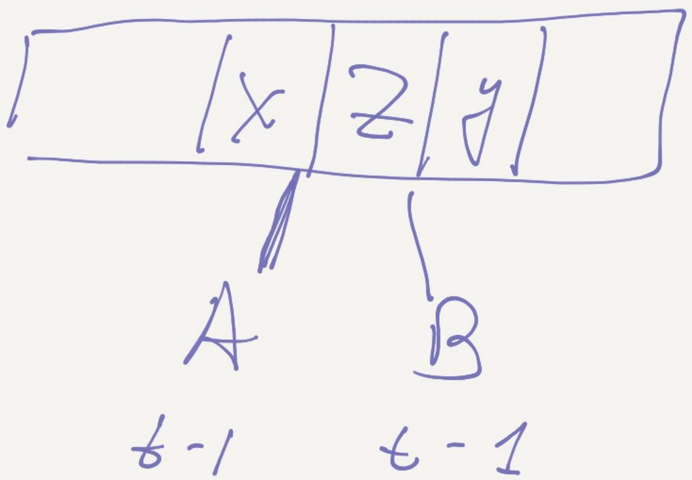


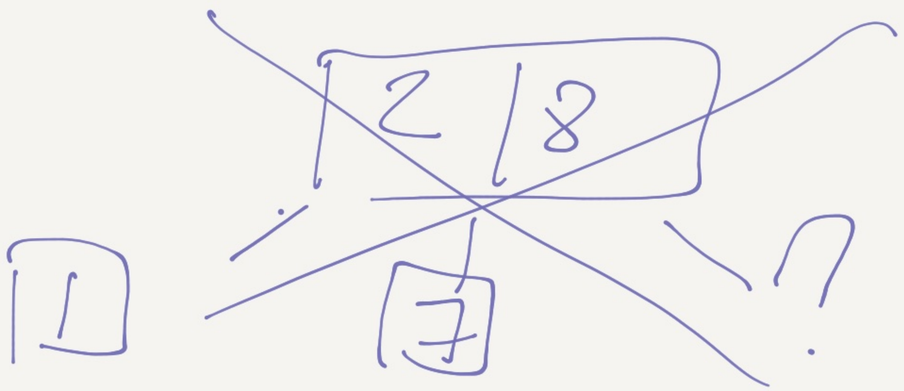




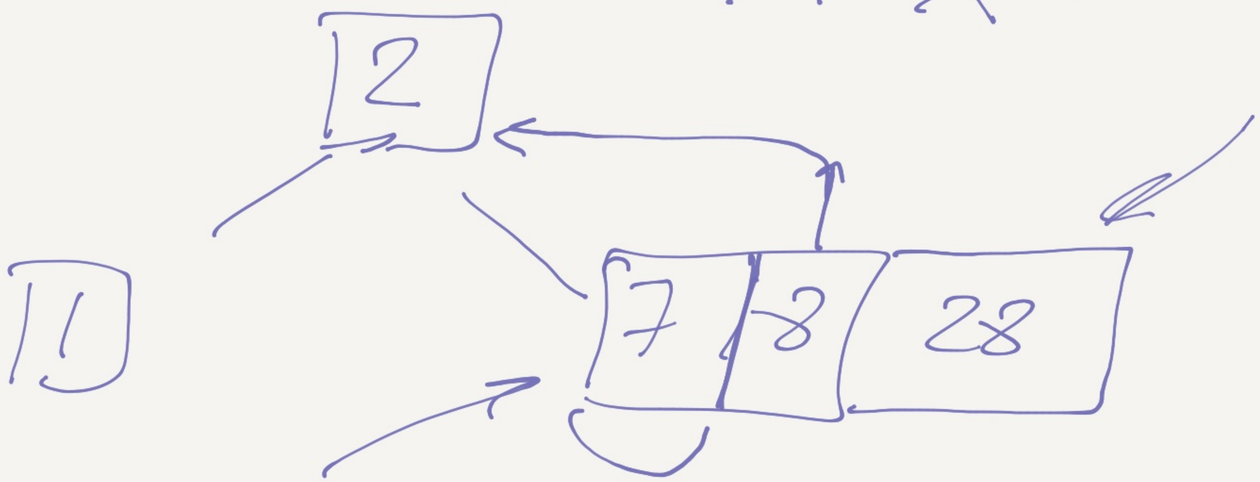


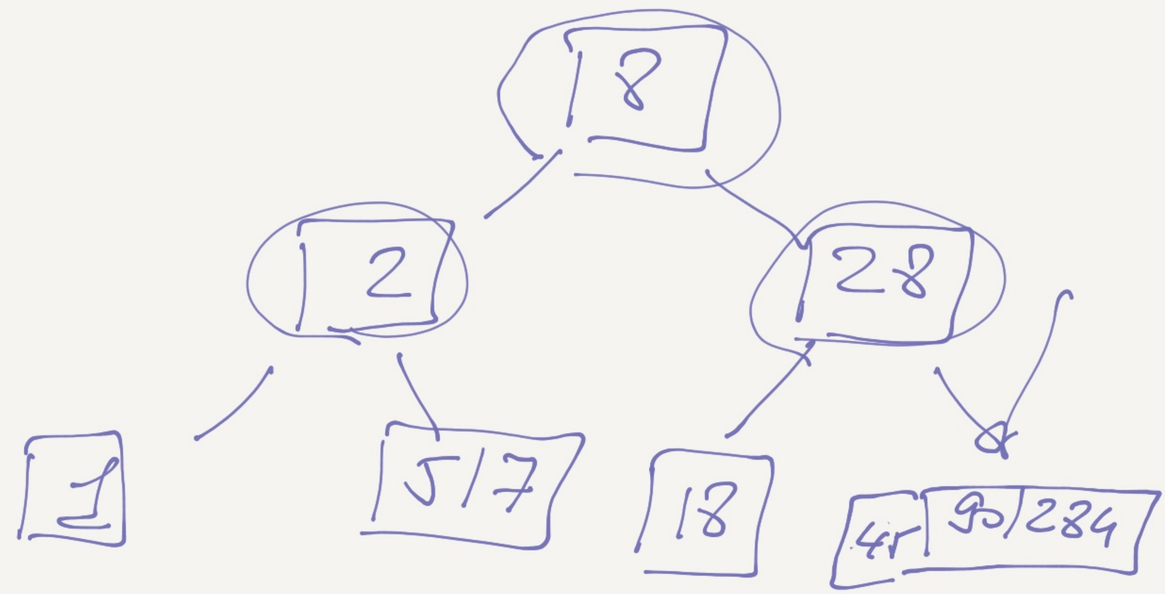






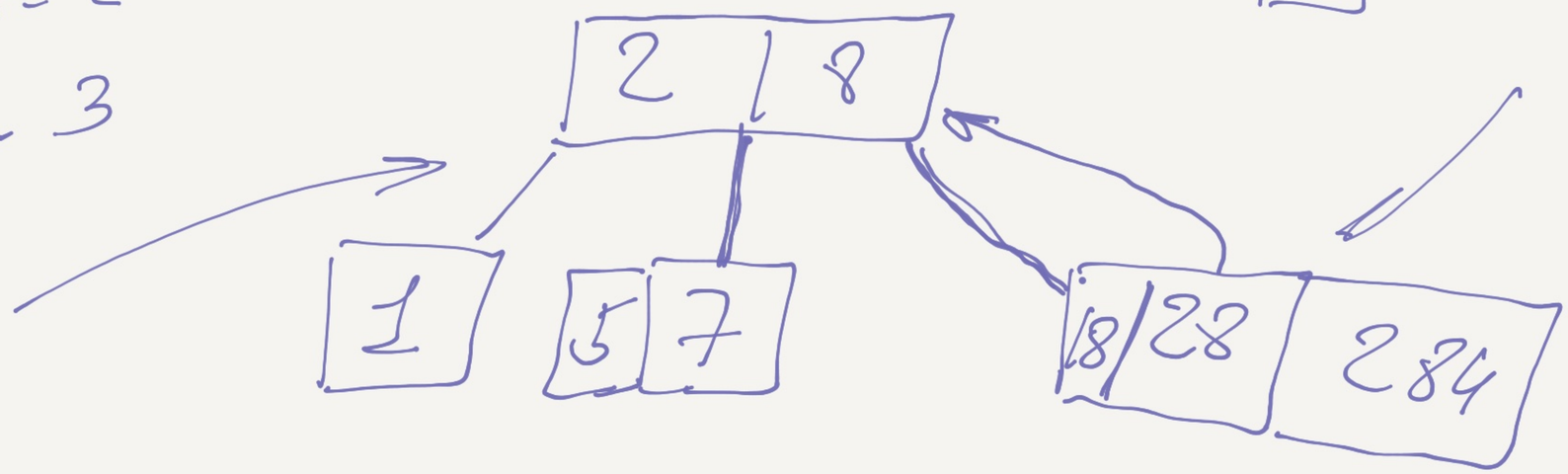
~~22~~ ~~18~~ ~~224~~ ~~90~~ ~~45~~

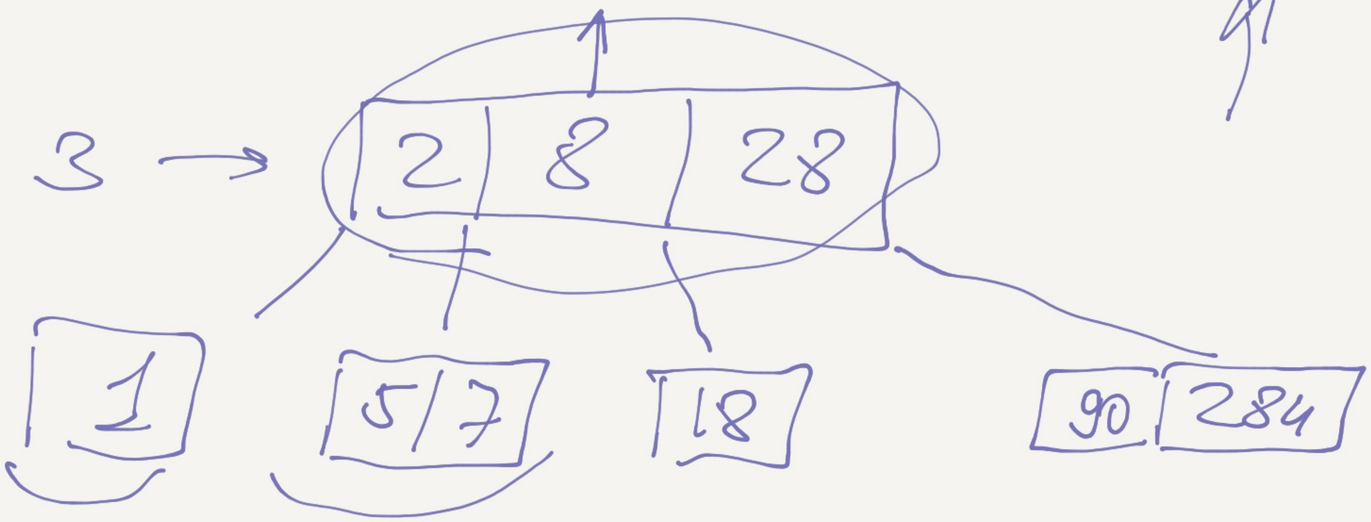




t = 2

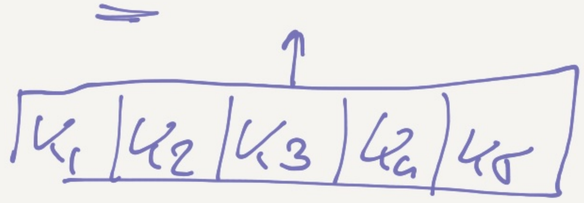
1 .. 3

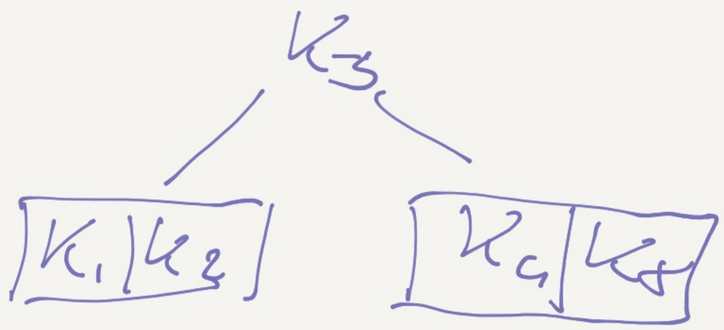




t = 3

2 ... 5





$t = 3$

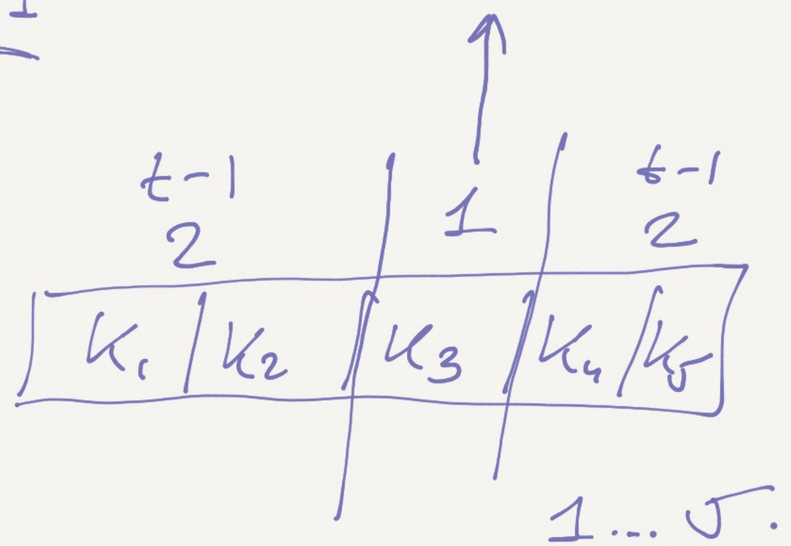
$2t - 1$

$t-1 \dots \underline{2t-1}$

$2 \dots 5$

$1 \dots 2t-1$

$1 \dots 5$



$t = ? \to 3$

$t = 3 \to \underline{5}$

h ↕

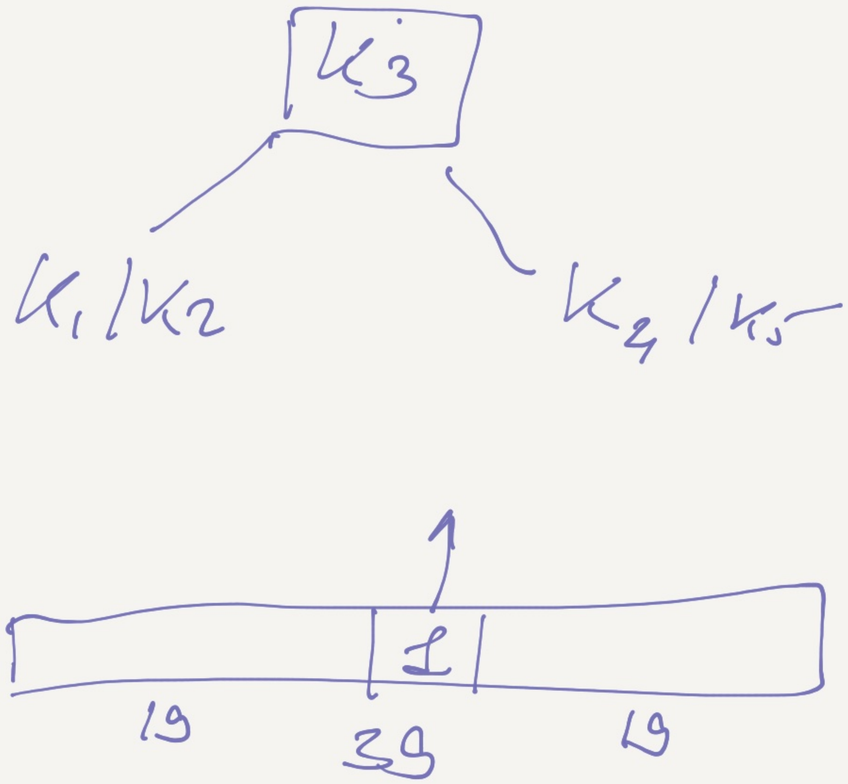
$\log_t n$

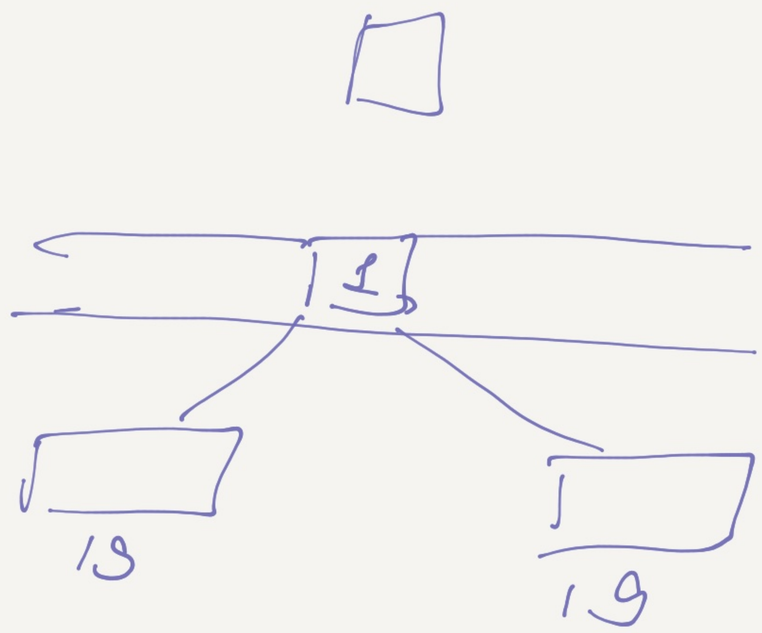
LRU-cache

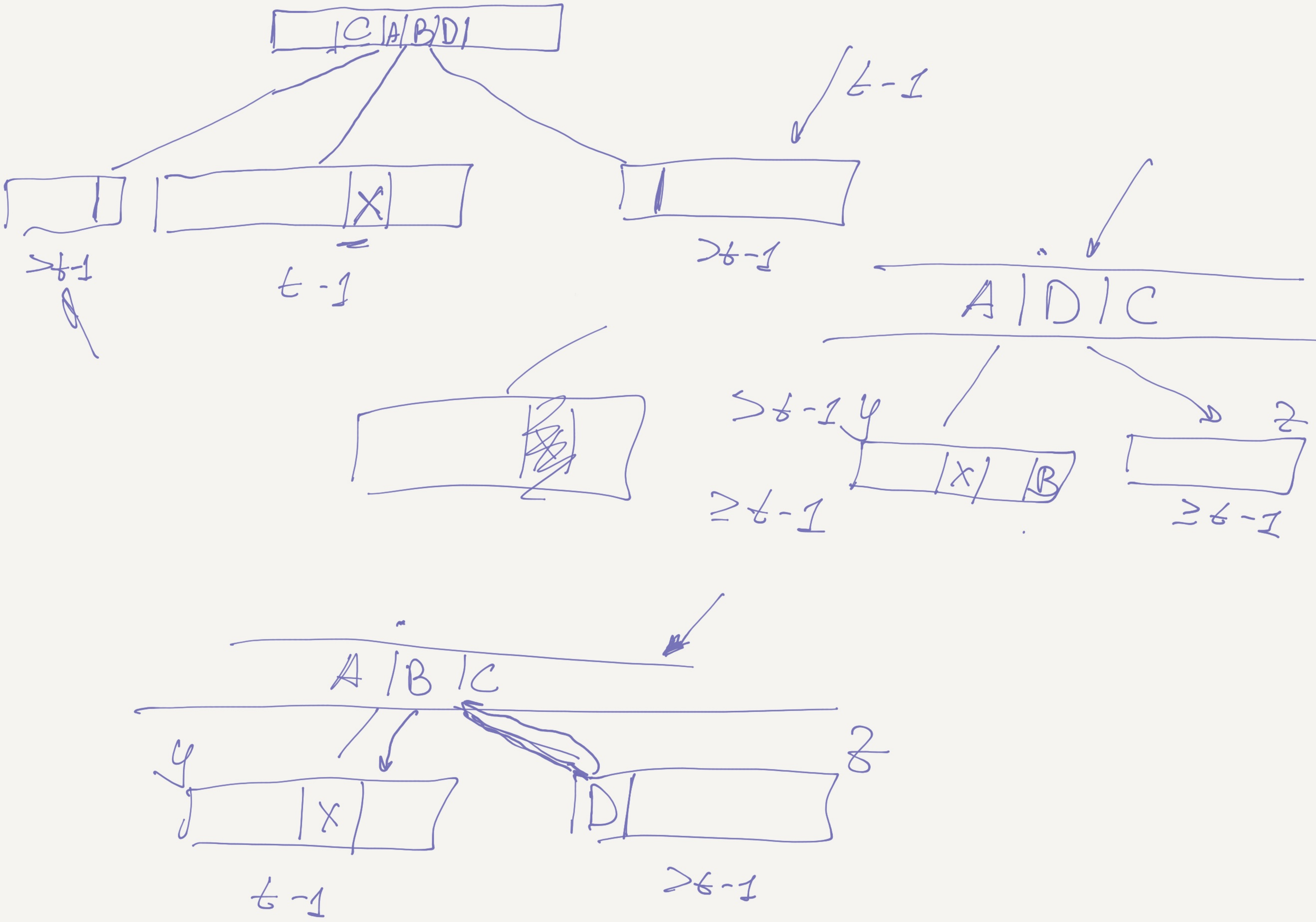
$t = 20$

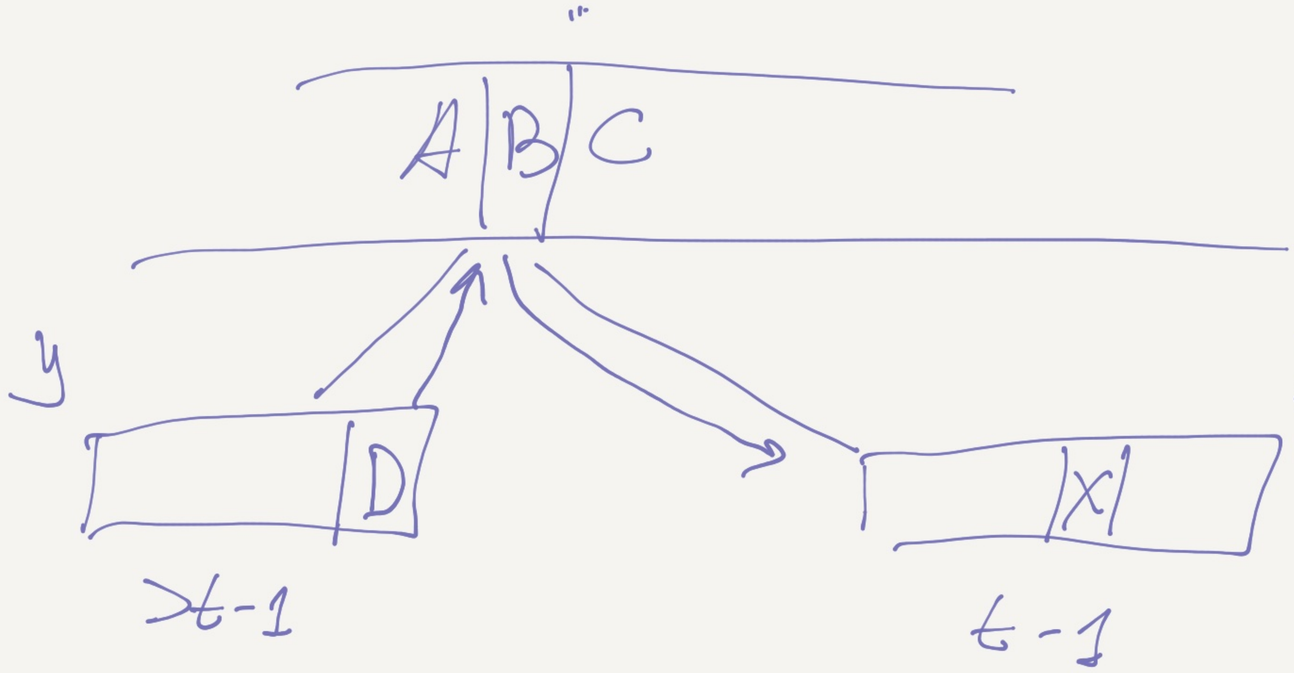
$19 \dots 39$

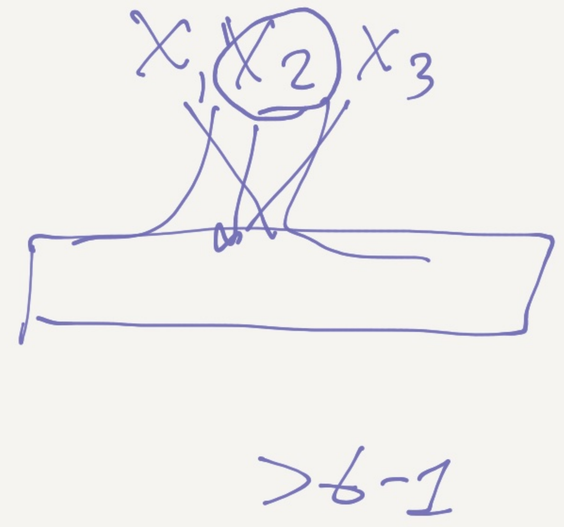
$\Rightarrow$

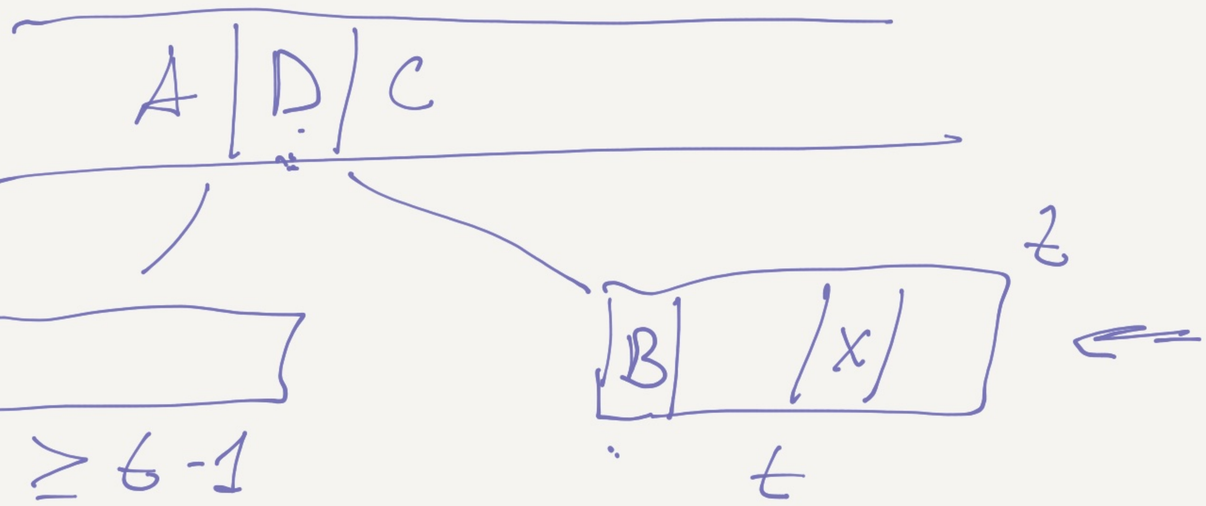


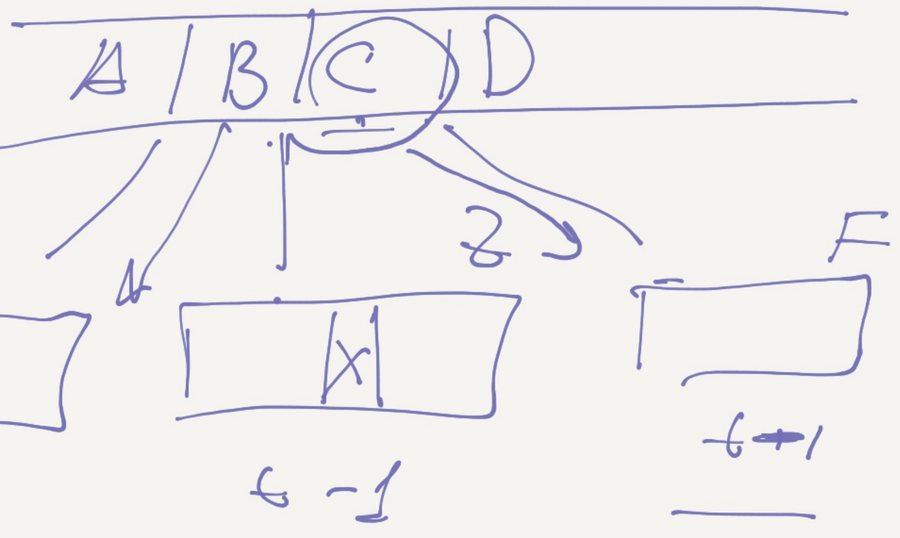


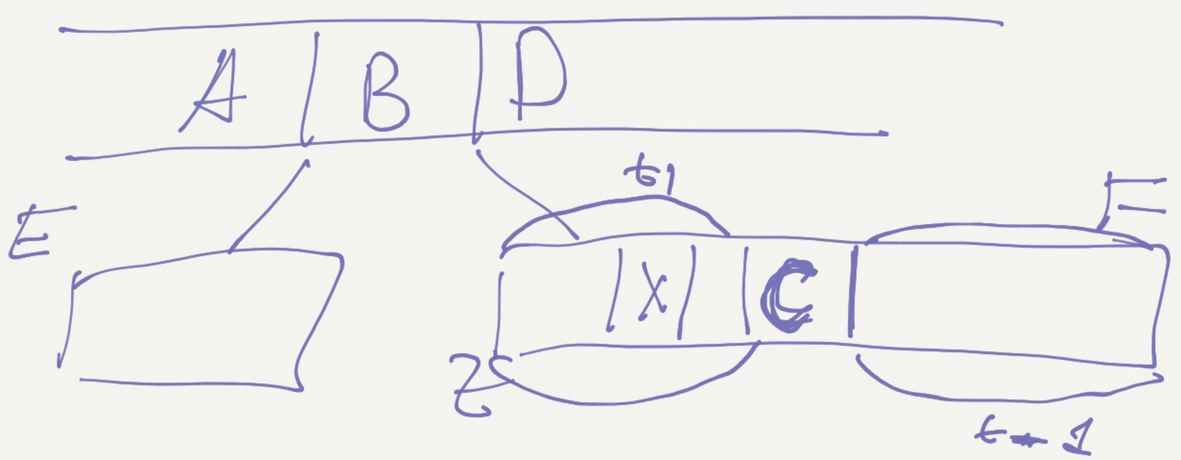

C A B D
t-1
X
t-1
>t-1
>t-1
A D C
>t-1 y
z
X
B
≥t-1
≥t-1
A B C
y
z
X
D
t-1
>t-1



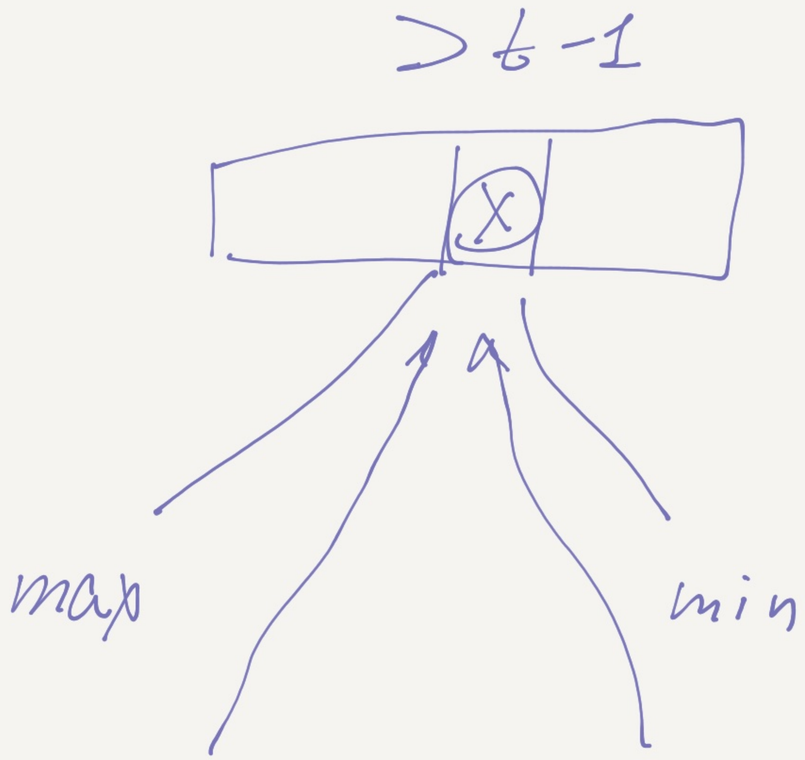


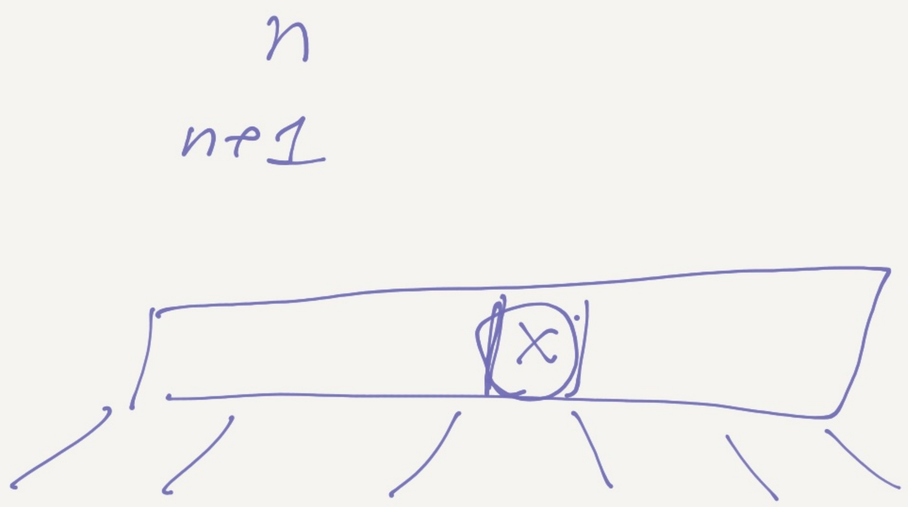


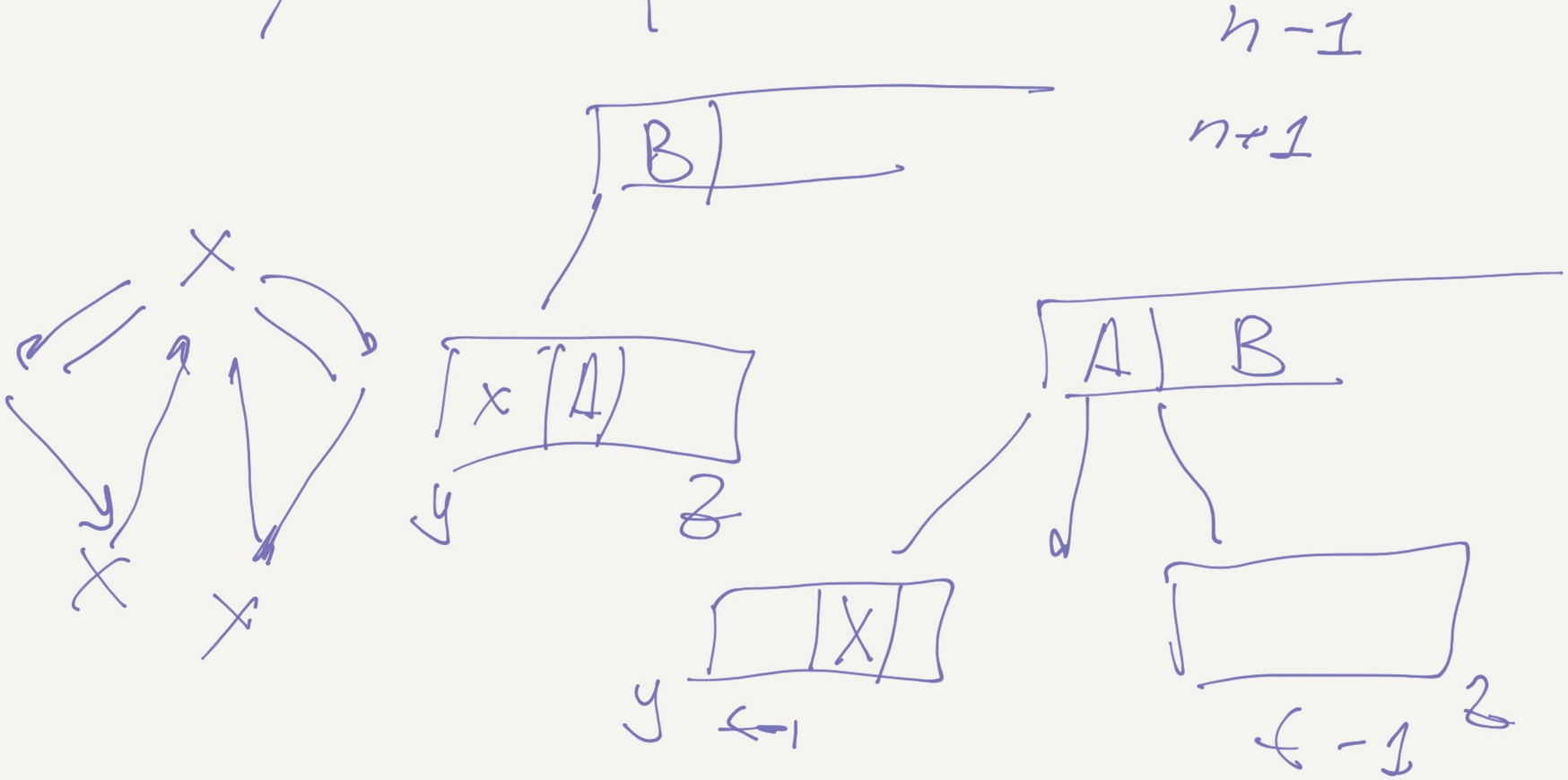




$z-1 \cdot t-1 \cdot t1 = \underline{z t-1}$


> b - 1
X
map
min


n
n+1
X


B
X
X
X
A
y
z
A
B
X
y
z
h - 1
n+1

8 1

6+1 6-1

2 28

1 5|7 18 45|90|284

X → 6

2|8|18

1 5|7 18 45|90|284

6-1. = 1.

2|8|45

1 5|7 18 90|284

2|8|90

1 5|7 45 284

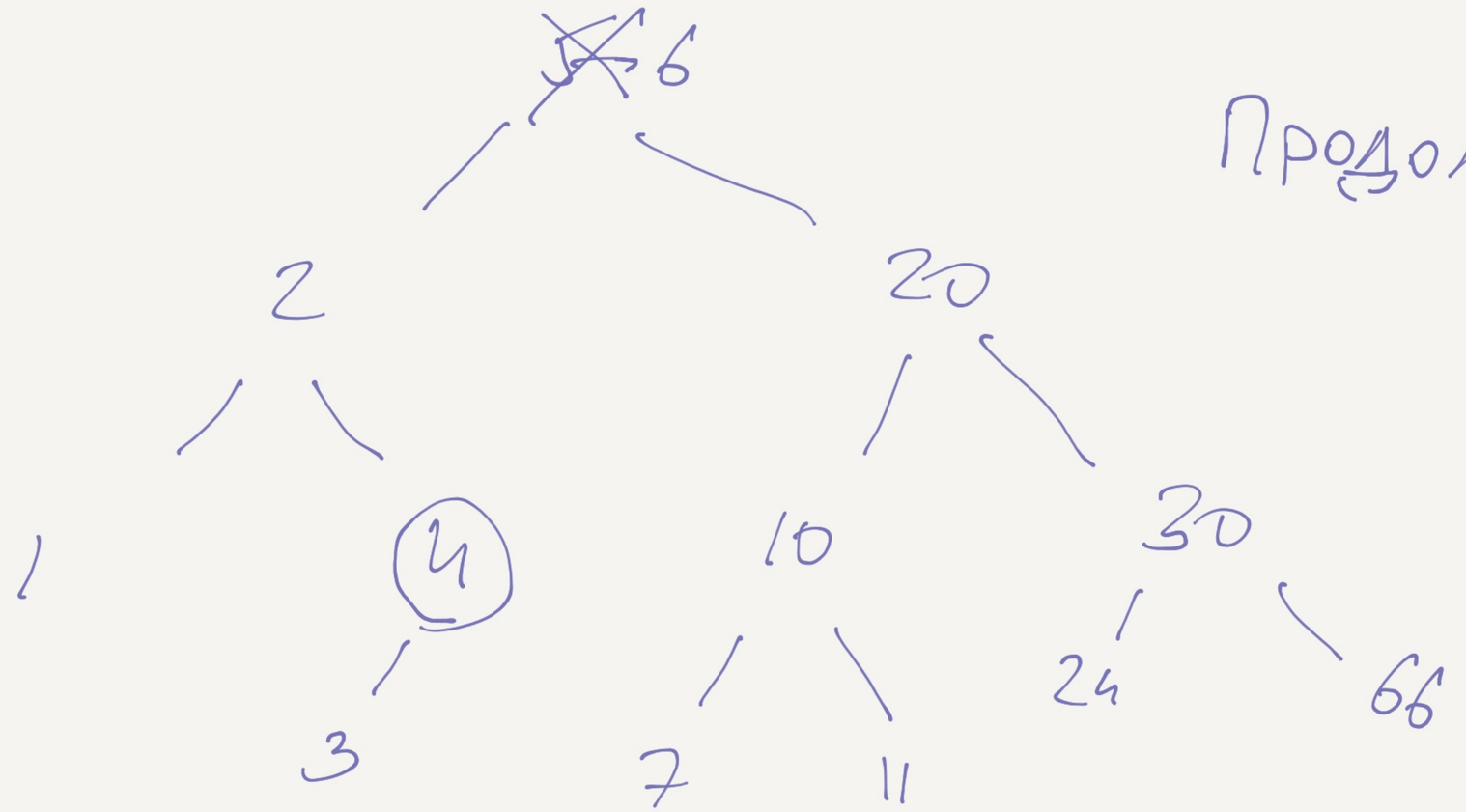
2|45|90

1 5|7 45 284

2|7|90

1 5 45 284

Продолжение в 14:00



zeitgeist

~~ЗАЯЧ~~

~~ВОЛК~~

~~ВОЛЯ~~

~~ЗАЙЦЕВ~~

~~ПОЛЕ~~

~~ПОЛК~~

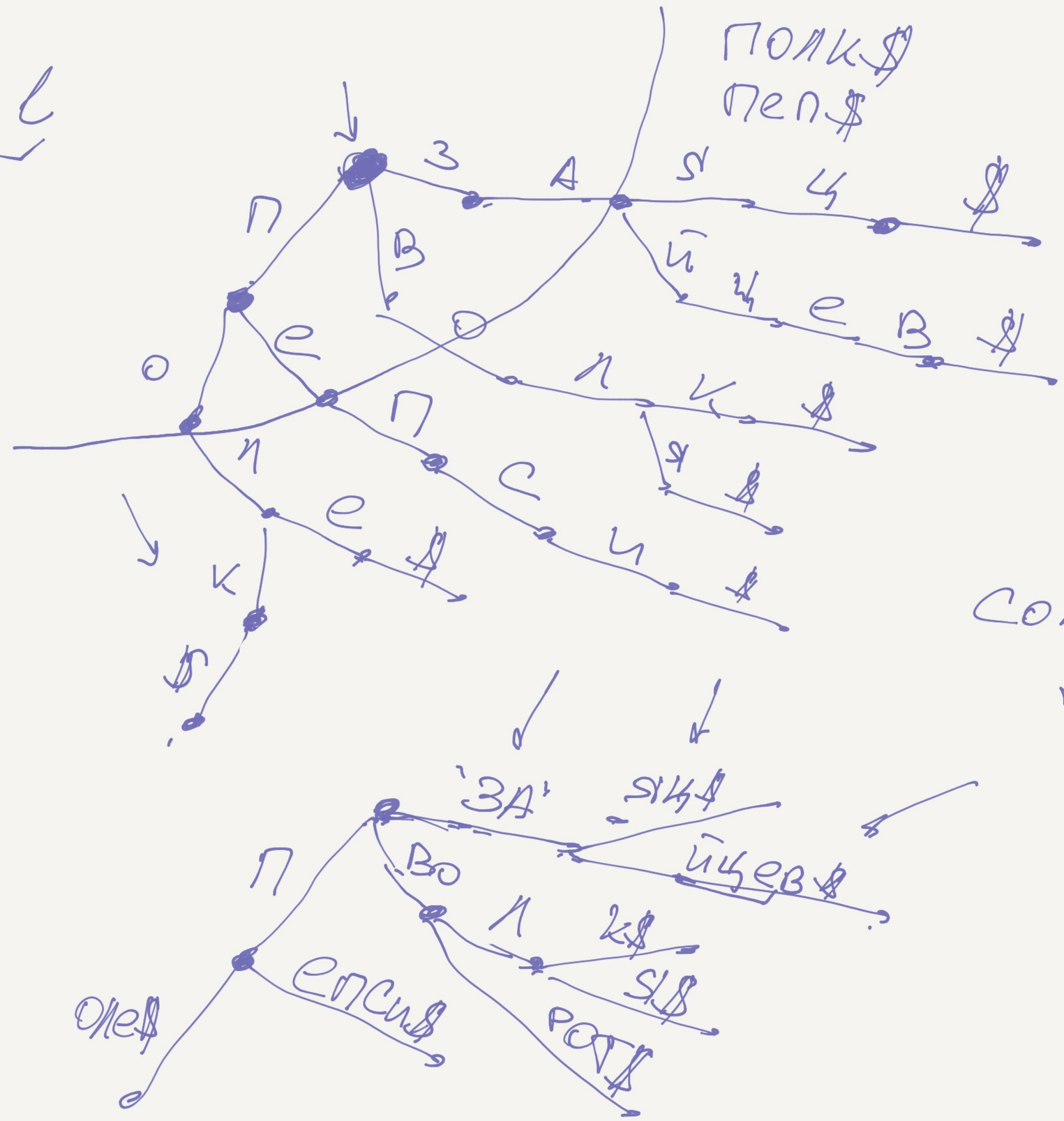
~~ПОЛКОВОДЕЦ~~

БУРГЕР

КУРОЧКА

~~ЛЕПЕСИ~~

СИСИ



Compact

Fig.