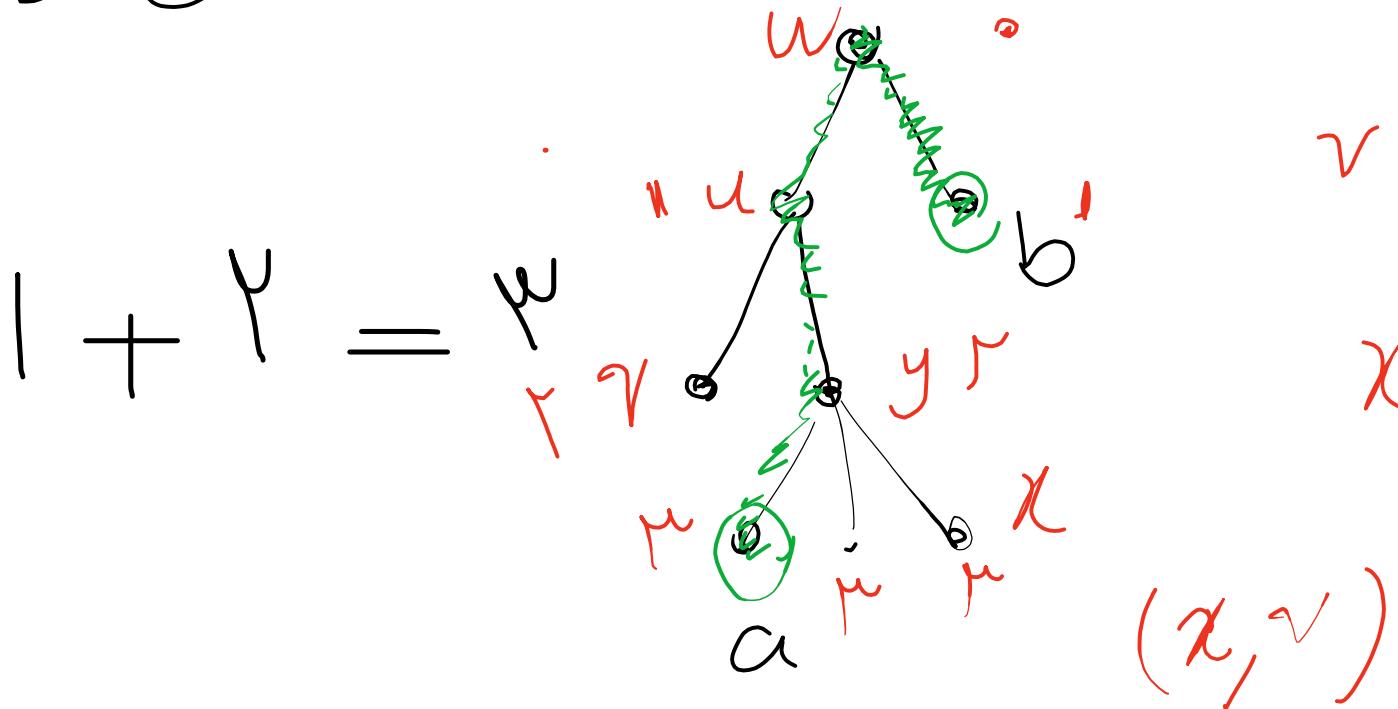


Graph Algorithms

Tuesday, April 16, 2024 2:19 in the afternoon

LCA



Lca (v, x) ?

$v - x$

par []

$n \leftarrow 1$

e

\ /

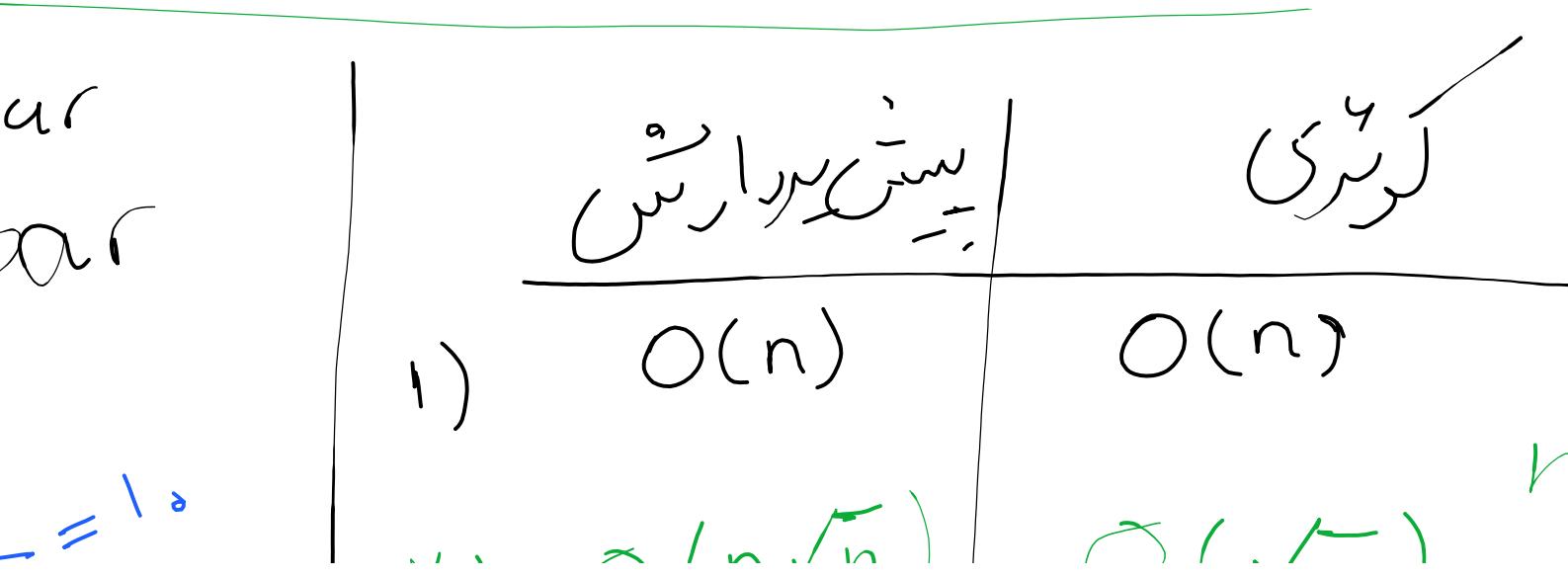
, k

؛ جبار = (v, \underline{u}, w)

؛ جبار = (x, y, \underline{u}, w)

جبار اولین جبار u

LCA Lowest Common Ancest

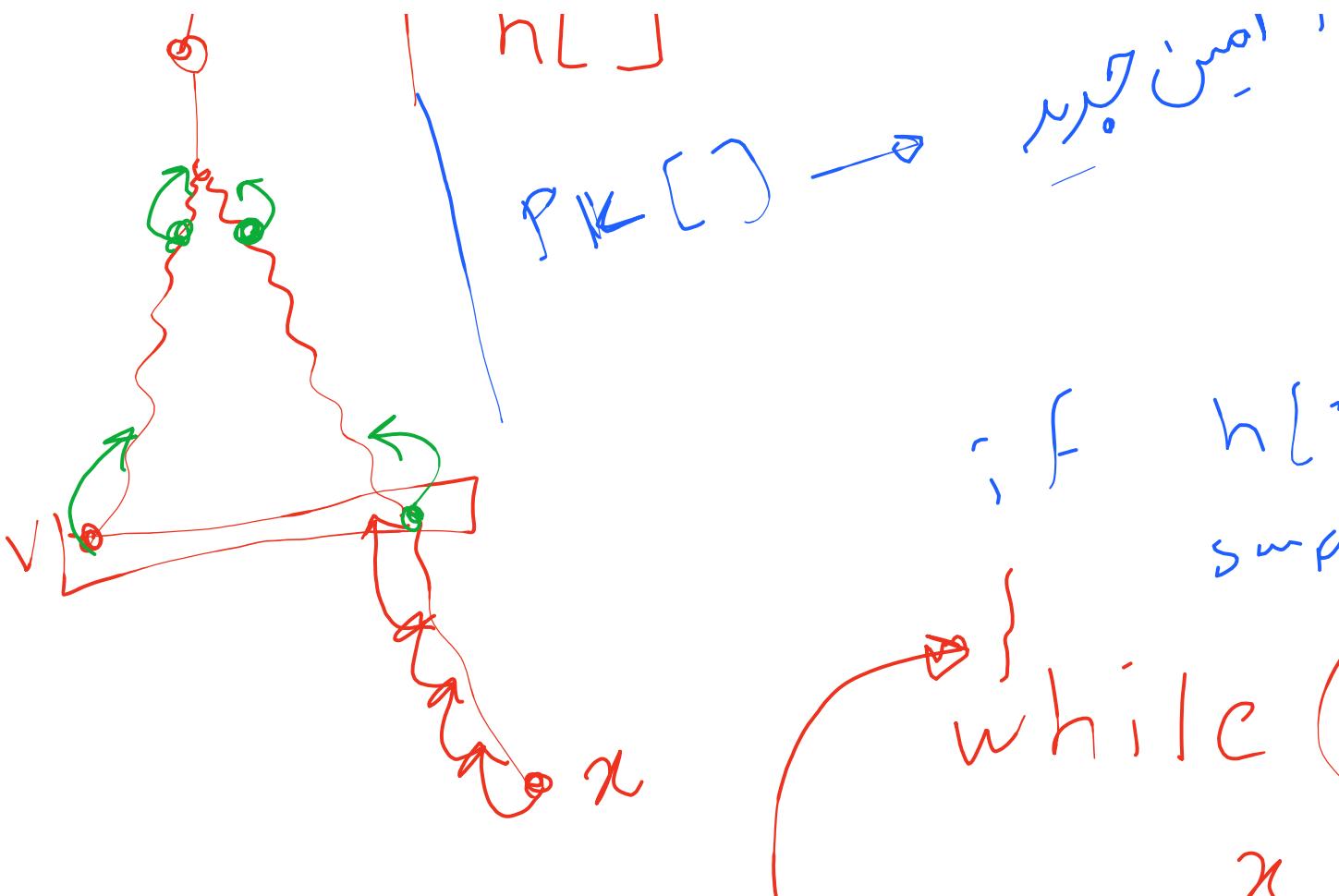


or

مسار

-

$n, q \leq 10^4$

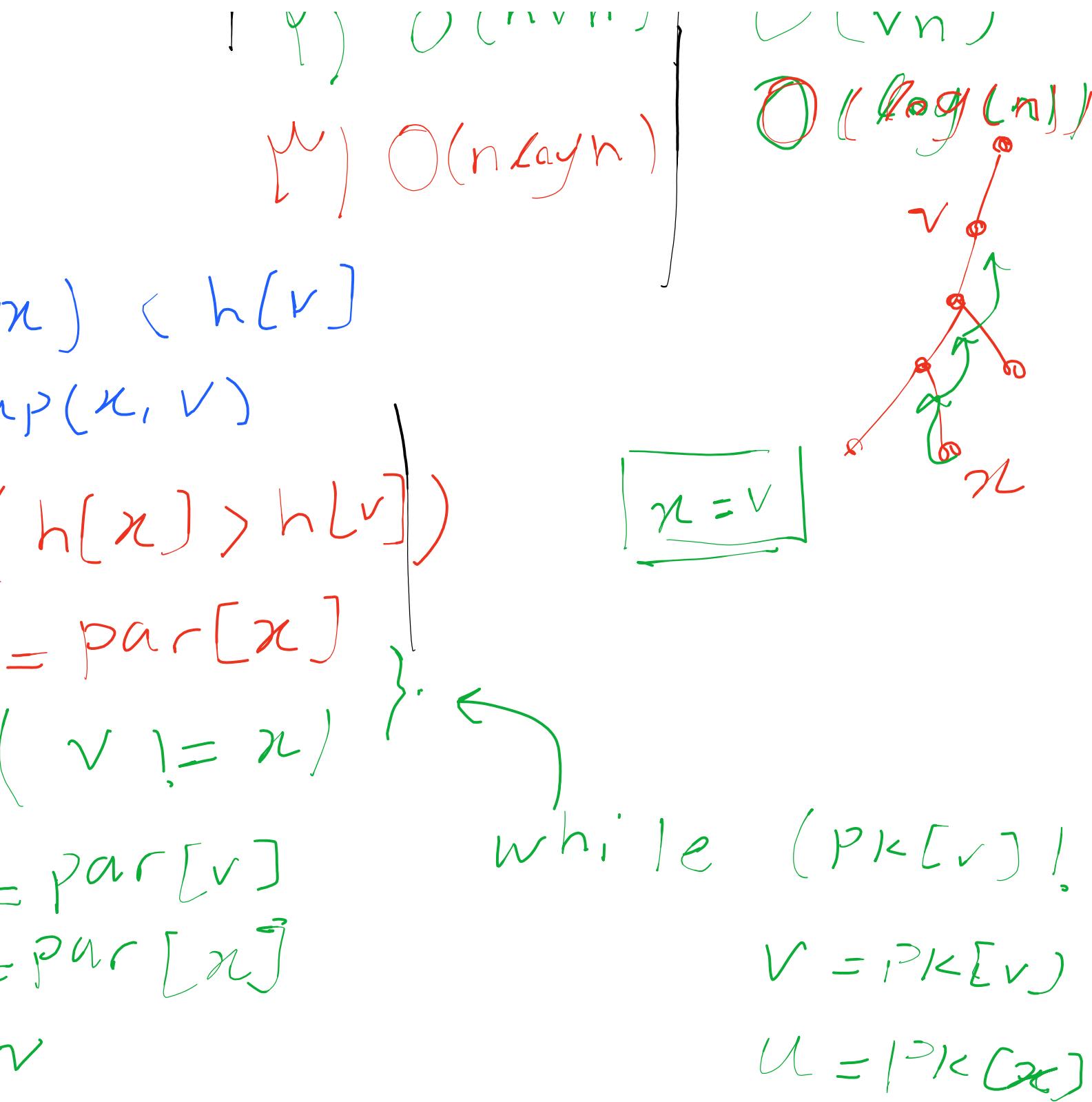


while $h[x] - h[y] \geq k$

$$x = PK[k]$$

return

$$\text{steps} \Rightarrow \left\lceil \frac{t}{k} \right\rceil + K$$



$$n_1 \gamma \lesssim 1 \cdot 10^{-4}$$

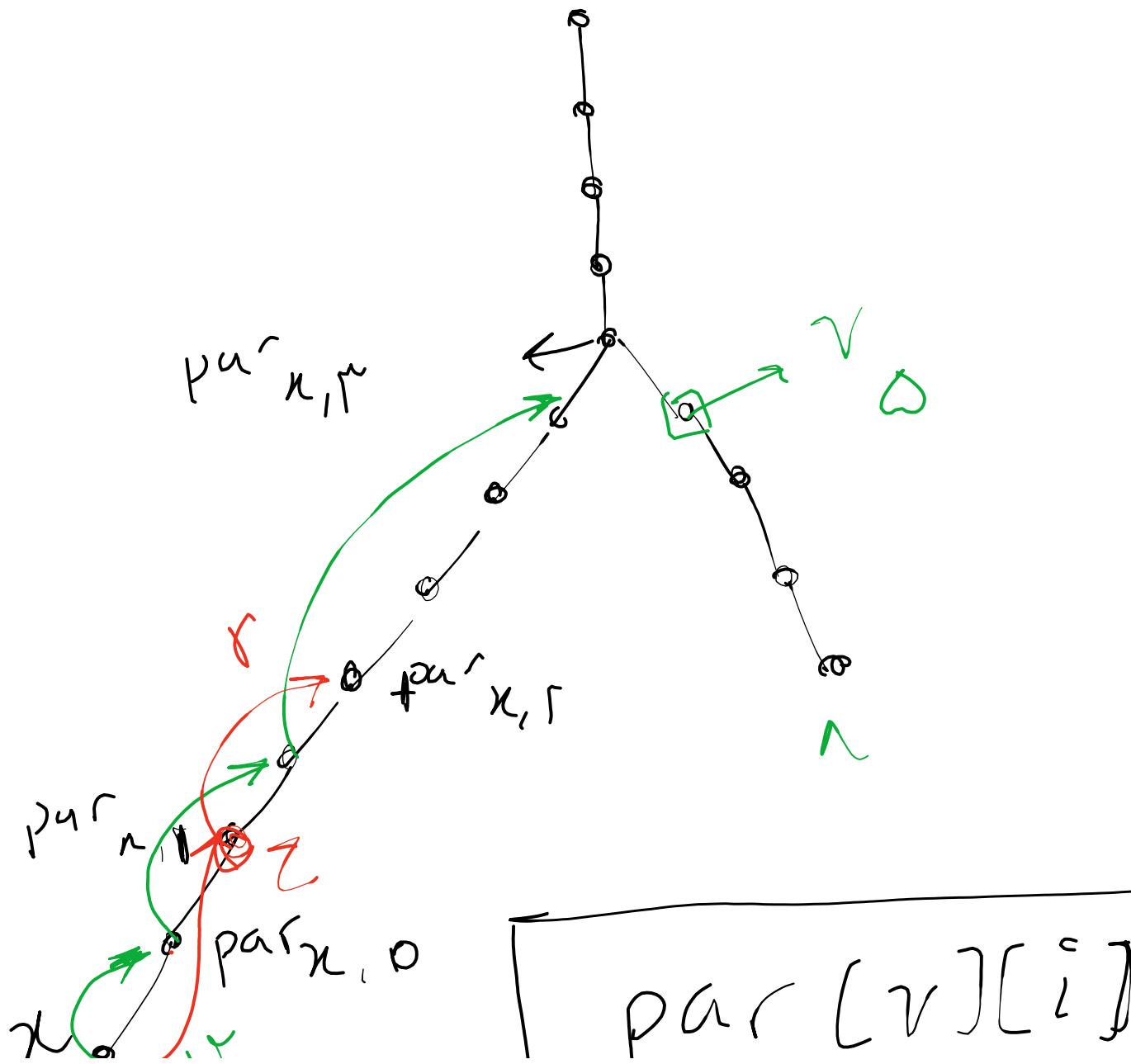


-PK(xJ)

~ ~

$\mathcal{O}(n)$

$$k = r$$



$$K = \sqrt{n} \Rightarrow O\left(\frac{n}{\sqrt{n}} + n\right)$$

$$= O(\sqrt{n} + n)$$

$$\boxed{= O(\sqrt{n})}$$

$$V = 000 \mid \underline{\underline{\mid}}$$

$$S = 10001001100$$

$$S' = 1000100\underline{1}000$$

$$\pi' = \text{par}[\pi][t]$$

$h[$

$$\Rightarrow V \text{ (ul), } r^i \text{ は}$$

\sqrt{n})

\sqrt{n})

)

$x' = h(a) - r^{\gamma}$

$$\begin{cases} r^0 = 1 \\ r^1 = r \\ r^2 = f \\ r^3 = \lambda \\ r^4 = \lambda \end{cases}$$

1) Par_{\sim}^{\sim} is
 $x \mapsto h[x] - h[\cdot]$
 $\in \mathcal{M}(\mu_0)$

$$S \leq n$$

$\log(n)$

$$S \leq r$$

$$|\delta(s)| \leq \log(n)$$



CA over $\underline{\mathbb{Z}_2}$

$$S = 00100110001001$$

$$b(S) = \{11, 0V, 1^2, 0\}$$

$$x' = \text{par}[x][j] \quad \forall j \in b$$

$$x' = h[x] - \sum_{j \in b(S)} i^j =$$

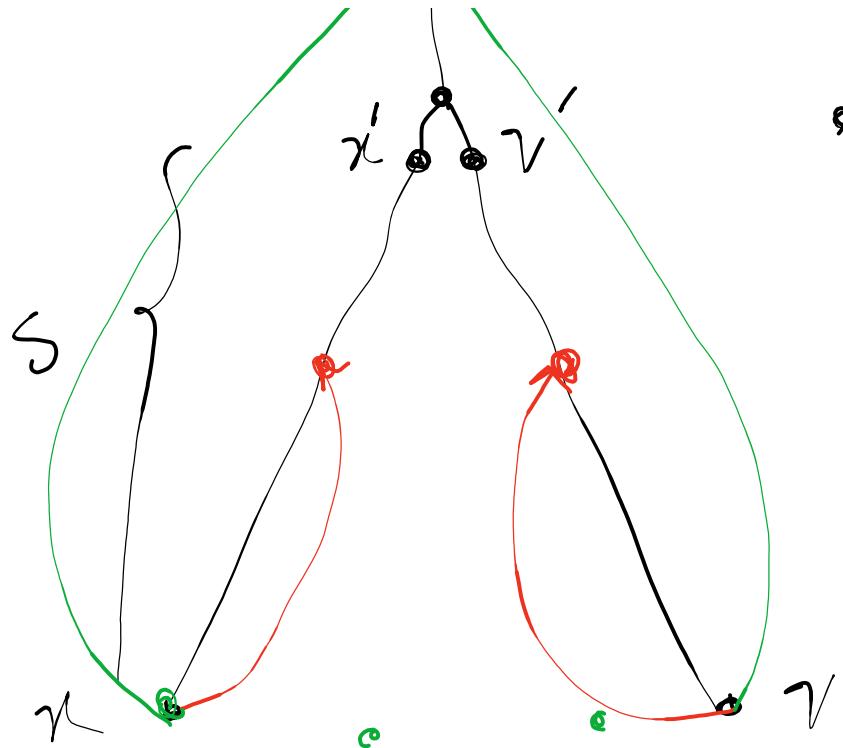
$$= h[v]$$

$\vdash \vdash \text{Glm}^\theta$

, (5)

S

green



green

$s \leq$

$j = e$

red

v) par

par[v][0]

for i = 1

$$S = h[x] - h[x'] = h[v] - h[v']$$

$$S \leq n$$

For $i = \lceil \log(n) \rceil \rightarrow$
 if $\text{par}[v][i] \neq$
 $v = \text{par}[v][i]$
 $x = \text{par}[x][i]$

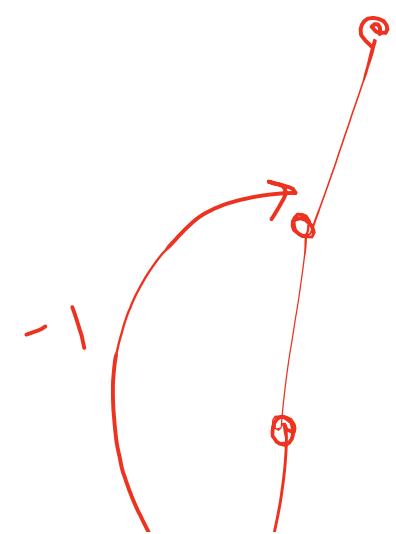
return $\text{par}[v][0]$

~~now we~~

$= \text{parent}(v)$

$\rightarrow \text{O}(\lg(n))$

$\circ \circ$
 $= \text{Par}[n][\mathfrak{p}]$



100

-

par

$\Theta(n \log n)$

$v[i] = \text{par}[\text{par}[v][i-1]]$

