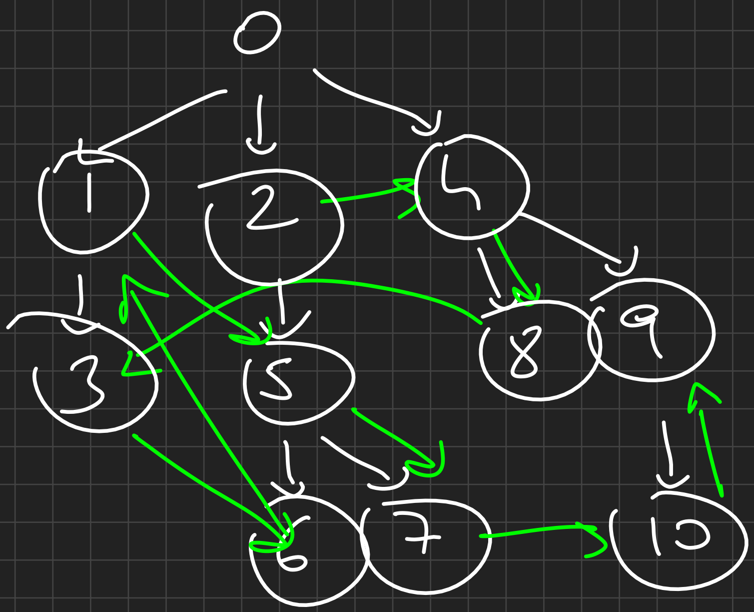
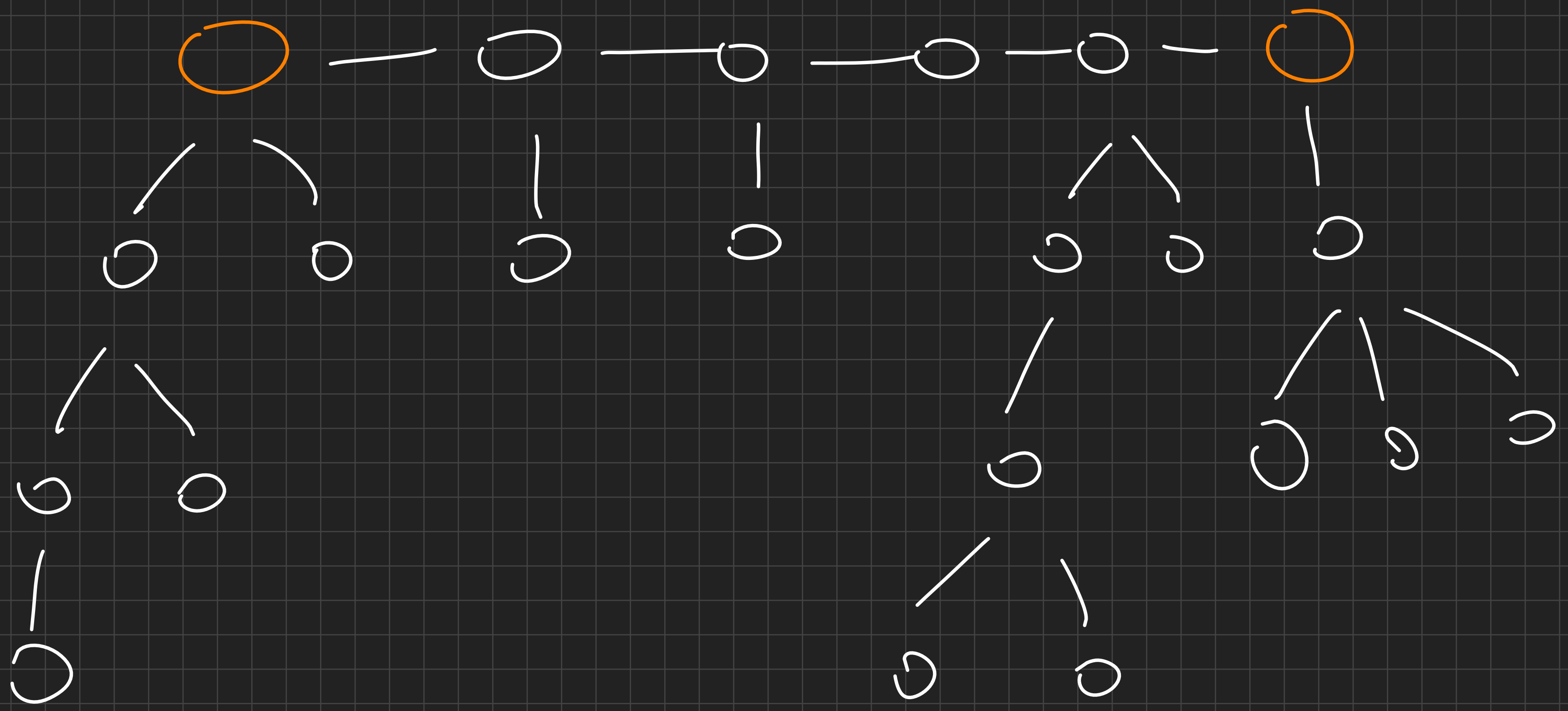


9 10 | 7 | 5 1 6 3 | 8 | 4 | 2



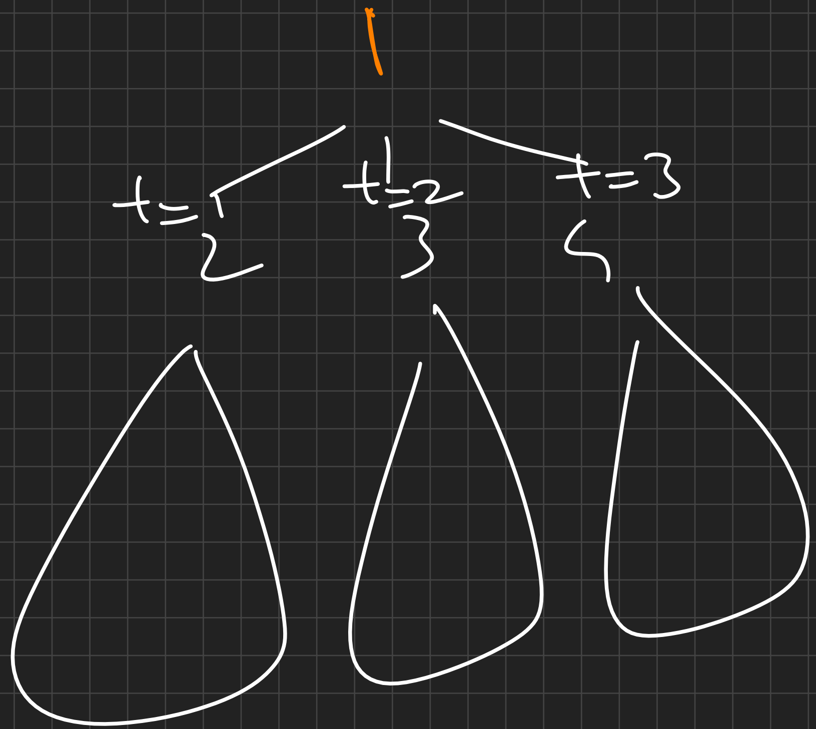
$dp[i]$ = tempo per finire dal nodo i

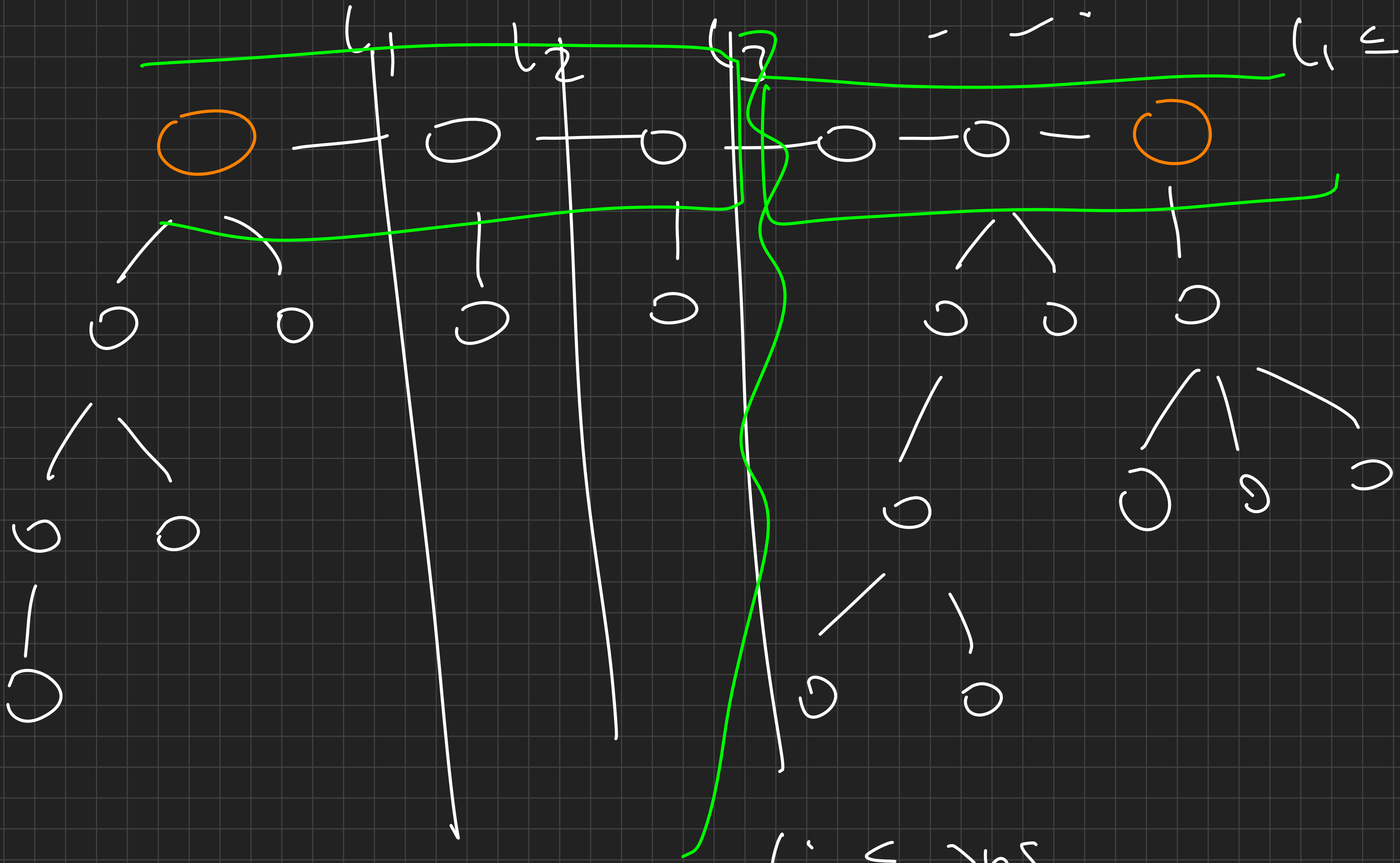
$a_1, \dots, a_k$

$dp[i] = \max(dp[a_i] + i)$

(a_i figli, devo scegliere l'ordine)

(ordino gli a_i per $dp[a_i]$ decrescente)

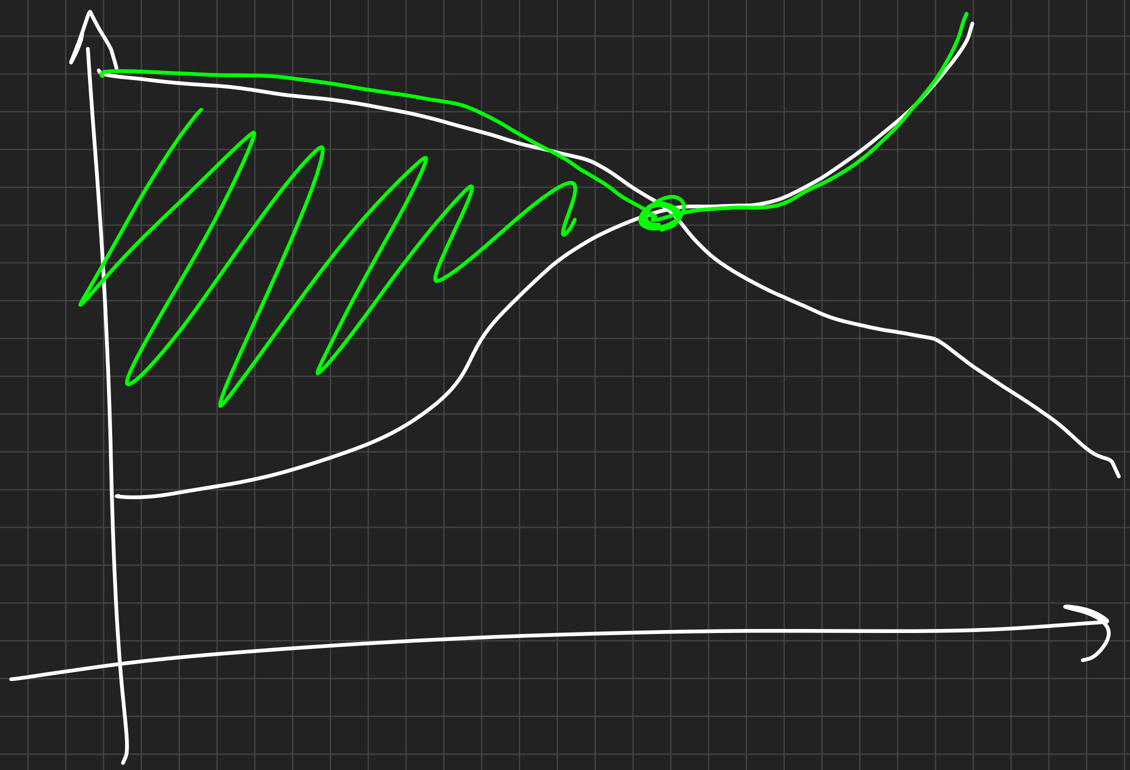




$l_1 \le l_2 \le \dots$

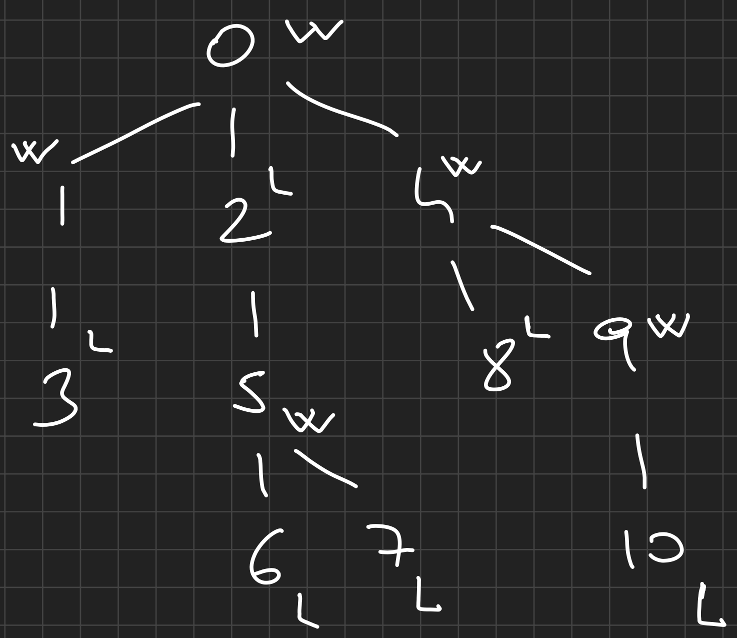
$l_i \le ans$

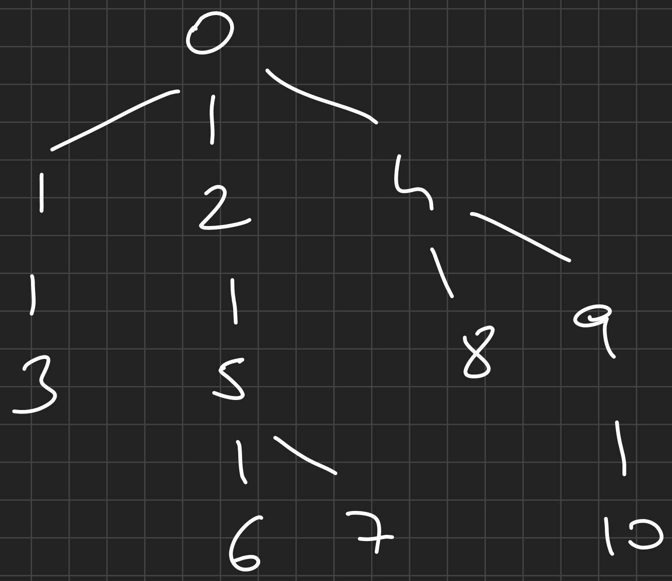
$r_j \ge ans$



OTTOBRE aka CEOI 2020 STAR TREK

- $D = 1 \quad N \leq 1000$





W nodi vincenti

L nodi perdenti

F nodi perdenti "forzabili"

1° caso: se la radice è vincente $(N-F)N + FW$

2° caso: se la radice è perdente FL

$D > 1$

Supponiamo di conoscere $\sum W$, $\sum L$ su ogni modo di connettere k alberi.

$$\sum W = W_k \qquad \sum L = L_k$$

$$W_{k+1} = \sum_{j\ \text{vinti}} (N - F_j)(W_k + L_k) + F_j W_k + \sum_{j\ \text{persi}} F_j L_k$$

$$= \sum_{j\ \text{vinti}} N W_k + N L_k - \cancel{F_j W_k} - F_j L_k + \cancel{F_j W_k} + \sum_{j\ \text{persi}} F_j L_k$$

$$= \sum_{j\ \text{vinti}} L_k (N - F_j) + N W_k + \sum_{j\ \text{persi}} F_j L_k$$

$$L_{k+1} = \sum_{j\ \text{vinti}} F_j L_k + \sum_{j\ \text{persi}} (N - F_j)(W_k + L_k)$$

$$= \sum_{j\ \text{vinti}} F_j L_k + \sum_{j\ \text{persi}} L_k (N - F_j) + N W_k$$

$$M_{00} = \sum_{j \text{ vinti}} F_j + \sum_{j \text{ persi}} N - F_j$$

$$M_{01} = \sum_{j \text{ persi}} N$$

$$M_{10} = \sum_{j \text{ persi}} F_j + \sum_{j \text{ vinti}} N - F_j$$

$$M_{11} = \sum_{j \text{ vinti}} N$$

$$\begin{cases} L_{k+1} = M_{00} L_k + M_{01} W_k \\ W_{k+1} = M_{10} L_k + M_{11} W_k \end{cases}$$

$$M = \begin{pmatrix} M_{00} & M_{01} \\ M_{10} & M_{11} \end{pmatrix}$$

$$\begin{pmatrix} L_{n+1} \\ W_{n+1} \end{pmatrix} = M \begin{pmatrix} L_n \\ W_n \end{pmatrix}$$

$$\begin{pmatrix} F_{n+1} \\ F_n \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} F_n \\ F_{n-1} \end{pmatrix}$$

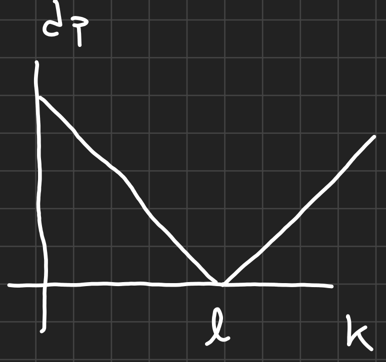
$$\begin{pmatrix} F_{n+k} \\ F_{n+k-1} \end{pmatrix} = \underbrace{\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} \cdots \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}}_{k} \begin{pmatrix} F_n \\ F_{n-1} \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}^k \begin{pmatrix} F_n \\ F_{n-1} \end{pmatrix}$$

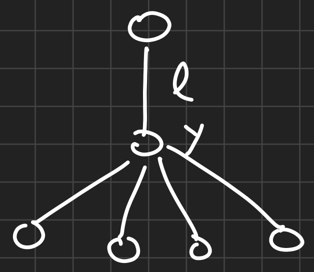
$$\begin{pmatrix} L_D \\ W_D \end{pmatrix} = M^D \begin{pmatrix} L_0 \\ W_0 \end{pmatrix}$$

DICEMBRE 2022 APIO 16 - FIREWORKS

$dp[i][k]$ = min costo per avere tutte le foglie nel sottoalbero di i a distanza k dal padre di i.



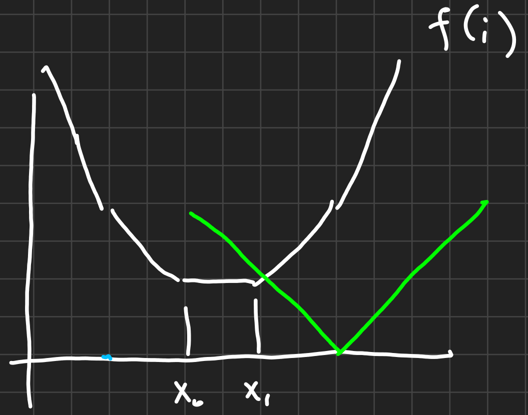
per una foglia $dp(k) = |k - l|$



$$dp[y][k] = \min_{i=0}^{k} \left(\sum_{z \text{ figli}} dp[z][i] + |k - i - \ell| \right)$$

$$\|$$

$$C(k) = \min_{i=0}^{k} \left(f(i) + |k - i - \ell| \right)$$



- $k \leq x_0 \Rightarrow C(k) = f(k) + \ell \leftarrow$
- $x_0 \leq k \leq x_0 + \ell \Rightarrow C(k) = f(x_0) + |k - x_0 - \ell|$
  $= f(x_0) + (\underline{x_0 - k}) + \ell$
- $x_0 + \ell \leq k \leq x_1 + \ell \Rightarrow C(k) = f(x_0) = f(x_1)$
- $k \geq x_1 + \ell \Rightarrow C(k) = f(x_1) + |k - x_1 - \ell|$
  $= f(x_1) - (x_1 + \ell) \underline{+ k}$

SLOPE TRICK

$\{1, 2, 3, 3\}$

$$\sum_{j \text{ figli}} dp = \bigcup \text{ slope trick}$$