

ER2024

① 
$$\left. \begin{array}{l} n > 0 \\ 0 < k \leq n \end{array} \right\} P(n, k) = P(n-1, k-1) + P(n-1, k)$$

function  $P(n, k)$   
 if  $(n=1 \text{ or } k=1 \text{ or } k=n)$   
 return 1

~~for  $i$  in  $1..n$ :~~

$\leftarrow \text{return}(P(n-1, k-1) + P(n-1, k))$

function main(n):

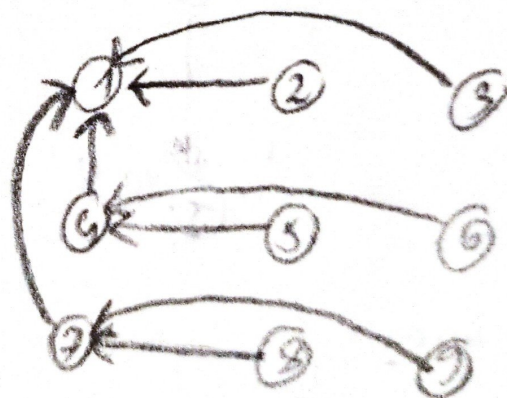
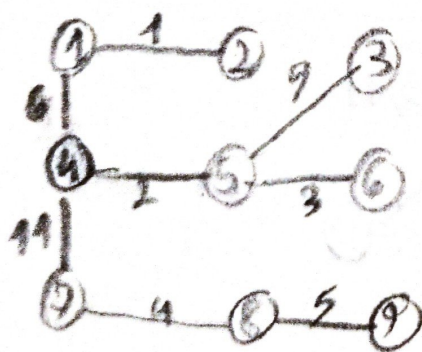
for  $i$  in  $1..n$ :

for  $j$  in  $1..i$ :

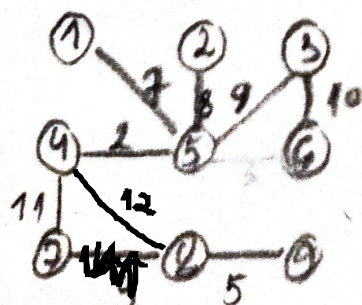
print( $P(i, j)$ )

print("\n")

②



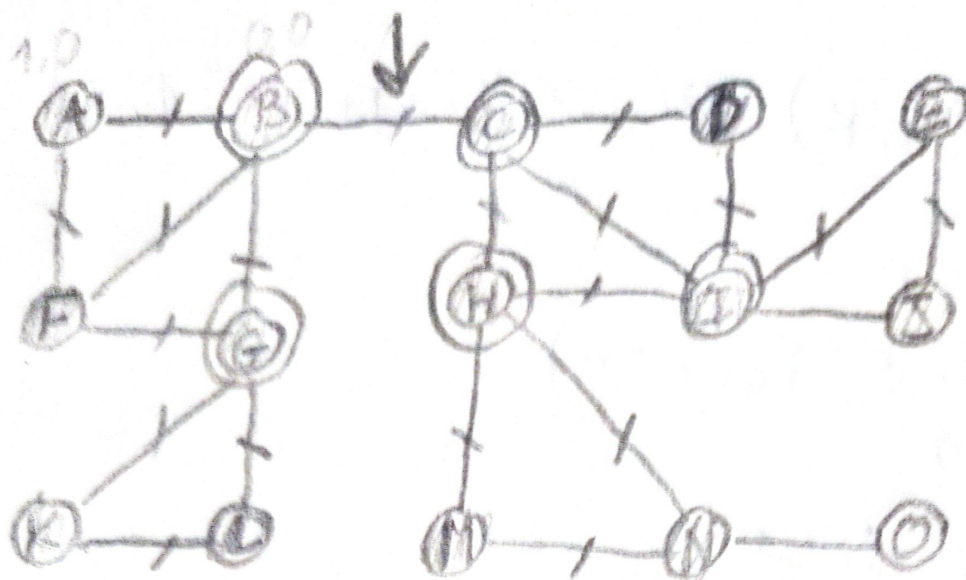
③



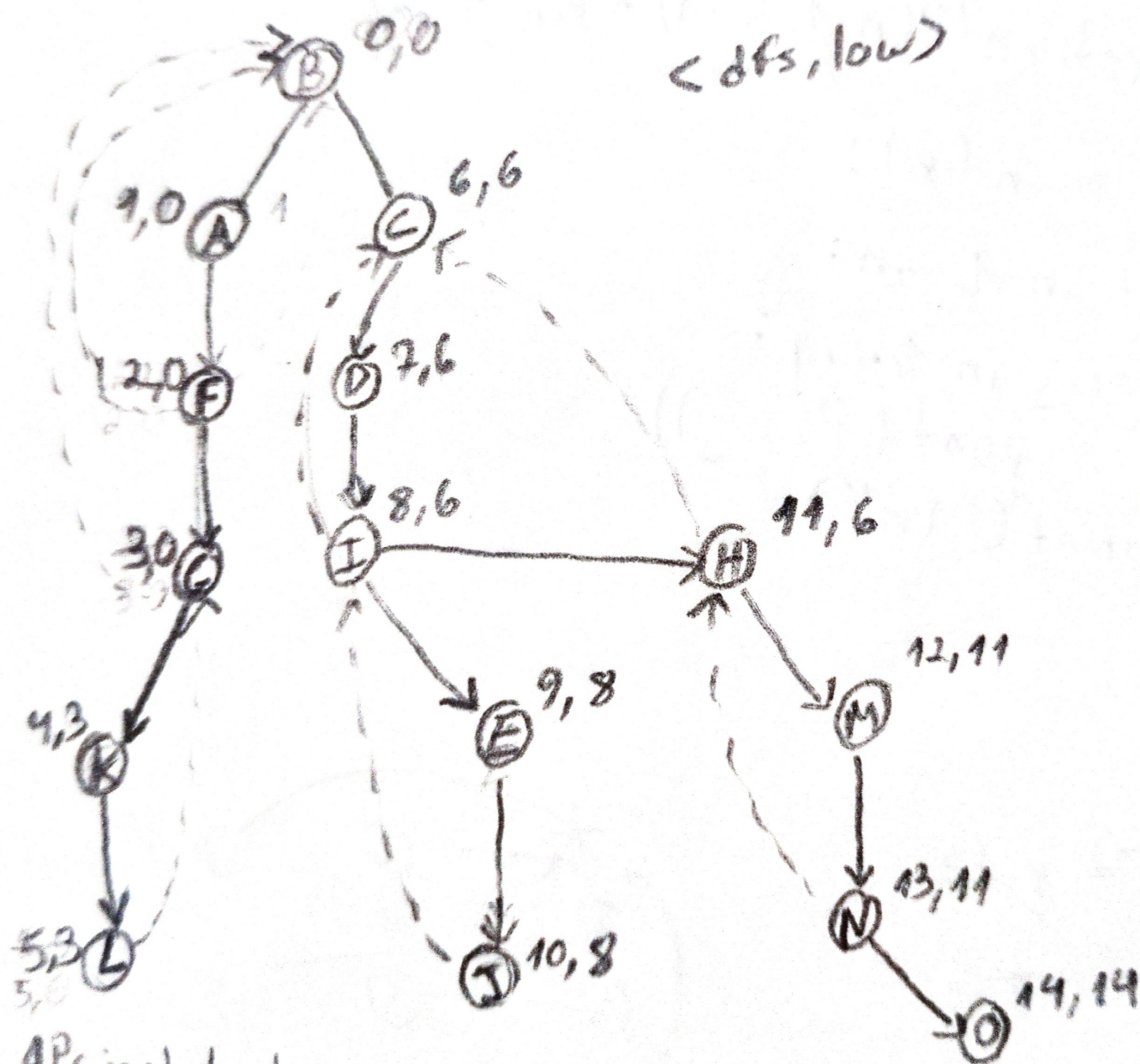
	1	2	3	4	5	6	7	8	9
d =	$\infty$	$\infty$	0	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$
	16	17		11	9	10	22	26	34
							23	28	

5 6 4 1 2 7 8 9

③



(dfs, low)



APs and bridges

$\langle N, 0 \rangle$   
 $\downarrow$   
 G, H, I, C, B,  $\langle B, C \rangle$



④

function  $D(n, m, d)$ :

for  $idx$  in  $0, \dots, n$ :

$dp[idx][0] = \infty$

for  $idx$  in  $0, \dots, m$ :

$dp[0][idx] = \infty, d$ :

for  $i$  in  $1, \dots, n$ :

$dp[i]$

for  $j$  in  $1, \dots, m$ :

$dp[i, j] = 0, m1, m2, m3 = \infty$

if  $i-1 \geq 1$

$m1 = dp[i-1, j]$

if  $j-1 \geq 1$

$m2 = dp[i, j-1]$

if  $(j-1 \geq 1) \text{ and } (i-1 \geq 1)$ :

$m3 = dp[i-1, j-1]$

$dp[i, j] = d[i] + \min(m1, m2, m3)$

return  $dp[n, m]$

Temporal:  $O(n^2)$

Espacial:  $O(n^2)$

call  $D(n, n, d)$