

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):

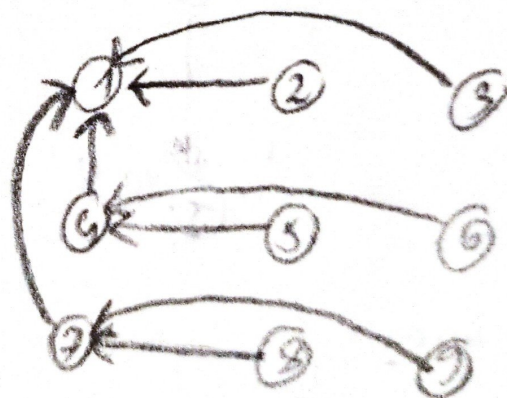
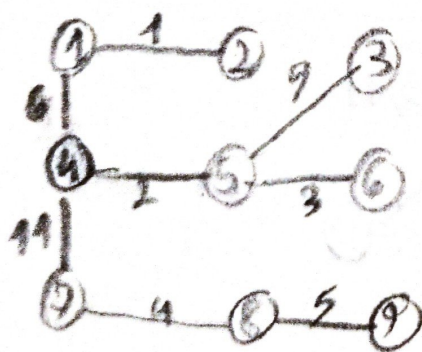
for  $i$  in  $1..n$ :

for  $j$  in  $1..n$ :

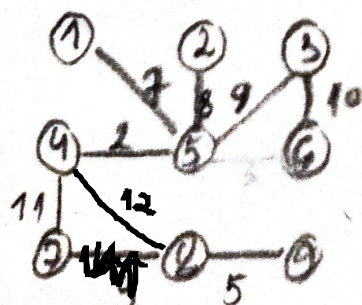
print( $P(i, j)$ )

print("\n")

②



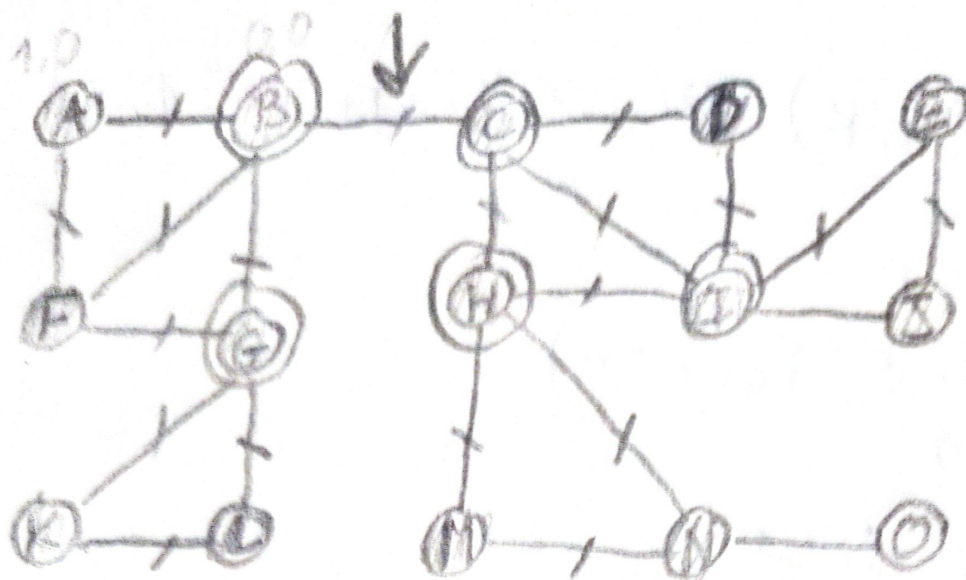
③



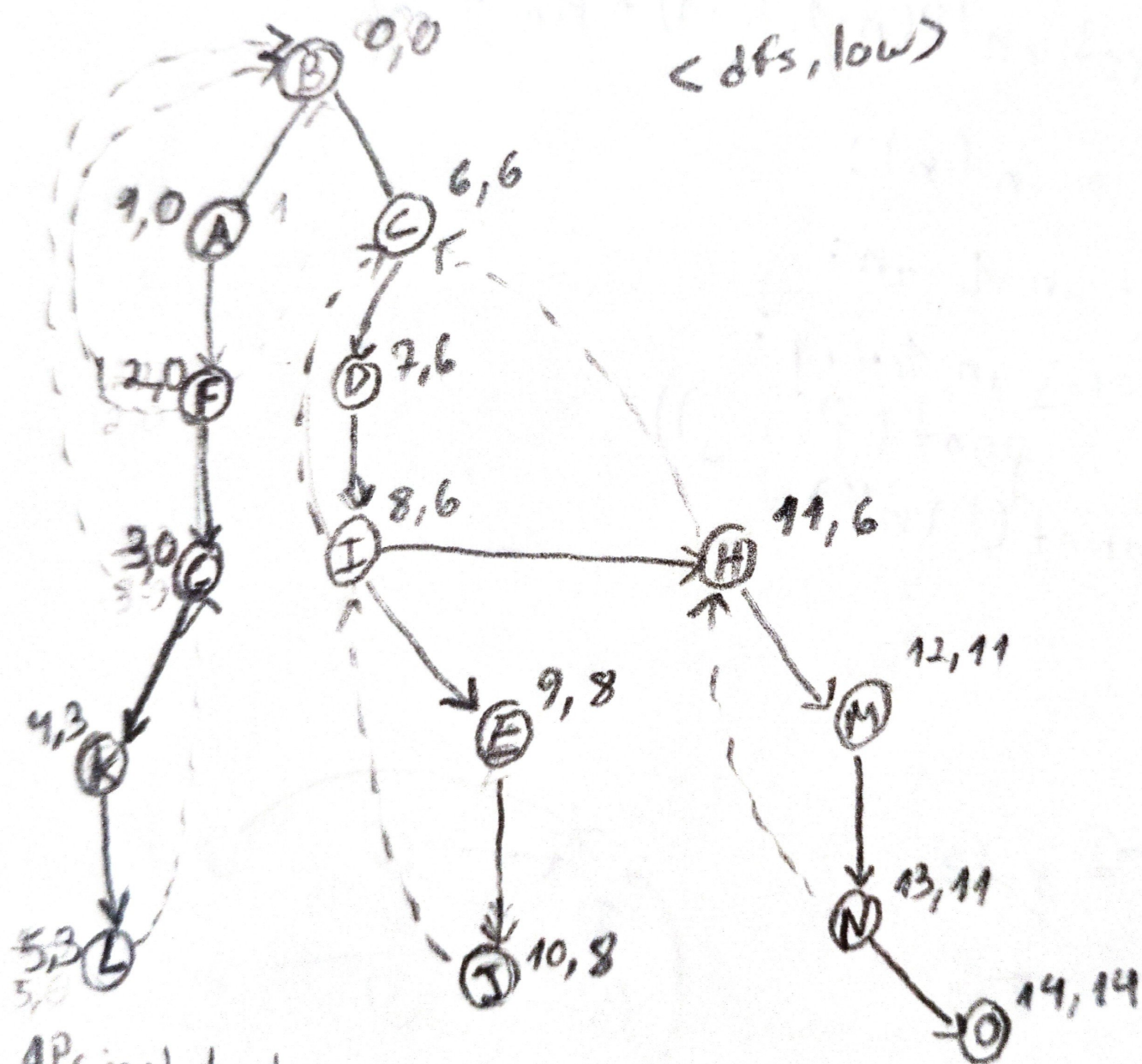
	1	2	3	4	5	6	7	8	9
d =	$\infty$	$\infty$	0	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$
	16	17		11	9	10	22	26	34
							23	28	

5 6 4 1 2 7 8 9

③



(dfs, low)



APs and bridges

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



④ function  $D(n, m, d)$ :

```
for idx in 0, ..., n:  
    dp[idx][0] = ∞  
for idx in 0, ..., m:  
    dp[0][idx] = ∞, d;
```

```
for i in 1, ..., n:
```

```
    dp[i][0] = ∞  
    for j in 1, ..., m:
```

```
        dp[i][j] = 0; m1, m2, m3 = ∞
```

```
        if i-1 > 1:  
            m1 = dp[i-1][j]
```

```
        if j-1 > 1:  
            m2 = dp[i][j-1]
```

```
        if (j-1 > 1) and (i-1 > 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  $D(n, n, d)$