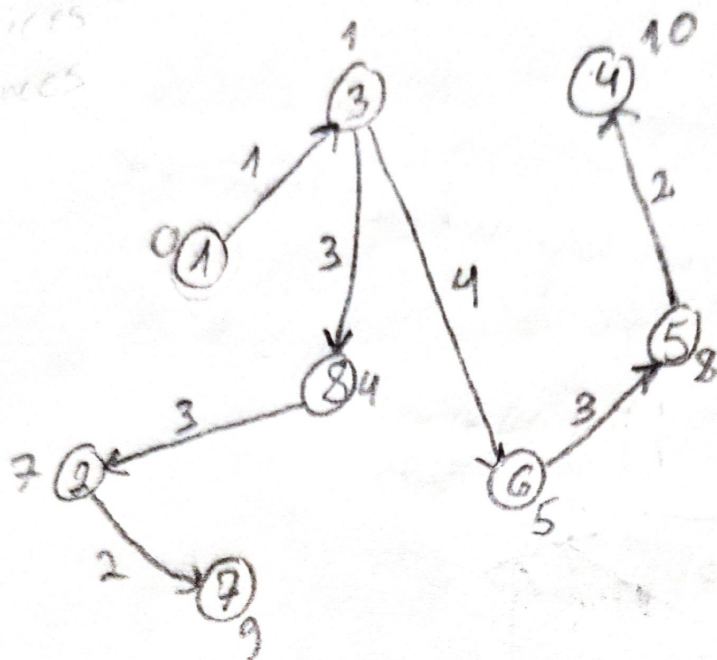


# EN 2022

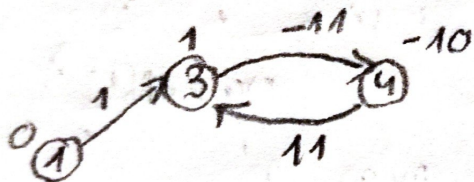
1) ① a)

vertices  
distances



vertices : 1 3 8 6 2 5 7 4  
distances : 0 1 4 5 7 8 9 10

②

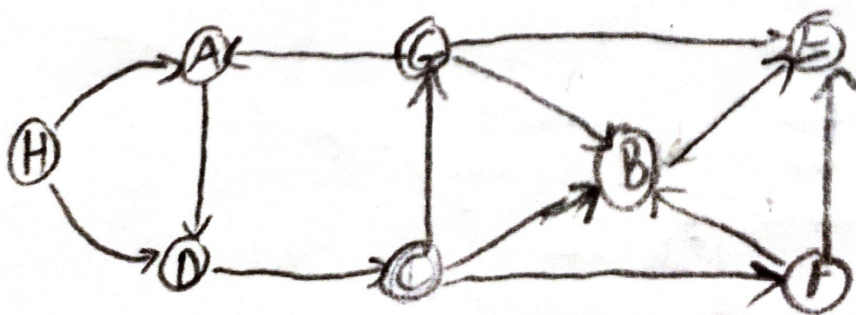


vertices : 1 3 4 3 4  
distances : 0 1 -10 1 -10 ...

Loop infinito  
↙ entre 3 e 4,  
o Dijkstra não  
tem razões para  
explorar outros  
nodes

Não podemos usar Dijkstra  
num grafo com loops negativos

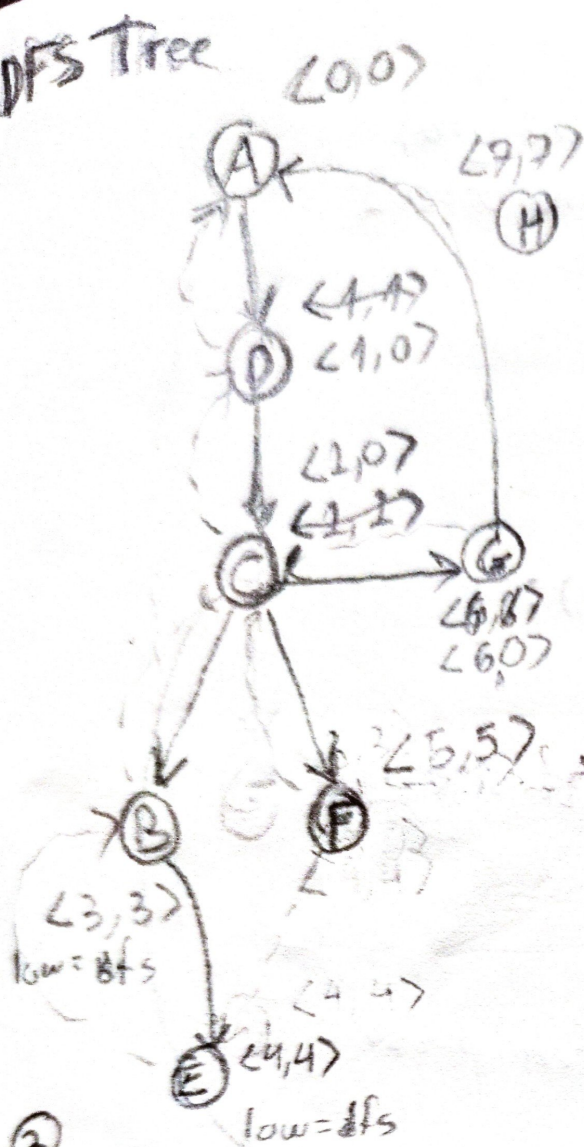
③ <dfs, low> vis[x] = has x been visited? rec



① <0,0>  
② <1,1>  
③ <2,2>



DFS Tree



Stack: A D C B E

F  
E  
G

GCSS:

{E}

{B}

{F}

{A, D, C, G}

{H}

②

③  $dp[x][y] = -1$  for each row  $x \in m$  and for each column  $y \in c$

function  $M(i, j)$ :

if  $(j=0 \text{ or } i=0)$ :

return 0

if  $(dp[i][j] \neq -1)$ :

return  $dp[i][j]$

lvals := []

for each  $v_i$  in  $(v_1, \dots, v_e)$ :

lvals.append( $v_i + M(i - v_i, j - 1)$ )

return  $dp[i][j] := \max\{lvals\}$

$M(i, j) =$

$$\begin{cases} 0 & , i \leq 0 \\ 0 & , j \leq 0 \\ \max \begin{cases} v_1 + M(i - v_1, j - 1) \\ v_2 + M(i - v_2, j - 1) \\ \vdots \\ v_e + M(i - v_e, j - 1) \end{cases} & i > 0 \text{ and } j > 0 \end{cases}$$



③ function  $M(m, c)$ :

$dp[x][y] = 0$  for each  $(x \leq m \text{ and } y = 0)$   
 $0$  for each  $(y \leq c \text{ and } x = 0)$

for each  $i$  in  $(0, \dots, m)$   
 for each  $j$  in  $(0, \dots, c)$ :  
 $lvals = []$   
 for each  $v_i$  in  $(v_1, \dots, v_e)$   
 if  $(i - v_i \leq 0)$  or  $(j - 1 \leq 0)$ :  
 $lvals.append(0)$   
 else:  
 $lvals.append(v_i + dp[i - v_i][j - 1])$   
 $dp[i][j] := \max(lvals)$   
 return  $dp[m-1][c-1]$

④  $O(m \times c \times l)$  — Percorrer a lista em cada passo  
 ↑ Preencher linhas  
 ↓ Preencher colunas

④  $dx = \{-1, -1, -1, 0, 0, 0, 1, 1, 1\}$   
 $dy = \{-1, 0, 1, -1, 0, 1, -1, 0, 1\}$   
 $vis[x][y] := 0$  for  $x \leq n$  and  $y \leq n$

function flood-fill( $x, y$ ):  
 if  $(vis[x, y] \neq 0)$  if  $(x < 0 \text{ or } x \geq n)$  or  $(y < 0 \text{ or } y \geq n)$  return  
 if  $(M[x, y] = 1)$  return  
 $vis[x, y] := 1$

for  $d$  in  $(0, \dots, 8)$ :  
 $nx := x + dx[d]$   
 $ny := y + dy[d]$

$ct = 0$  flood-fill( $nx, ny$ )

for  $x$  in  $(0, \dots, n)$   
 for  $y$  in  $(0, \dots, n)$   
 if  $(vis[x, y] = 0 \text{ and } M[x, y] = 0)$ :  
 $ct += 1$   
 flood-fill( $x, y$ )

print( $ct$ )