
Algoritmi 1: TRACEBACK-PATH(x, π, π_{REV})

```
1  $u = x$ 
2  $p = \langle \rangle$ 
3 while  $u$  is not nil do
4   | lisää  $u$   $p$ :n alkuun
5   |  $u = \pi(u)$ 
   | Kaksisuuntainen haku?
6 if  $\pi_{REV}$  is not nil then
7   |  $u = \pi_{REV}(x)$ 
8   | while  $u$  is not nil do
9   | | lisää  $u$   $p$ :n loppuun
10  | |  $u = \pi_{REV}(u)$ 
11 return  $p$ 
```

Algoritmi 2: BREADTH-FIRST-SEARCH(G, s, t)

```
1  $Q = \langle s \rangle$ 
2  $\pi(s) = \text{nil}$ 
3 while  $|Q| > 0$  do
4   |  $u = \text{DEQUEUE}(Q)$ 
5   | if  $u$  is  $t$  then
6   | | return TRACEBACK-PATH( $u, \pi, \text{nil}$ )
7   | for  $(u, v) \in G.A$  do
8   | | if  $v$  is not yet mapped in  $\pi$  then
9   | | |  $\pi(v) = u$ 
10  | | | ENQUEUE( $Q, u$ )
11 | return  $\langle \rangle$ 
```

Algoritmi 3: BIDIRECTIONAL-BREADTH-FIRST-SEARCH(G, s, t)

```

1  $Q, \pi, d = (\langle s \rangle, (s, \mathbf{nil}), (s, 0))$ 
2  $Q_{REV}, \pi_{REV}, d_{REV} = (\langle t \rangle, (t, \mathbf{nil}), (t, 0))$ 
3  $\tau, \mu = (\mathbf{nil}, \infty)$ 
4 while  $|Q||Q_{REV}| > 0$  do
5   if  $\tau$  is not nil and  $d(\text{HEAD}(Q)) + d_{REV}(\text{HEAD}(Q_{REV})) \geq \mu$  then
6     return TRACEBACK-PATH( $\tau, \pi, \pi_{REV}$ )
7    $u = \text{DEQUEUE}(Q)$ 
8   if  $u$  is mapped in  $\pi_{REV}$  and  $\mu > d(u) + d_{REV}(u)$  then
9      $\mu = d(u) + d_{REV}(u)$ 
10     $\tau = u$ 
11   for  $(u, v) \in G.A$  do
12     if  $v$  is not mapped in  $\pi$  then
13        $\pi(v) = u$ 
14       ENQUEUE( $Q, v$ )
15        $d(v) = d(u) + 1$ 
16    $u = \text{DEQUEUE}(Q_{REV})$ 
17   if  $u$  is mapped in  $\pi$  and  $\mu > d(u) + d_{REV}(u)$  then
18      $\mu = d(u) + d_{REV}(u)$ 
19      $\tau = u$ 
20   for  $(v, u) \in G.A$  do
21     if  $v$  is not mapped in  $\pi_{REV}$  then
22        $\pi_{REV}(v) = u$ 
23       ENQUEUE( $Q_{REV}, v$ )
24        $d_{REV}(v) = d_{REV}(u) + 1$ 
25 return  $\langle \rangle$ 

```
