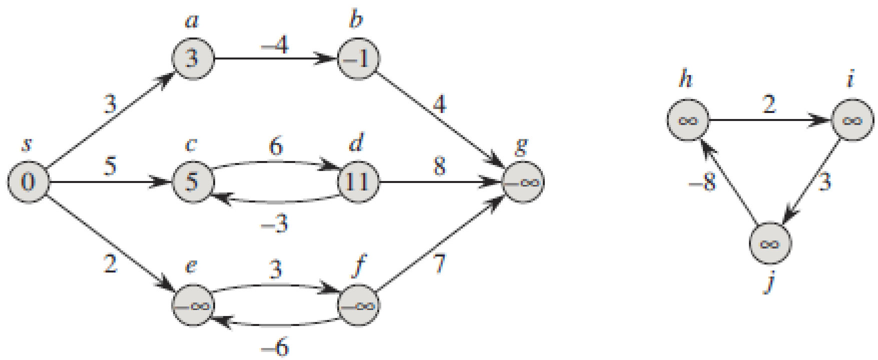
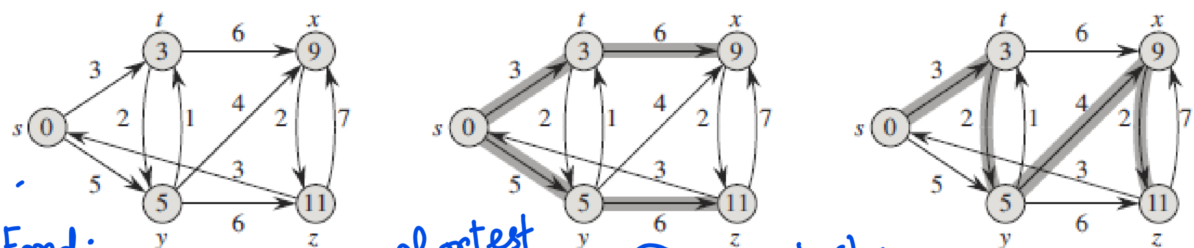
$$w(p) = \sum_{i=1}^{k} w(v_{i-1}, v_i)$$

$$\delta(u,v) = \begin{cases} \min\{w(p) : u \overset{p}{\leadsto} v\} & \text{if there is a path from } u \text{ to } v \\ \infty & \text{otherwise .} \end{cases}$$

$s \to g$





Bellman - Ford : → Single source shortest Path Problem

↓ Edge weights may be negative.

① Shortest-path tree

② Shortest-Path tree

✓ INITIALIZE-SINGLE-SOURCE(G, s)

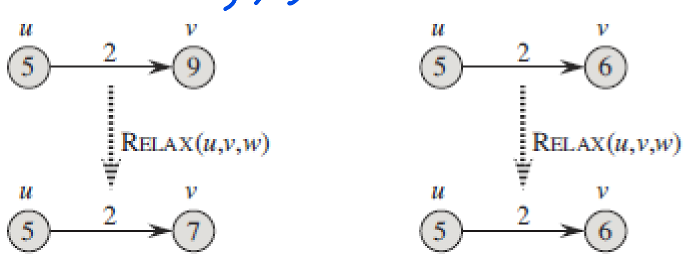
```
for each vertex v ∈ G.V
    v.d = ∞
    v.π = NIL
s.d = 0
```

✓ RELAX(u, v, w)

```
if v.d > u.d + w(u,v)
    v.d = u.d + w(u,v)
    v.π = u
```

$9 > 5+2$

$6 \not> 5+2$



Time complexity $\boxed{O(V \cdot E)}$

BELLMAN-FORD(G, w, s) ← Source

```
INITIALIZE-SINGLE-SOURCE(G, s)          → V
for i = 1 to |G.V| - 1                  → V-1 passes
    for each edge (u, v) ∈ G.E          → all edges of G·E
        RELAX(u, v, w)
for each edge (u, v) ∈ G.E
    if v.d > u.d + w(u, v)
        return FALSE
return TRUE
```

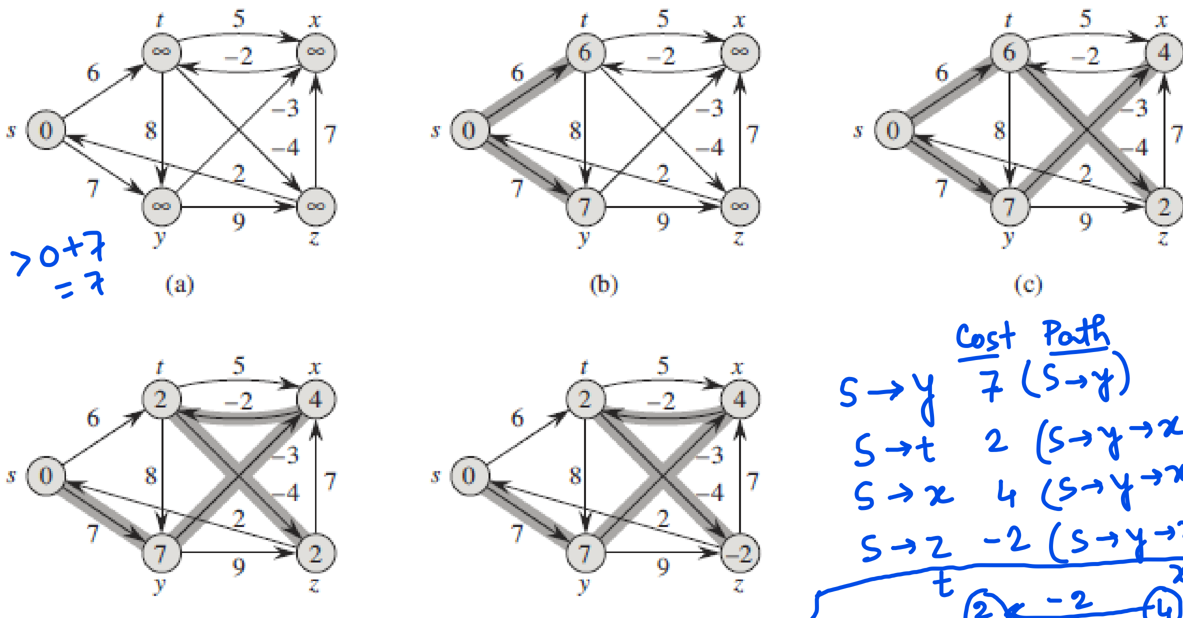
V·E: lines 2–4

E: lines 5–7 } to find out any -ve weighted cycle

return FALSE → Having -ve weighted cycle

$\infty > \underline{0+6} = 6$

$\infty > 0+7 = 7$



(a) (b) (c) (d) (e)

	Cost	Path
$s \to y$	7	$(s \to y)$
$s \to t$	2	$(s \to y \to x \to t)$
$s \to x$	4	$(s \to y \to x)$
$s \to z$	-2	$(s \to y \to x \to t \to z)$

Shortest-Path tree