
Algorithms and Data Structures

CSCI 4041

Session 26c

Single-Source Shortest Path, Dijkstra

ssspDijkstra(Graph G, Weights w, Vertex s):

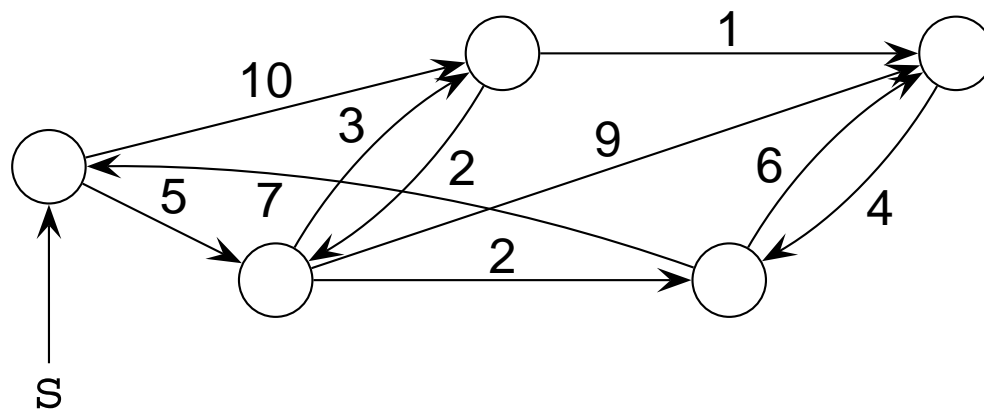
initializeSingleSource(G, s), S \leftarrow \emptyset , Q \leftarrow vertices(G)

while Q \neq \emptyset

u \leftarrow extractMin(Q), S \leftarrow S \cup {u}

for each Vertex v \in adjacent(u)

relax(u, v, w)



Single-Source Shortest Path, Dijkstra (1)

ssspDijkstra(Graph G, Weights w, Vertex s):

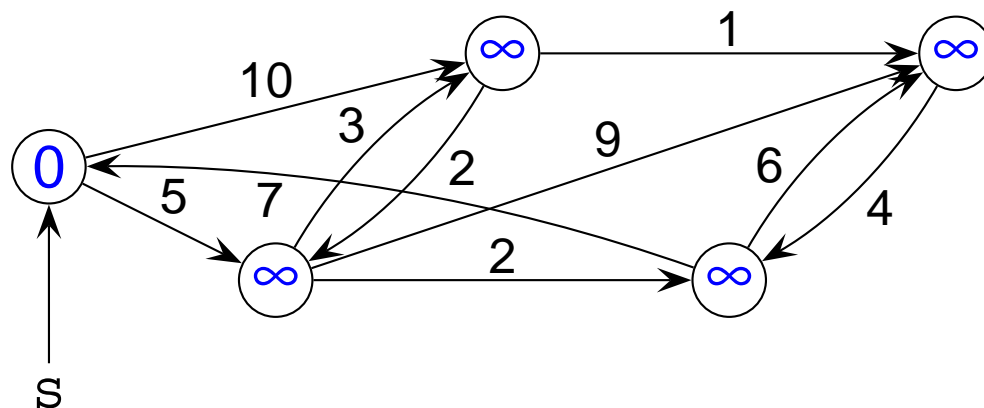
initializeSingleSource(G,s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

 relax(u, v, w)



Single-Source Shortest Path, Dijkstra (2)

ssspDijkstra(Graph G, Weights w, Vertex s):

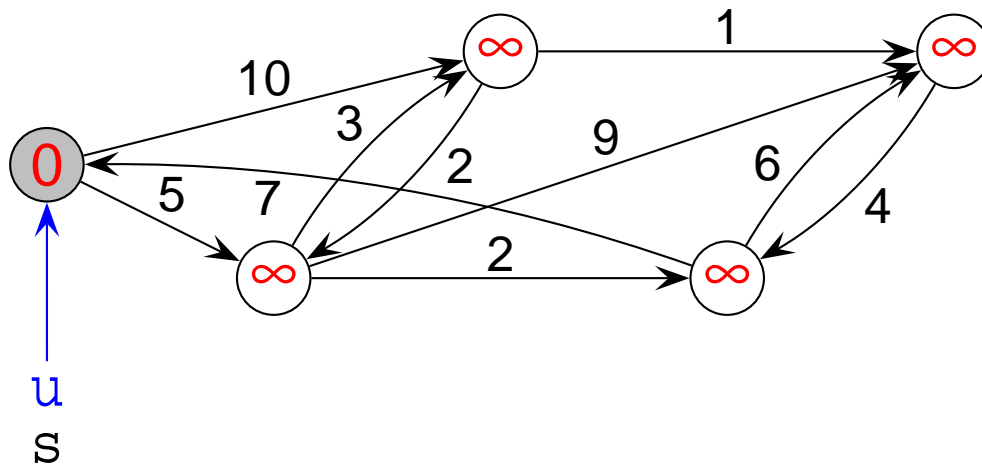
initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)



Single-Source Shortest Path, Dijkstra (3)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), S \leftarrow \emptyset , Q \leftarrow vertices(G)

while Q \neq \emptyset

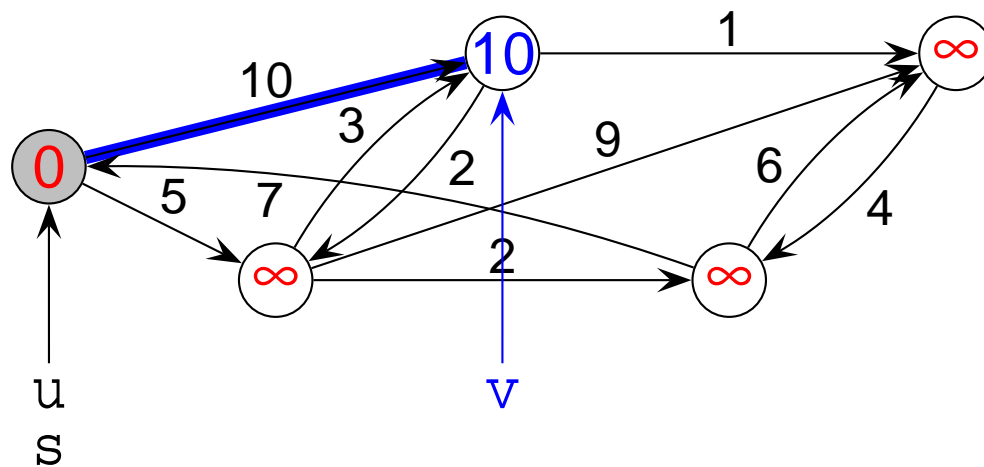
u \leftarrow extractMin(Q), S \leftarrow S \cup {u}

for each Vertex v \in adjacent(u)

relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (4)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

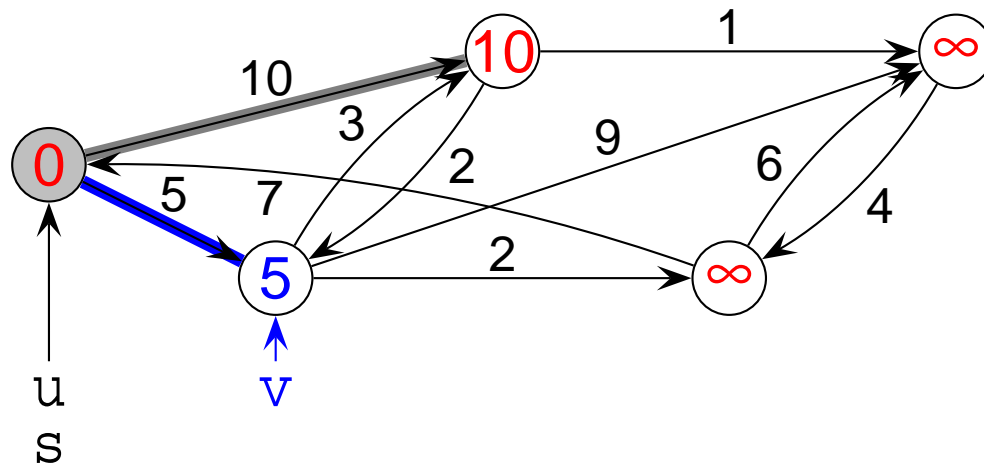
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (5)

ssspDijkstra(Graph G, Weights w, Vertex s):

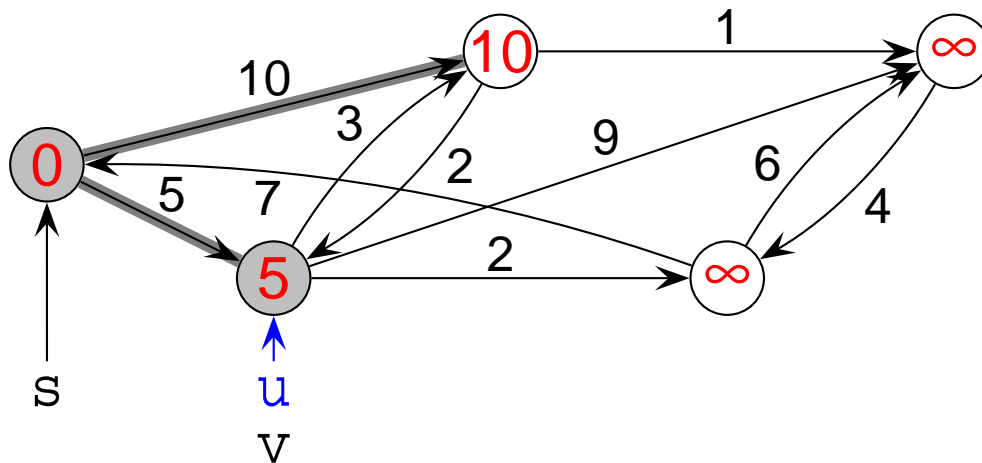
initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)



Single-Source Shortest Path, Dijkstra (6)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

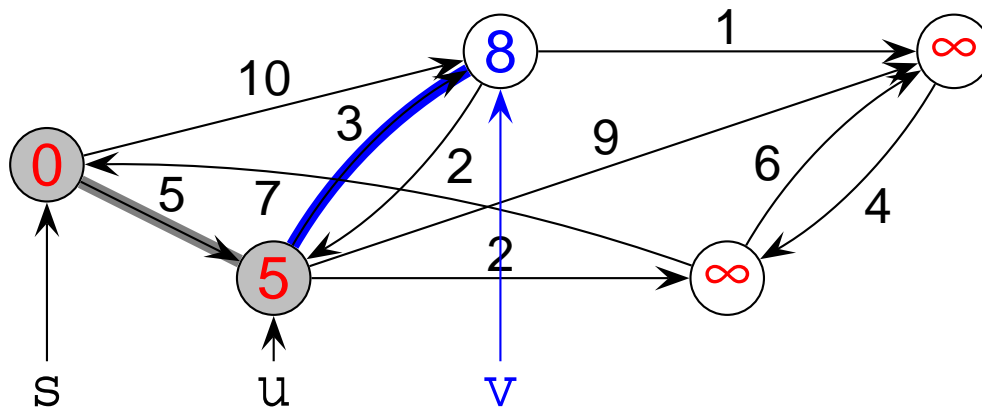
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

 relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (7)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

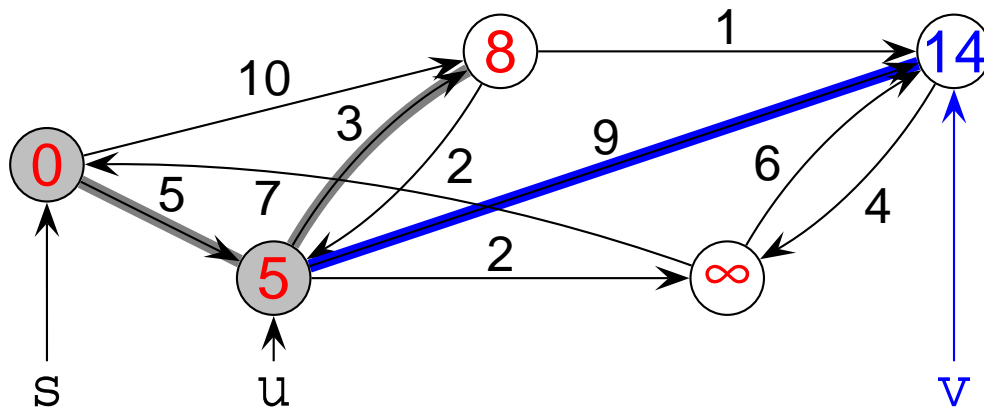
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

 relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (8)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

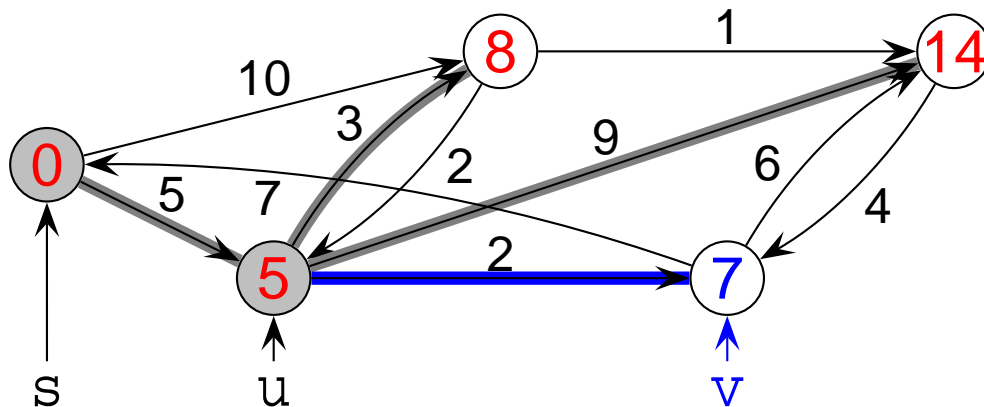
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (9)

ssspDijkstra(Graph G, Weights w, Vertex s):

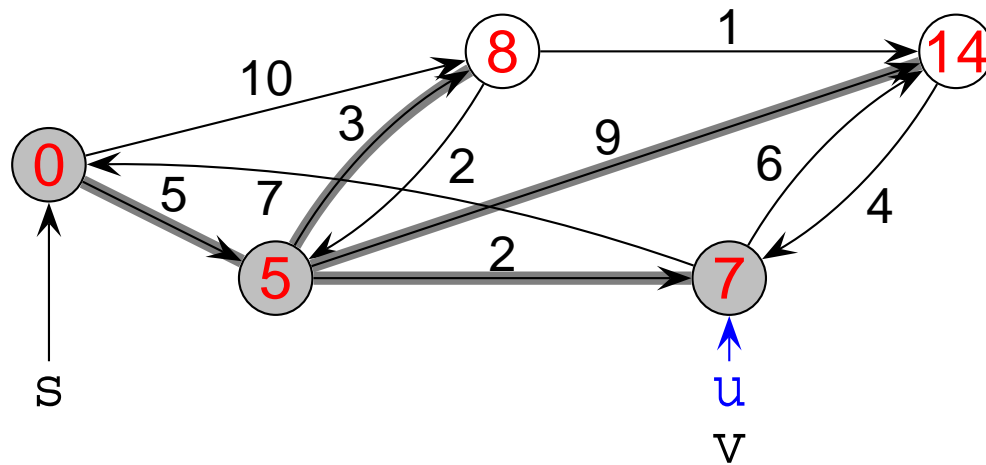
initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)



Single-Source Shortest Path, Dijkstra (10)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

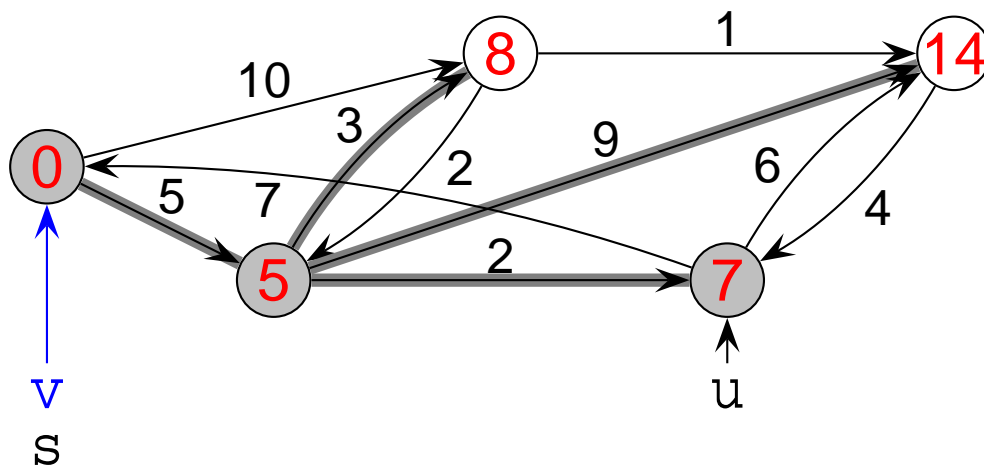
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

 relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (11)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

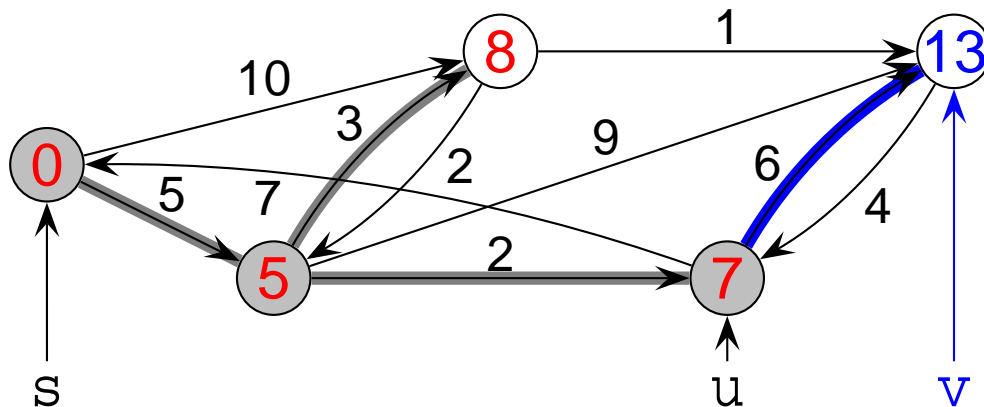
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

 relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (12)

ssspDijkstra(Graph G, Weights w, Vertex s):

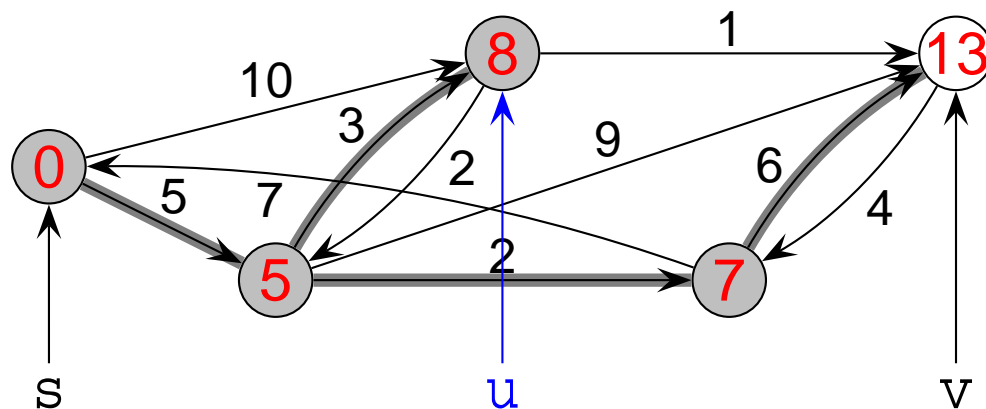
initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)



Single-Source Shortest Path, Dijkstra (13)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

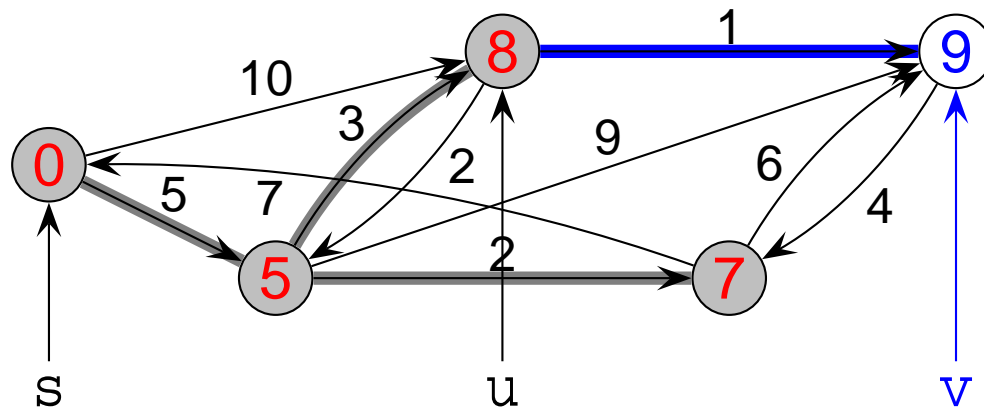
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

 relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (14)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

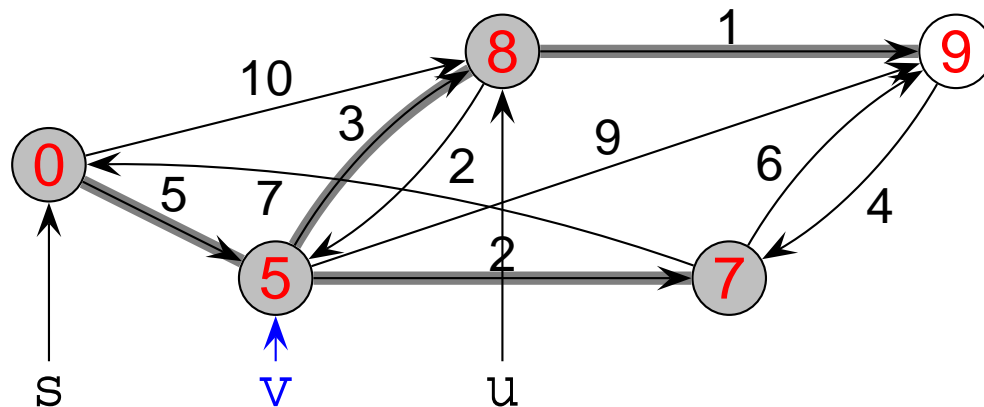
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (15)

ssspDijkstra(Graph G, Weights w, Vertex s):

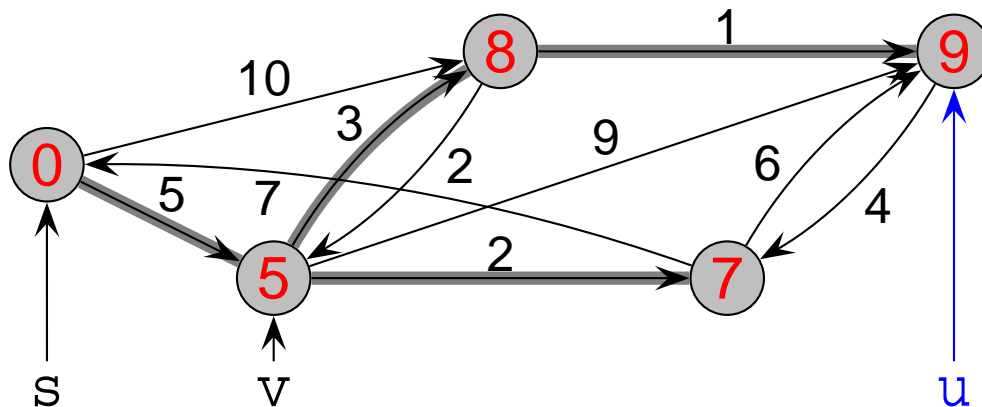
initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)



Single-Source Shortest Path, Dijkstra (16)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G, s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

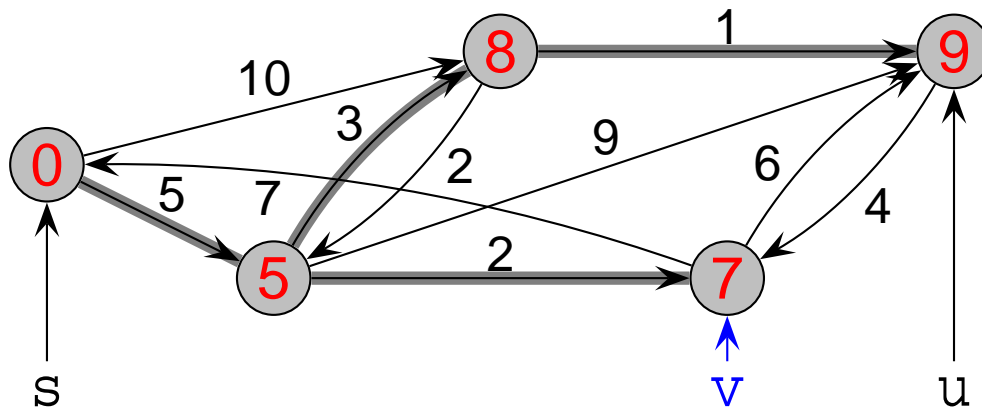
$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

relax(u, v, w)

relax(Vertex u, Vertex v, Weights w):

if $d(v) > d(u) + w(u, v)$ **then** $d(v) \leftarrow d(u) + w(u, v)$, $p(v) \leftarrow u$



Single-Source Shortest Path, Dijkstra (done)

ssspDijkstra(Graph G, Weights w, Vertex s):

initializeSingleSource(G,s), $S \leftarrow \emptyset$, $Q \leftarrow \text{vertices}(G)$

while $Q \neq \emptyset$

$u \leftarrow \text{extractMin}(Q)$, $S \leftarrow S \cup \{u\}$

for each Vertex $v \in \text{adjacent}(u)$

 relax(u, v, w)

