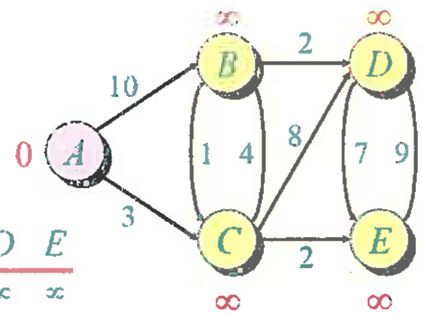
Dijkstra's Algorithm is a greedy algorithm which always works for finding shortest path in connected graph G

DIJKSTRA ANIMATED EXAMPLE

L(A) = (A, 0)
L(B) = (-, ∞)
L(C) = (-, ∞)
L(D) = (-, ∞)
L(E) = (-, ∞)



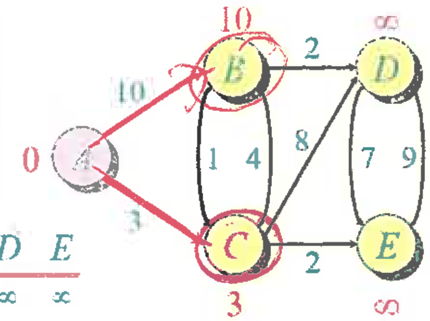
Q:	A	B	C	D	E
	0	∞	∞	∞	∞

Given a fixed vertex in G: v = A
Find all shortest paths from v to w ∀w∈V(G)

t = 0: R(A) = S(A) ∪ N(A) = {A}∪{B, C} = {A, B, C}

DIJKSTRA ANIMATED EXAMPLE

L(A) = (A , 0)
L(B) = (A , 10)
L(C) = (A , 3)
L(D) = (,   )
L(E) = (,   )



Q:	A	B	C	D	E
	0	∞	∞	∞	∞
		10	3	∞	∞

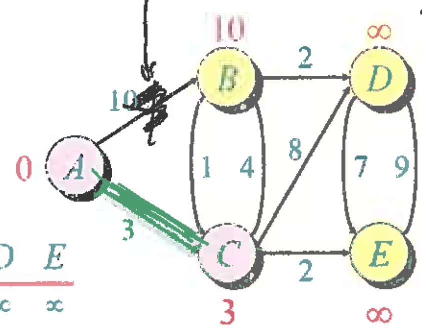
S: { A }

t = 0: R(A) = S(A) ∪ N(A) = {A}∪{B, C} = {A, B, C}

DIJKSTRA ANIMATED EXAMPLE

may or may not need but ~~not~~ don't know at this step

L(A) = (A , 0)
L(B) = (A , 10)
L(C) = (A , 3)
L(D) = (,   )
L(E) = (,   )



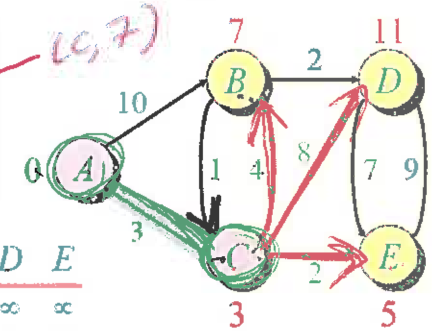
Q:	A	B	C	D	E
	0	∞	∞	∞	∞
		10	3	∞	∞

S: { A, C }

t = 1: R(A) = S(A) ∪ N(C) = {A, C}∪{B, D, E}

DIJKSTRA ANIMATED EXAMPLE

L(A) = (A , 0)
L(B) = (C , 7) (C, 7)
L(C) = (A , 3)
L(D) = (C , 11)
L(E) = (C , 5)



Q:	A	B	C	D	E
	0	∞	∞	∞	∞
		10	3	∞	∞
		7		11	5

S: { A, C }

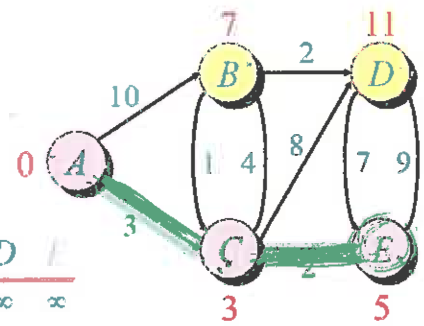
t = 1: R(A) = S(A) ∪ N(C) = {A, C}∪{B, D, E}

in unweighted graph

If G is not weighted (ie if ~~an~~ edges are not assigned weights, then can assume all edges have weight 1 to find shortest path in vertex just before I get to E

Dijkstra Animated Example

L(A) = (A , 0)
L(B) = (C , 7)
L(C) = (A , 3)
L(D) = (C , 11)
L(E) = (C , 5)



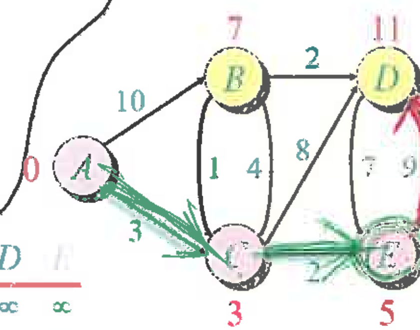
Q: A	B	C	D	E
0	∞	∞	∞	∞
	10	3	∞	∞
	7		11	5

S: { A, C, E }

t = 2: R(A) = S(A) U N(E) = {A, C, E}U{D}

Dijkstra Animated Example

L(A) = (A , 0)
L(B) = (C , 7)
L(C) = (A , 3)
L(D) = (C , 11)
L(E) = (C , 5)



$5+9=14>11$

$14>11$

ignore ~~edge~~ arc $\overrightarrow{\langle ED \rangle}$

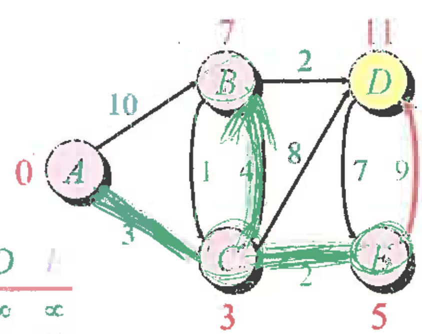
Q: A	B	C	D	E
0	∞	∞	∞	∞
	10	3	∞	∞
	7		11	5
	7		11	

S: { A, C, E }

t = 2: R(A) = S(A) U N(E) = {A, C, E}U{D}

Dijkstra Animated Example

L(A) = (A , 0)
L(B) = (C , 7)
L(C) = (A , 3)
L(D) = (C , 11)
L(E) = (C , 5)



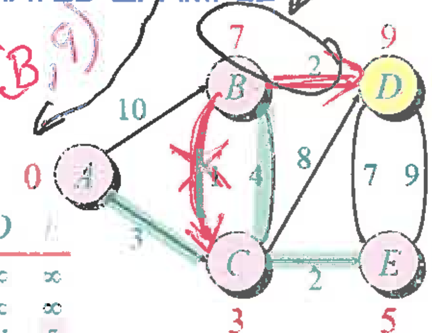
Q: A	B	C	D	E
0	∞	∞	∞	∞
	10	3	∞	∞
	7		11	5
	7		11	

S: { A, C, E, B }

t = 3: R(A) = S(A) U N(B) = {A, C, E, B}U{C, D}

Dijkstra Animated Example

L(A) = (A , 0)
L(B) = (C , 7)
L(C) = (A , 3)
L(D) = ~~(C , 11)~~ (B , 9)
L(E) = (C , 5)



$7+2=9<11$ update

Q: A	B	C	D	E
0	∞	∞	∞	∞
	10	3	∞	∞
	7		11	5
	7		11	
			9	

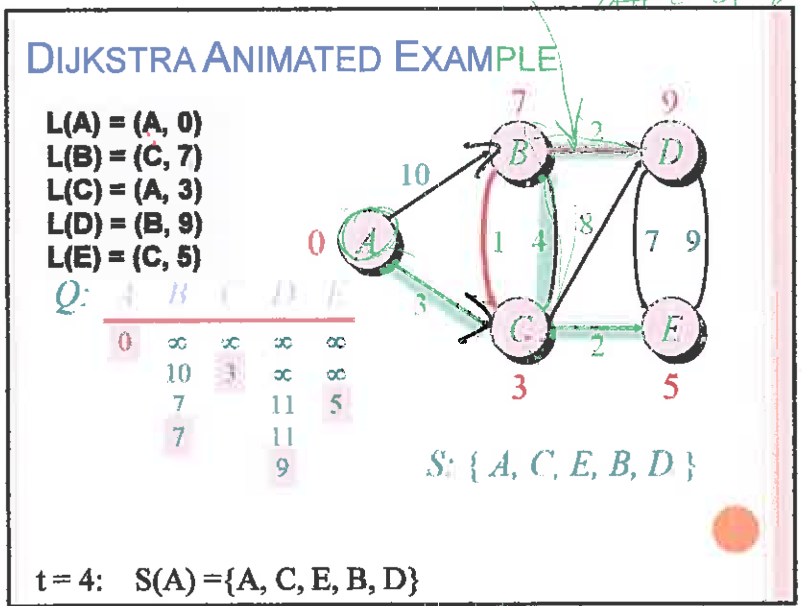
S: { A, C, E, B }

t = 3: R(A) = S(A) U N(B) = {A, C, E, B}U{C, D}

$P(A) = N(B) \setminus S(A)$

$\{C, D\} \setminus \{A, C, E, B\} = \{D\}$

Found a spanning tree
~~for undirected graph obtained from directed graph~~



starts from A

Spanning tree includes all vertices

Given graph G Connected

Given vertex $A \in G$

Find all paths P

$P = A, v_1, \ldots v_k = v_0, v_1, \ldots v_k$ where $A = v_0$

st $\sum_{i=0}^{k-1} w(\langle v_i, v_{i+1} \rangle)$ is ~~min~~ smallest among all paths from $v_0 = A$ to v_k

directed or undirected

If unweighted graph, let $w(\langle v, w \rangle) = 1$ $\forall$ edges

Note for shortest path problem, greedy algorithm works
We don't need to look at all paths