

# Lecture 13

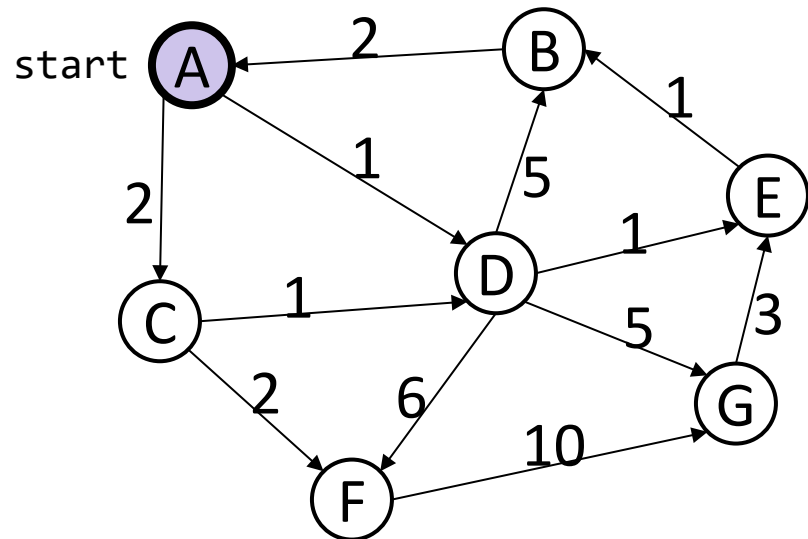
## Shortest Paths

## Exercises ANS

Department of Computer Science  
Hofstra University

# Q. Dijkstra's Algorithm

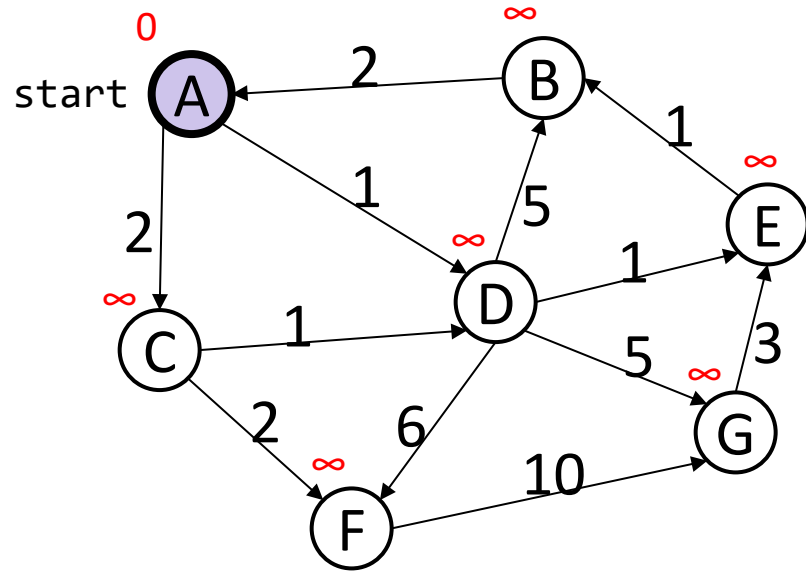
*Exam question:* Given this directed graph, run Dijkstra's Algo to find shortest paths starting from **source node A**. Give the node visit order, and fill in this table of SN (Shortest Distance) and PN (Previous Node), crossing out old SD and PN as you find a shortcut path with smaller SD



Visit Order

Node	SD	PN
A		
B		
C		
D		
E		
F		
G		

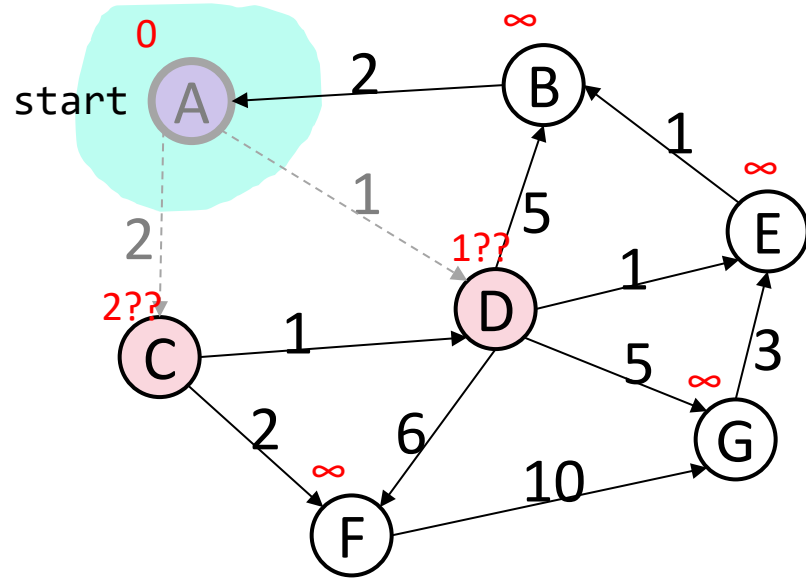
# Q. Dijkstra's Algorithm



Visit Order

Node	SD	PN
A	$\infty$	
B	$\infty$	
C	$\infty$	
D	$\infty$	
E	$\infty$	
F	$\infty$	
G	$\infty$	

# Q. Dijkstra's Algorithm

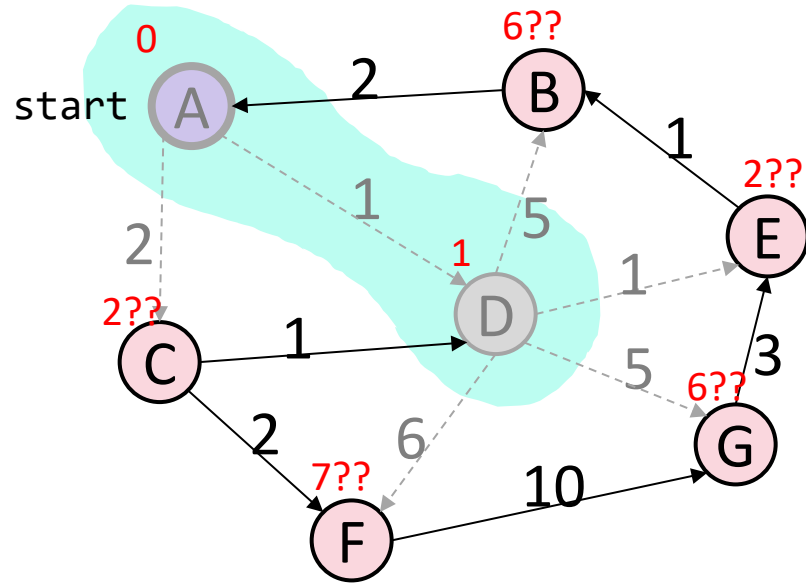


Visit Order

A

Node	SD	PN
A	0	/
B	$\infty$	
C	2	A
D	1	A
E	$\infty$	
F	$\infty$	
G	$\infty$	

# Q. Dijkstra's Algorithm

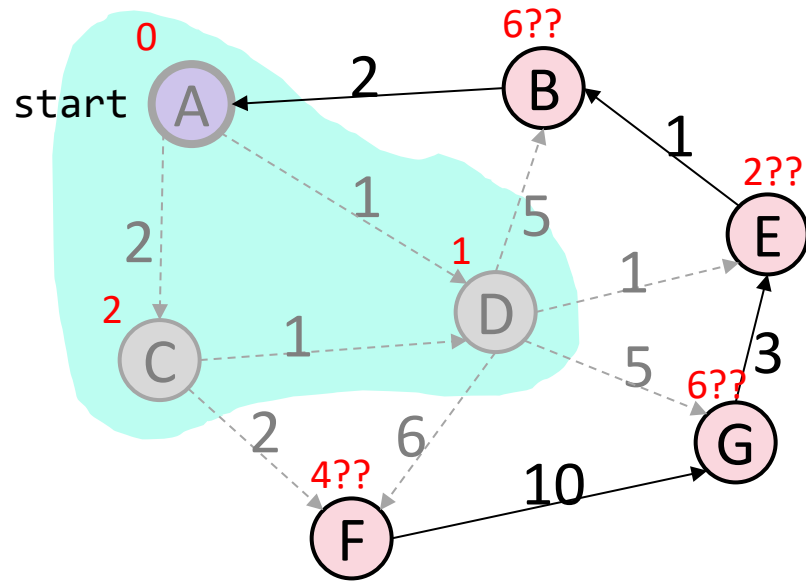


Visit Order

A, D

Node	SD	PN
A	0	/
B	6	D
C	2	A
D	1	A
E	2	D
F	7	D
G	6	D

# Q. Dijkstra's Algorithm

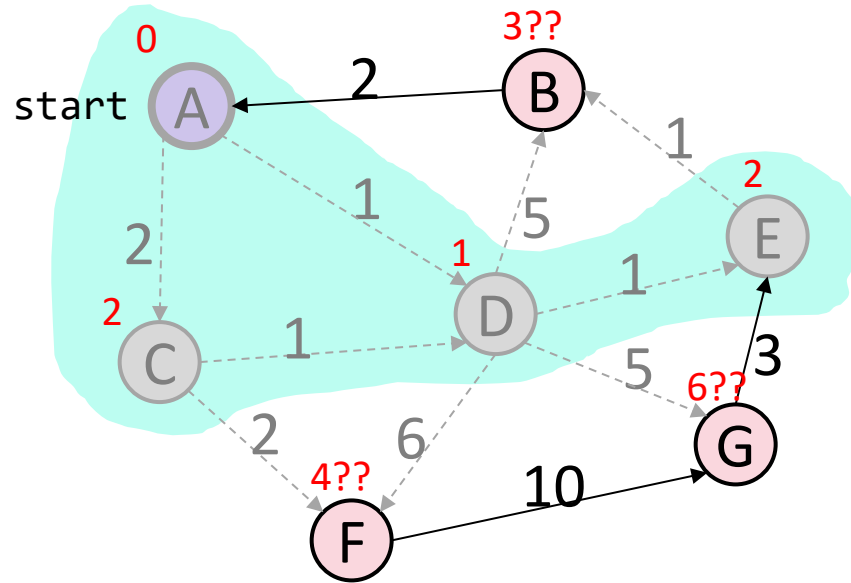


Visit Order

A, D, C

Node	SD	PN
A	0	/
B	6	D
C	2	A
D	1	A
E	2	D
F	<del>7</del> 4	<del>D</del> C
G	6	D

# Q. Dijkstra's Algorithm

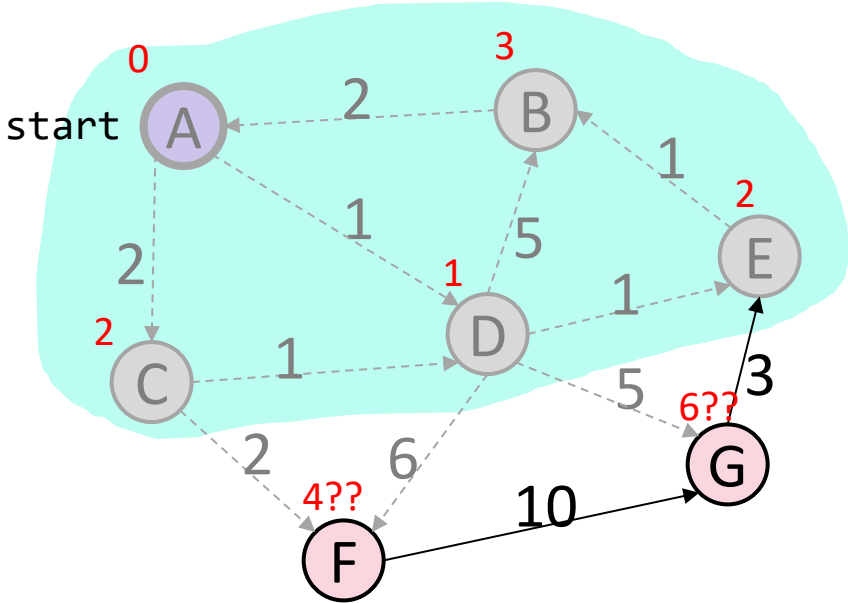


Visit Order

A, D, C, E

Node	SD	PN
A	0	/
B	<del>6</del> 3	<del>D</del> E
C	2	A
D	1	A
E	2	D
F	<del>7</del> 4	<del>D</del> C
G	6	D

# Q. Dijkstra's Algorithm

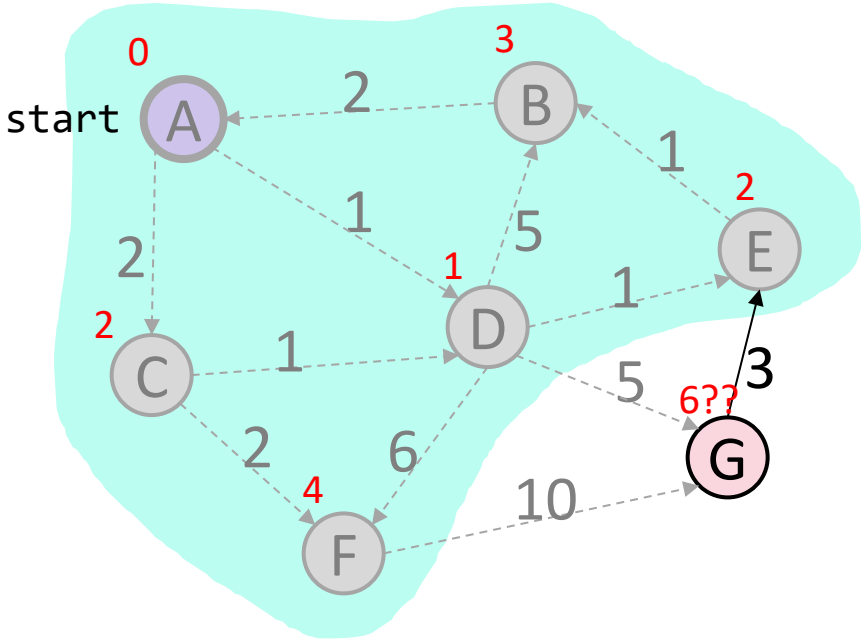


Visit Order  
A, D, C, E, B

Node	SD	PN
A	0	/
B	3	E
C	2	A
D	1	A
E	2	D
F	4	C
G	6	D



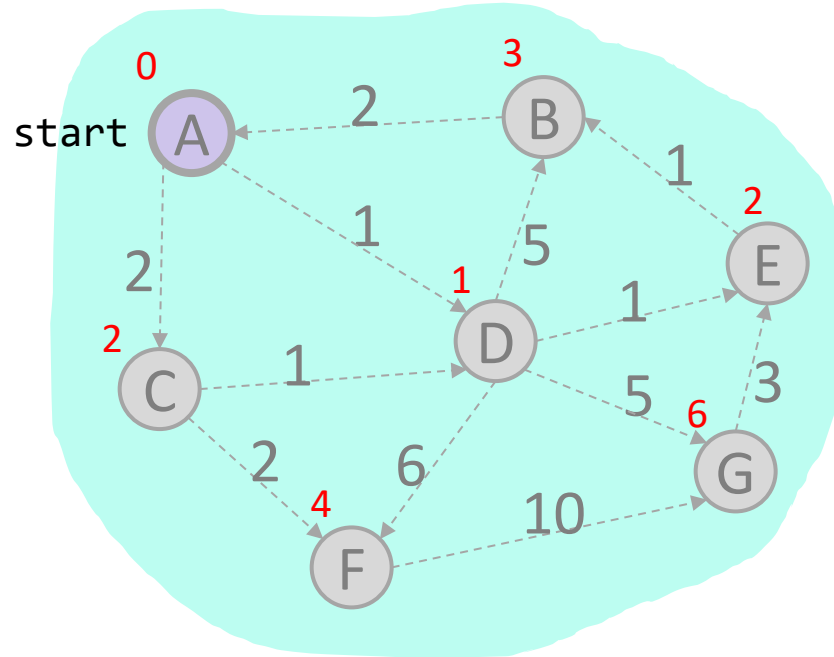
# Q. Dijkstra's Algorithm



Visit Order  
A, D, C, E, B, F

Node	SD	PN
A	0	/
B	3	E
C	2	A
D	1	A
E	2	D
F	4	C
G	6	D

# Q. Dijkstra's Algorithm Final Answer

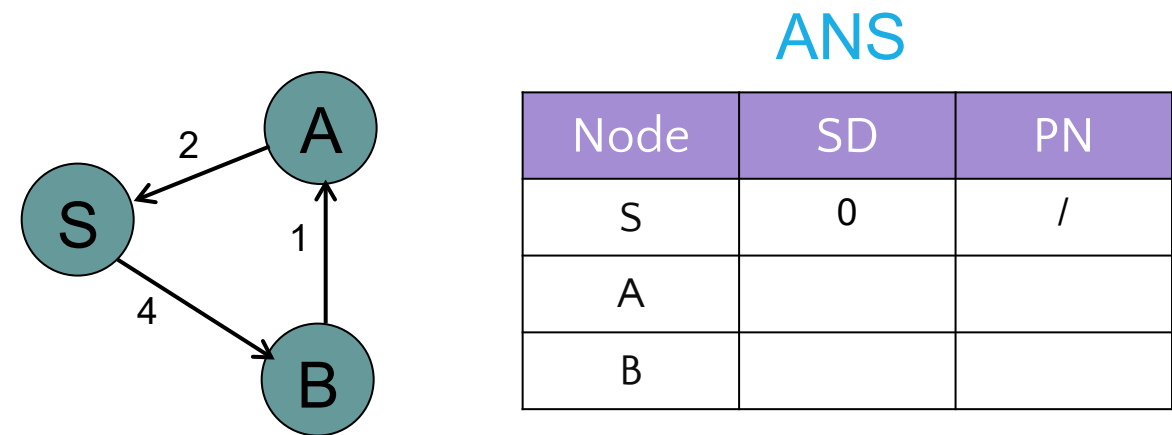
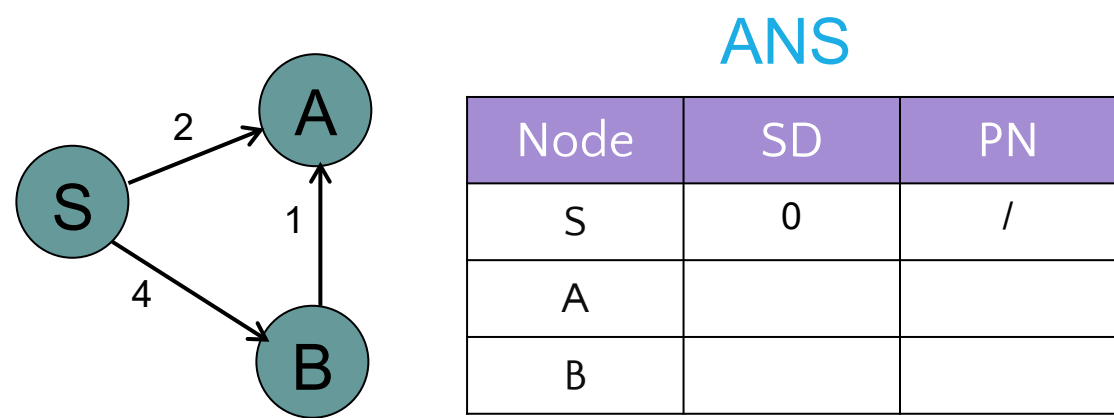
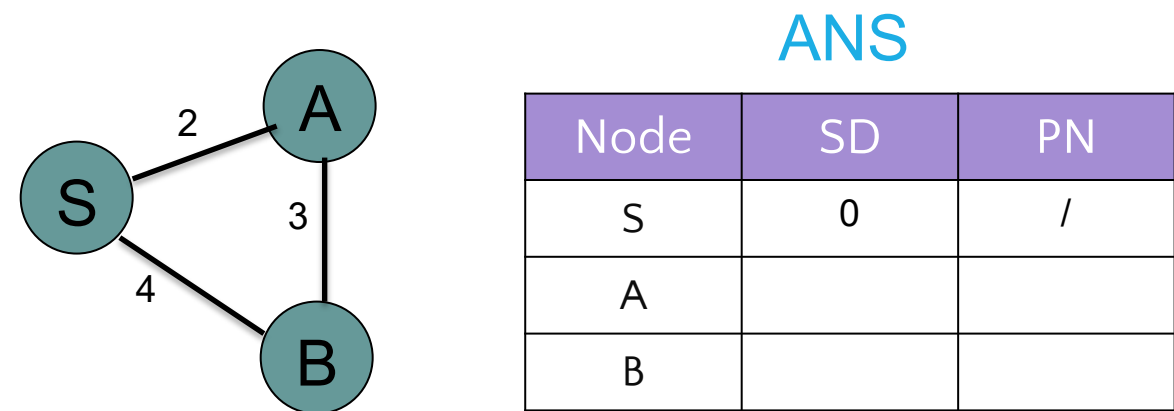
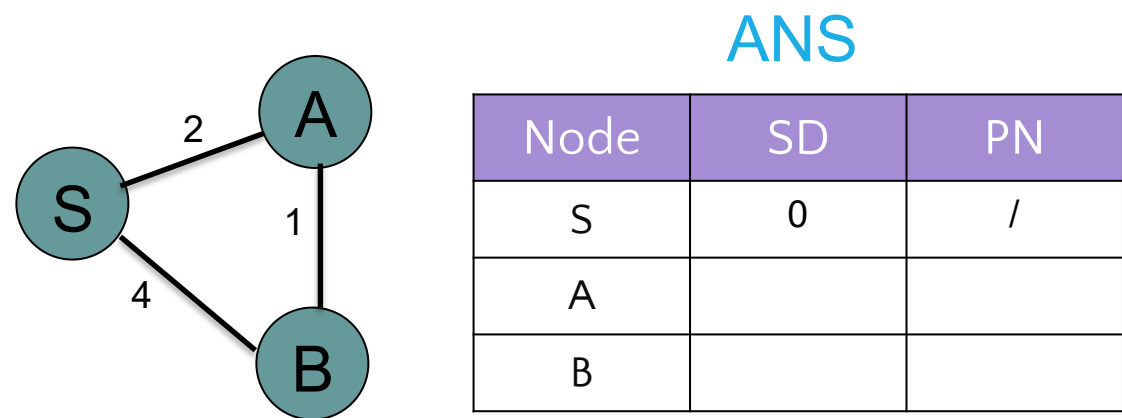


Visit Order

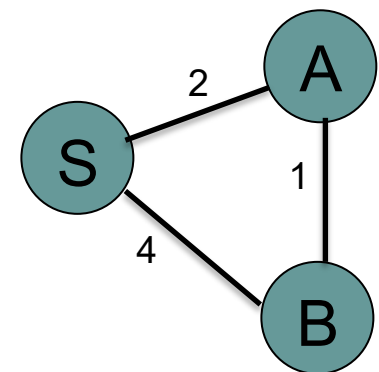
A, D, C, E, B, F, G

Node	SD	PN
A	0	/
B	3	E
C	2	A
D	1	A
E	2	D
F	4	C
G	6	D

# Q. Dijkstra's Algorithm (Source Node S)

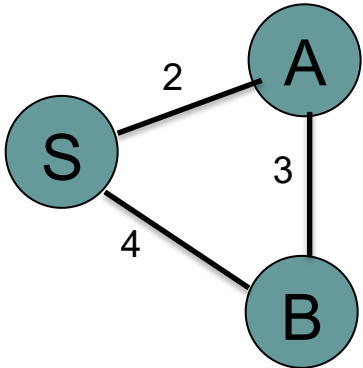


# Q. Dijkstra's Algorithm (Source Node S) Final Answer



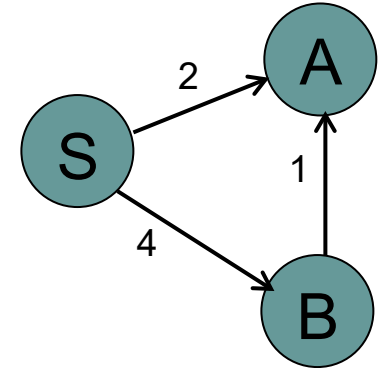
ANS

Node	SD	PN
S	0	/
A	2	S
B	4	S



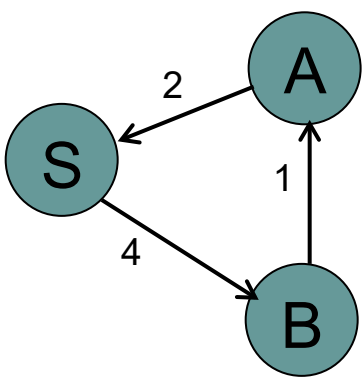
ANS

Node	SD	PN
S	0	/
A	2	S
B	4	S



ANS

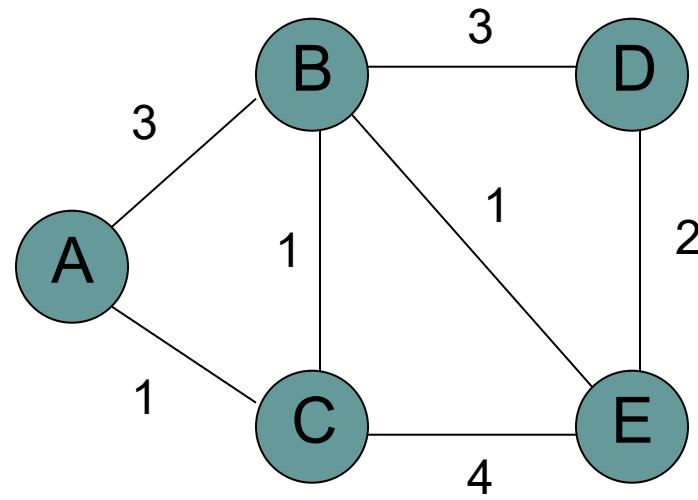
Node	SD	PN
S	0	/
A	2	S
B	4	S



ANS

Node	SD	PN
S	0	/
A	5	B
B	4	S

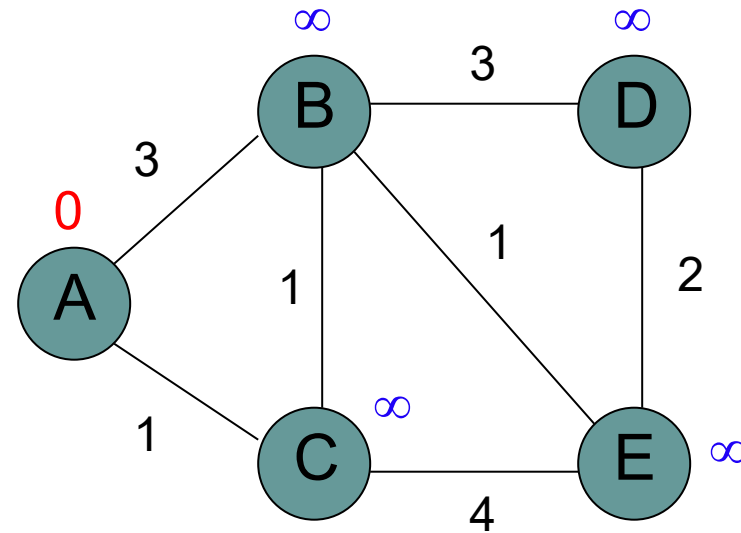
# Q. Dijkstra's Algorithm (Source Node A, Undirected Graph)



Visit Order

Node	SD	PN
A		
B		
C		
D		
E		

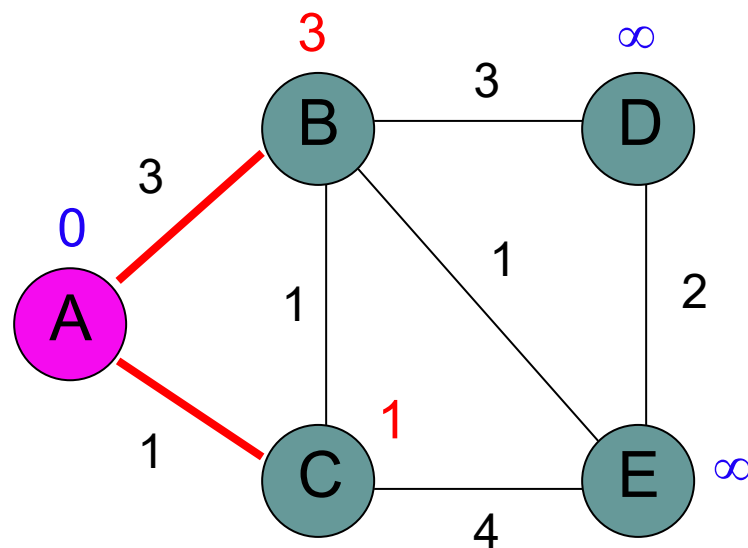
# Initialize



Visit Order

Node	SD	PN
A	0	/
B	$\infty$	
C	$\infty$	
D	$\infty$	
E	$\infty$	

# Visit Node A

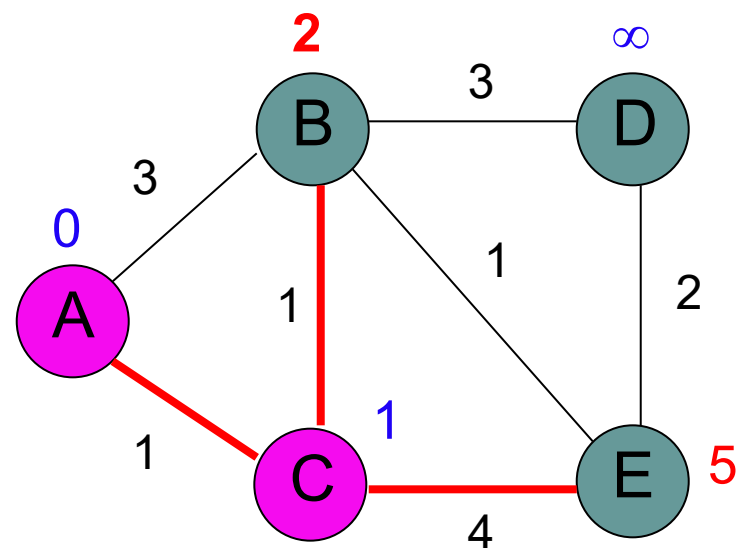


Visit Order

A

Node	SD	PN
A	0	/
B	3	A
C	1	A
D	∞	
E	∞	

# Visit Node C

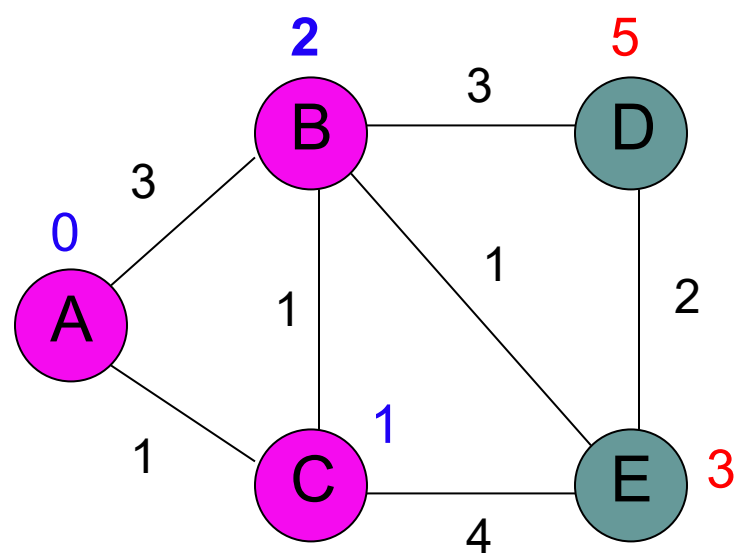


Visit Order  
A, C

Node	SD	PN
A	0	/
B	3 2	A C
C	1	A
D	∞	
E	5	C



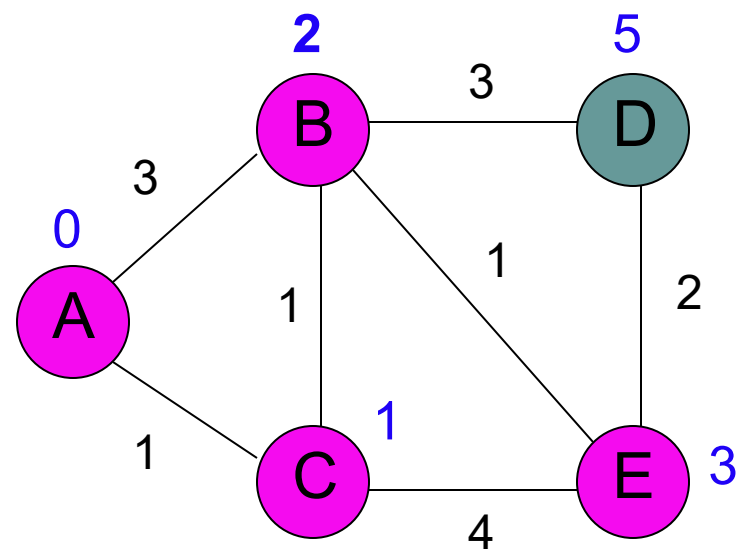
# Visit Node B



Visit Order  
A, C, B

Node	SD	PN
A	0	/
B	3 2	A C
C	1	A
D	5	B
E	<del>5</del> 3	∈ B

# Visit Node E

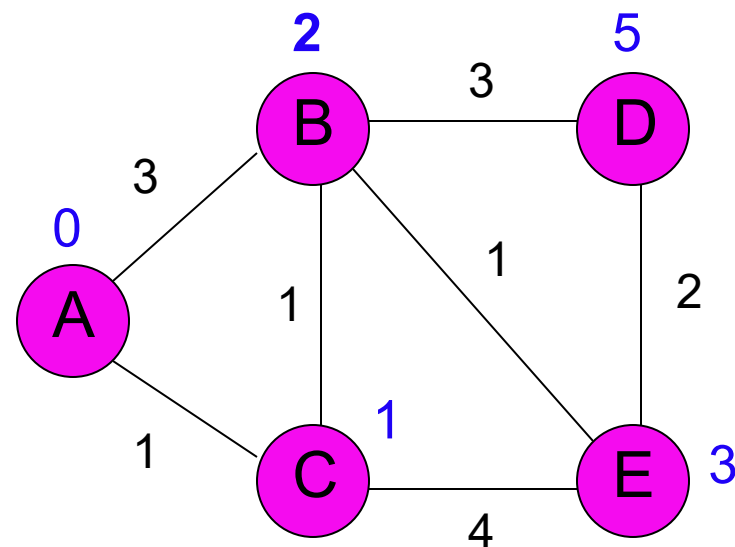


Visit Order  
A, C, B, E

Node	SD	PN
A	0	/
B	3 2	A C
C	1	A
D	5	B
E	<del>5</del> 3	∈ B

Nothing changes

# Visit Node D

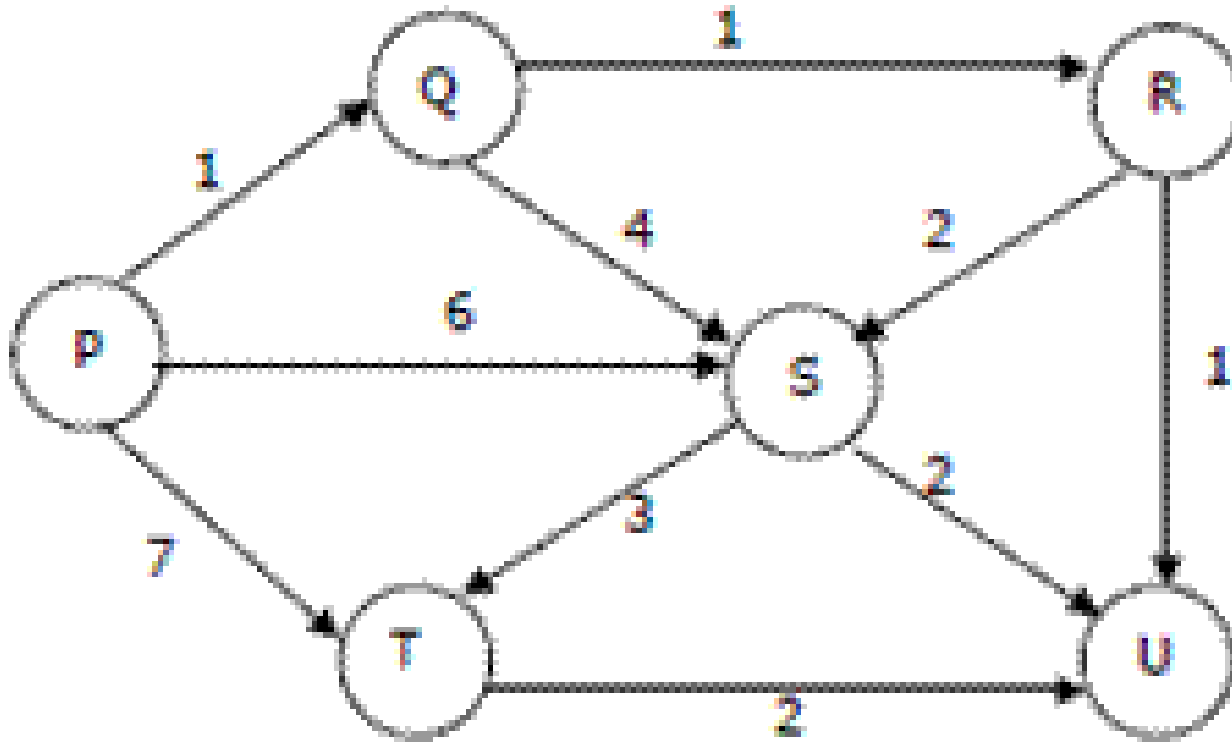


Visit Order  
A, C, B, E, D

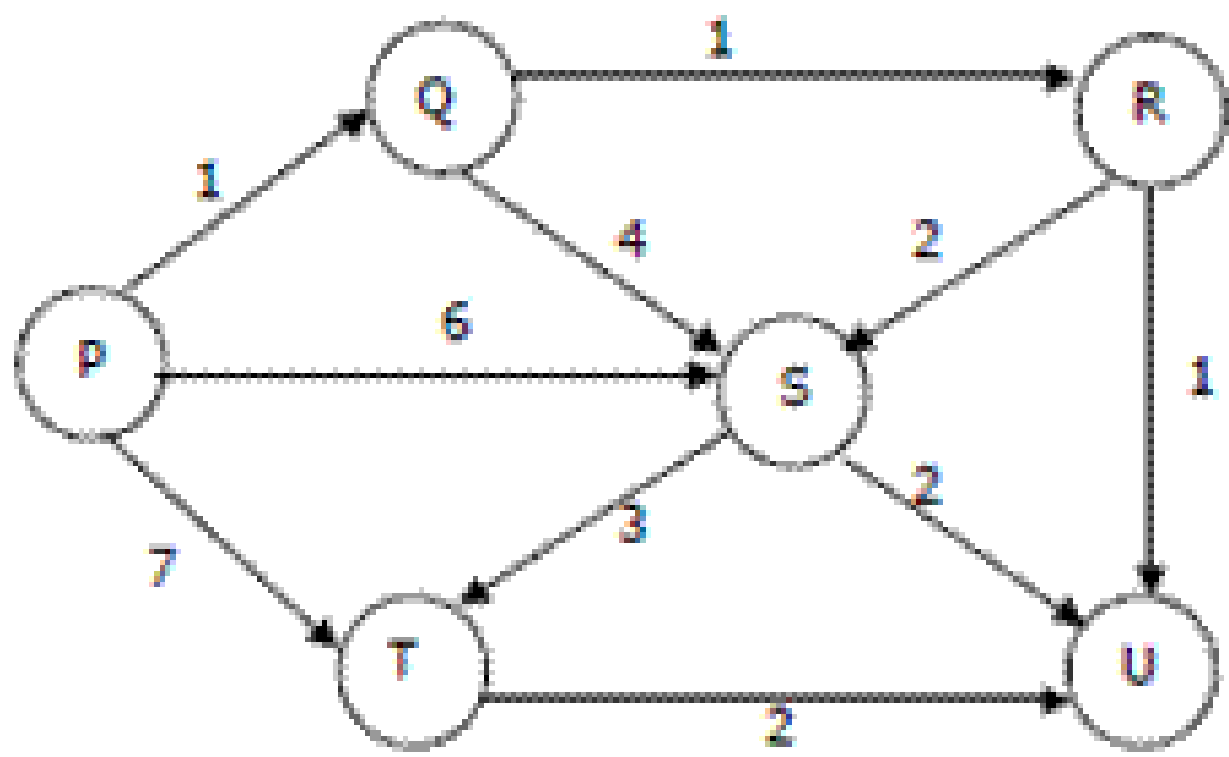
Node	SD	PN
A	0	/
B	3 2	A C
C	1	A
D	5	B
E	5 3	€ B

Nothing changes

# Q. Dijkstra's Algorithm (Source Node P, Directed Graph)



# Q. Dijkstra's Algorithm (Source Node P, Directed Graph) Final Answer

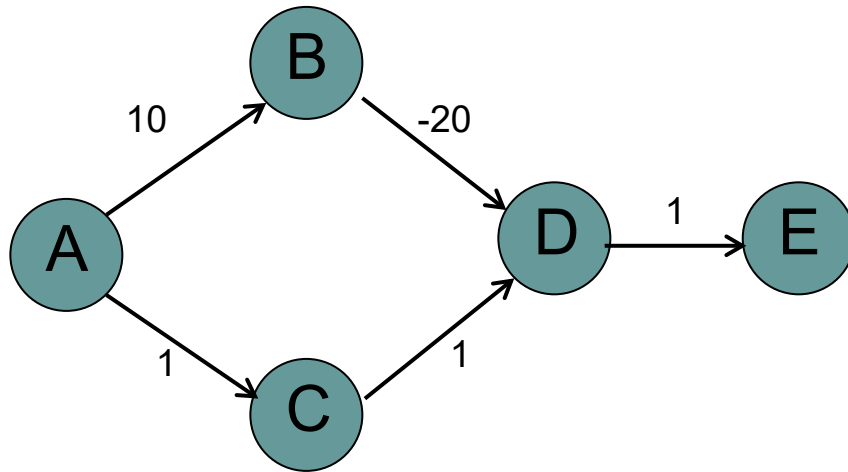


Visit order: P, Q, R, U, S, T

Node	SD	PN
P	0	
Q	1	P
R	2	Q
S	6 5 4	P Q R
T	7	P
U	3	R

# Q. Topological Sort

Consider this DAG, use Topological Sort to find Shortest Paths in DAG, considering all possible topological orders



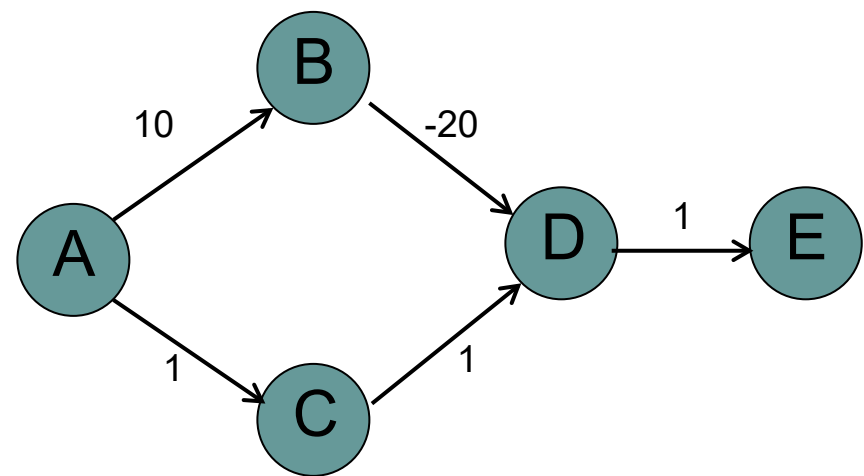
Visit Order

0, 1, 4, 7, 5, 2, 3, 6

Node	SD	PN
A	0	/
B		
C		
D		
E		

# Q. Topological Sort Final Answer

Consider this DAG, use Topological Sort to find Shortest Paths in DAG, considering **all possible** topological orders



Visit Order		
A, B, C, D, E		

Node	SD	PN
A	0	
B	10	A
C	1	A
D	-10	B
E	-9	D

Visit Order		
A, C, B, D, E		

Node	SD	PN
A	0	
B	10	A
C	1	A
D	<del>2</del> -10	∈ B
E	-9	D