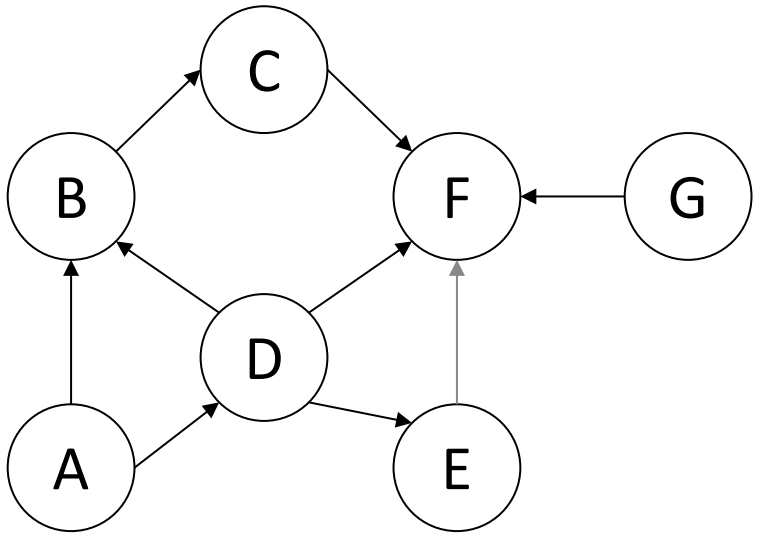
Lecture 12
Graphs
Exercises ANS

Department of Computer Science
Hofstra University

Acknowledgement: Lecture slides based on UofW Course on Data Structures

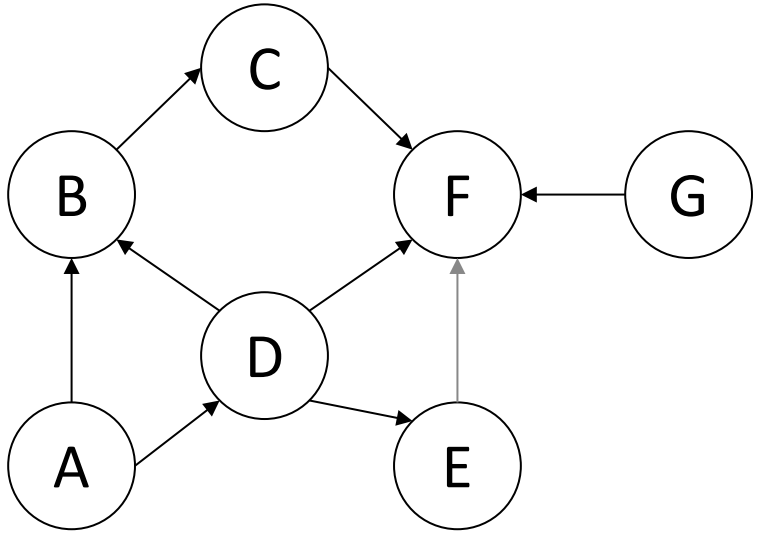
Q. Adjacency matrix and adjacency list

- Write out the adjacency matrix and adjacency list for the directed graph.

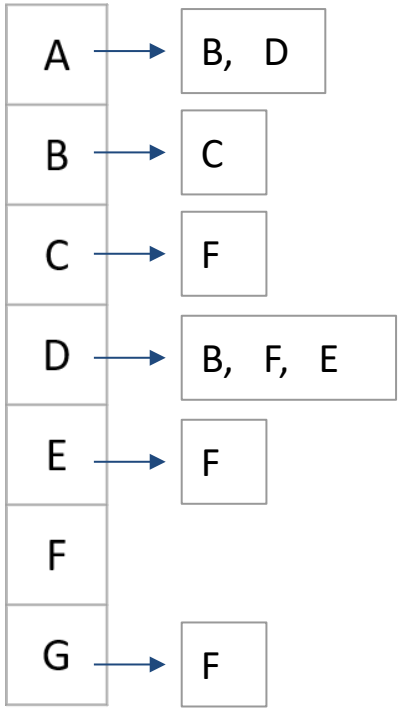


Q. Adjacency matrix and adjacency list ANS

- Write out the adjacency matrix and adjacency list for the directed graph.

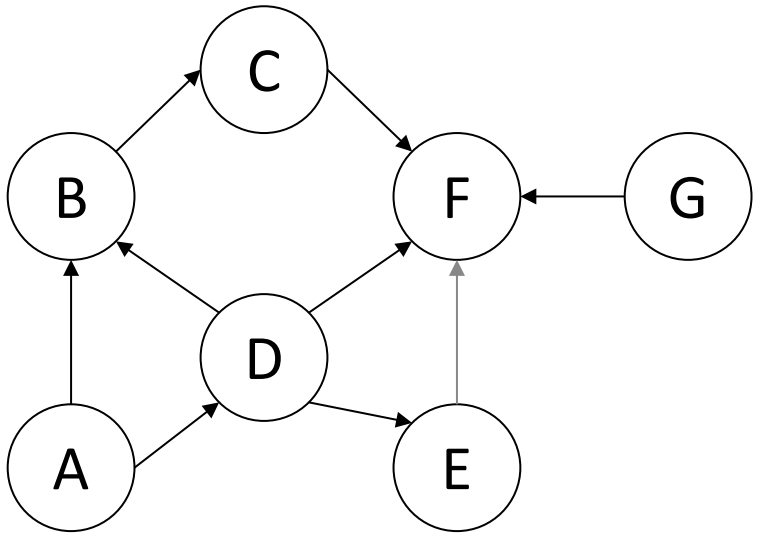


	A	B	C	D	E	F	G
A	0	1	0	1	0	0	0
B	0	0	1	0	0	0	0
C	0	0	0	0	0	1	0
D	0	1	0	0	1	1	0
E	0	0	0	0	0	1	0
F	0	0	0	0	0	0	0
G	0	0	0	0	0	1	0



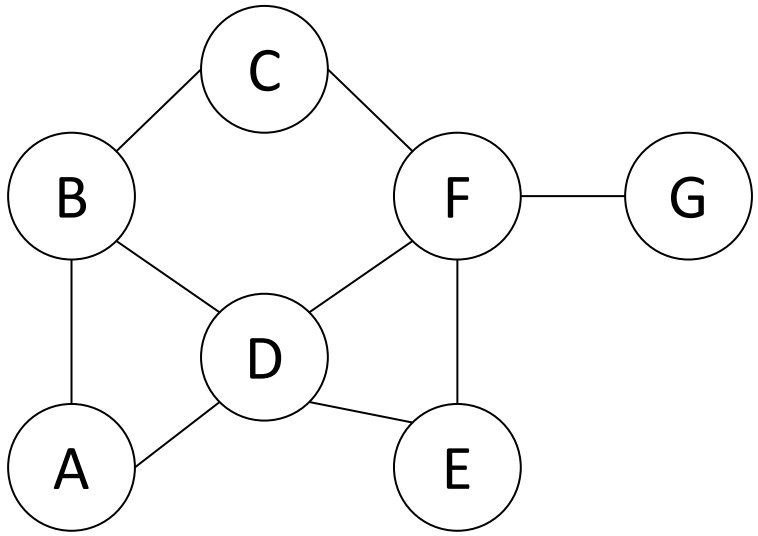
Q. Adjacency matrix and adjacency list

- Write out the adjacency matrix and adjacency list for the undirected graph.

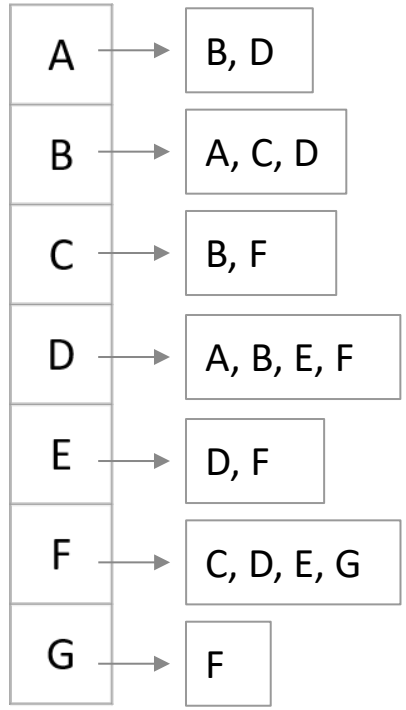


Q. Adjacency matrix and adjacency list ANS

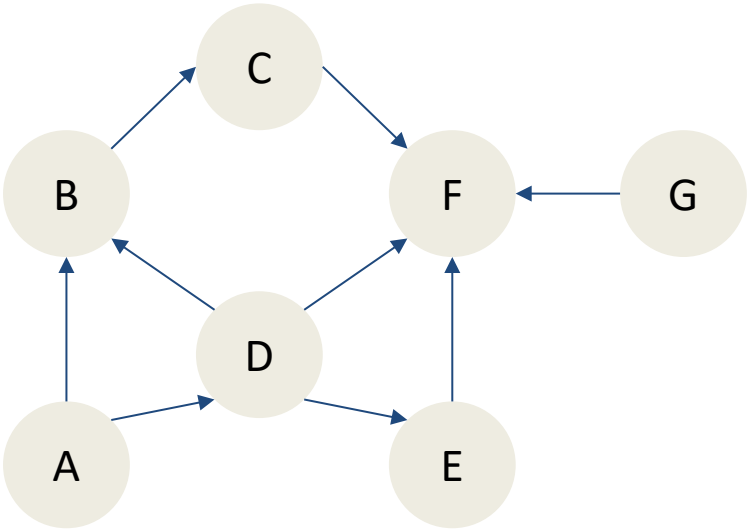
- Write out the adjacency matrix and adjacency list for the directed graph.



	A	B	C	D	E	F	G
A	0	1	0	1	0	0	0
B	1	0	1	1	0	0	0
C	0	1	0	0	0	1	0
D	1	1	0	0	1	1	0
E	0	0	0	1	0	1	0
F	0	0	1	1	1	0	1
G	0	0	0	0	0	1	0



Q: Graph Traversals (Pre-Order & Post-Order)



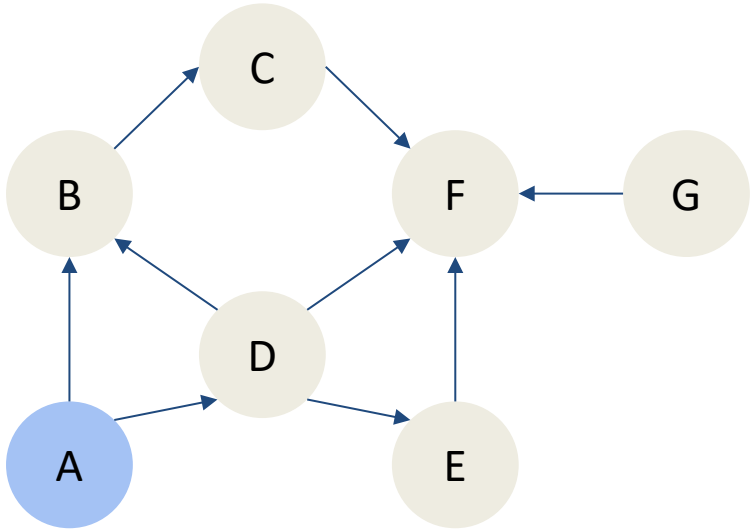
Give the DFS pre-order and post-order traversals of this directed graph, starting from node A. When there are muliple possible orders of visiting the next node, select the next node in alphabetical order.

DFS Pre-Order:

DFS Post-Order:

Stack:

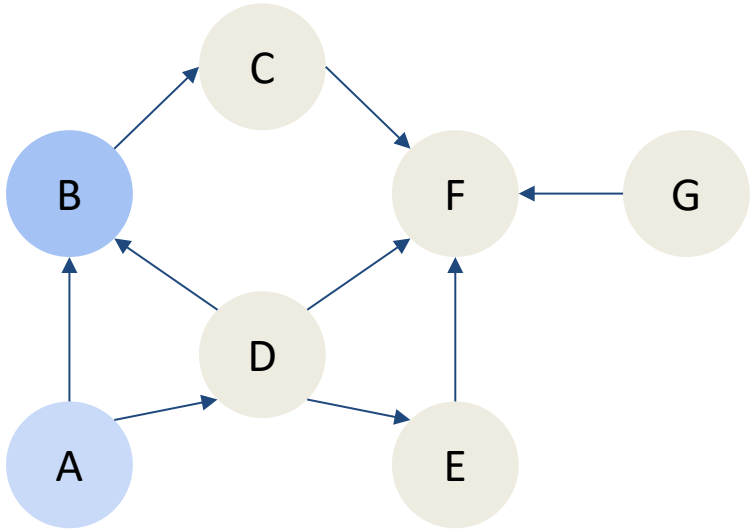
You do NOT need to write out the stack or queue contents in the exam



Stack: A

DFS Pre-Order:
A

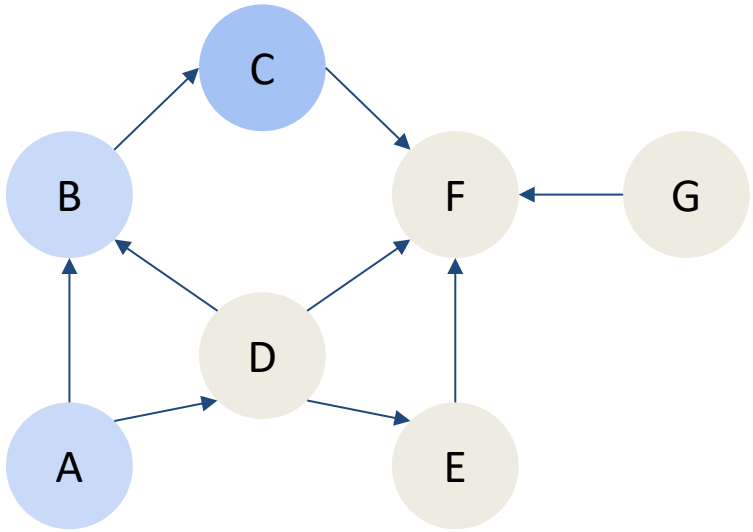
DFS Post-Order:



Stack: A, B

DFS Pre-Order:
A, B

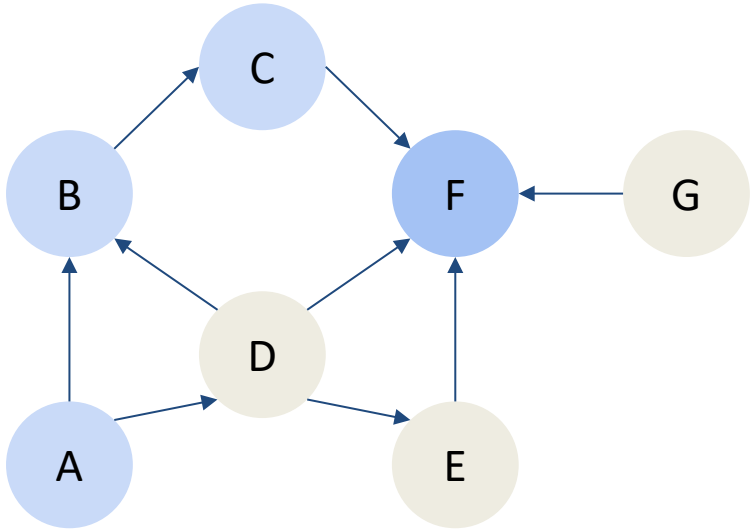
DFS Post-Order:



DFS Pre-Order:
A, B, C

DFS Post-Order:

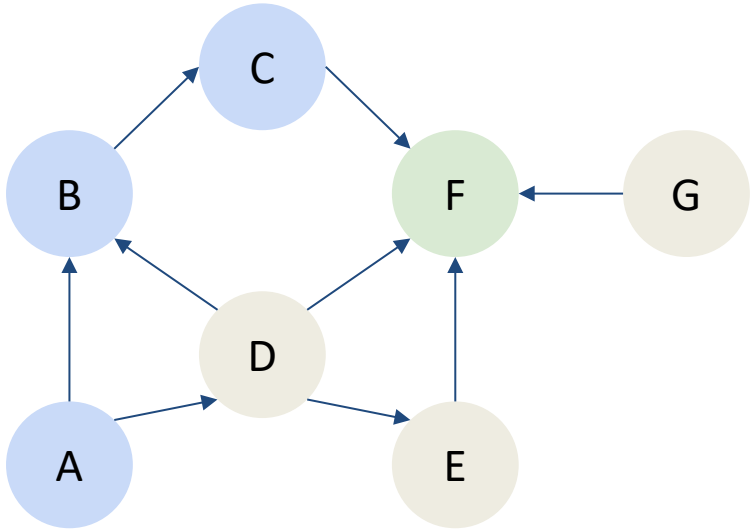
Stack: A, B, C



DFS Pre-Order:
A, B, C, F

DFS Post-Order:

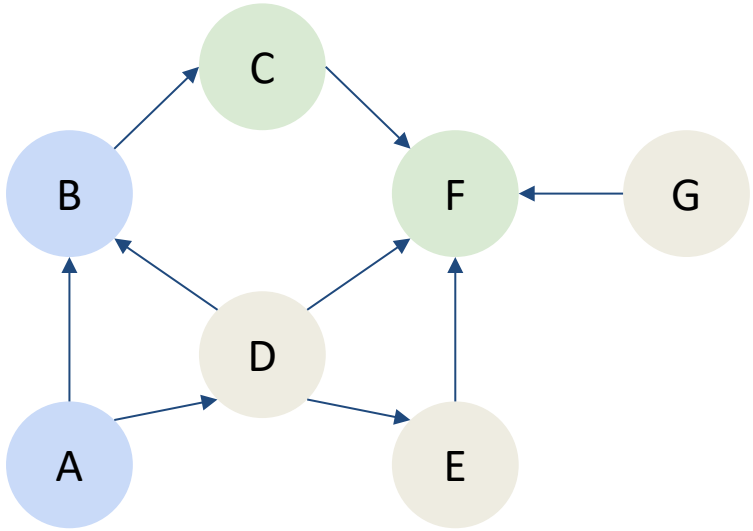
Stack: A, B, C, F



Stack: A, B, C

DFS Pre-Order:
A, B, C, F

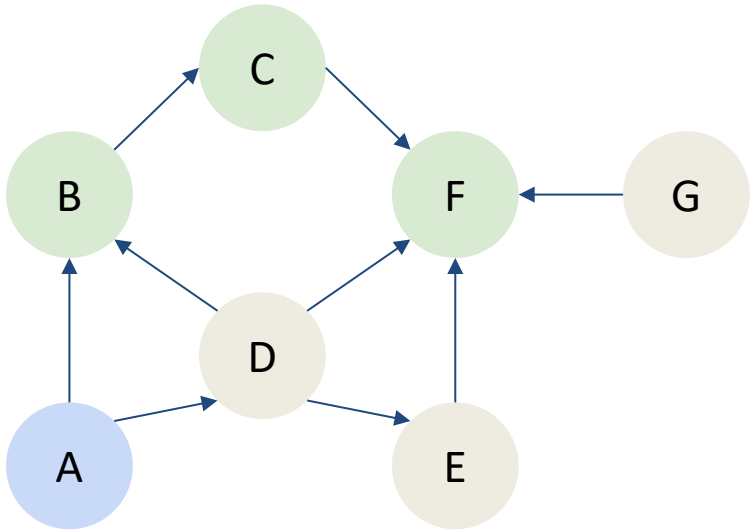
DFS Post-Order:
F



DFS Pre-Order:
A, B, C, F

DFS Post-Order:
F, C

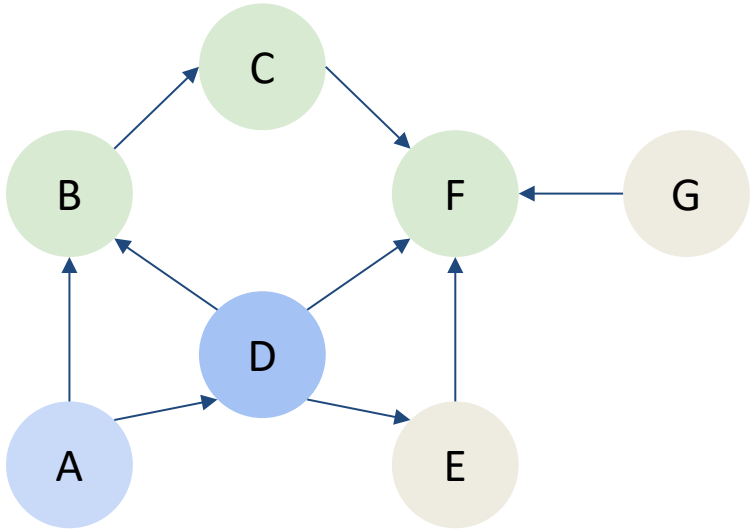
Stack: A, B



DFS Pre-Order:
A, B, C, F

DFS Post-Order:
F, C, B

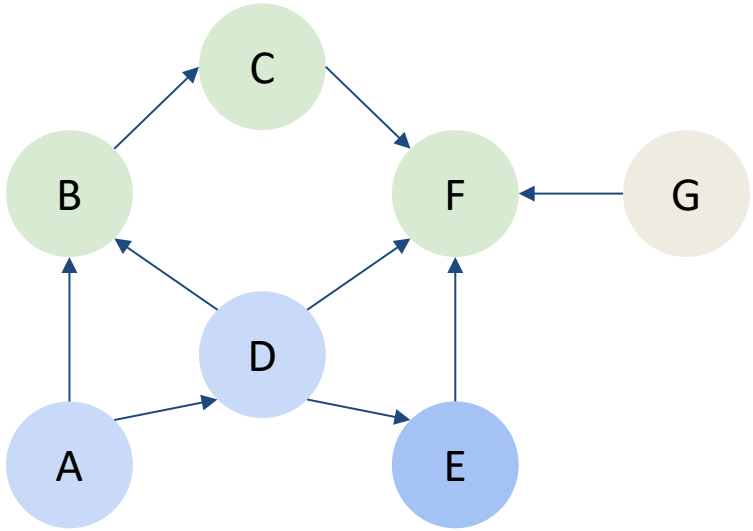
Stack: A



Stack: A, D

DFS Pre-Order:
A, B, C, F, D

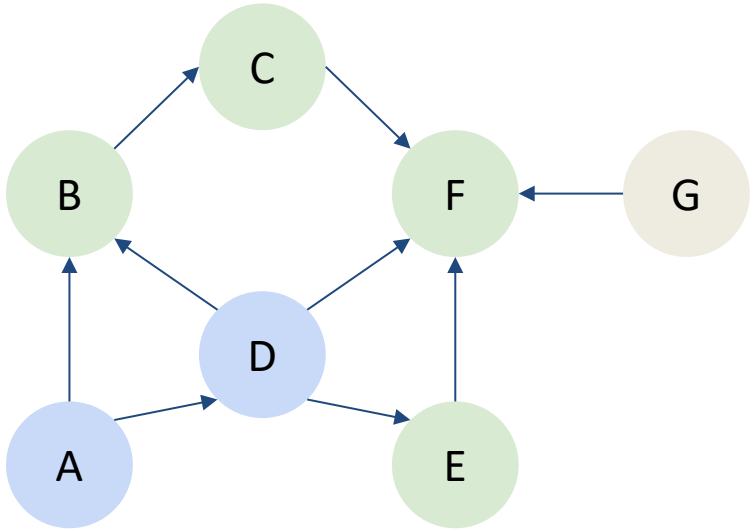
DFS Post-Order:
F, C, B



DFS Pre-Order:
A, B, C, F, D, E

DFS Post-Order:
F, C, B,

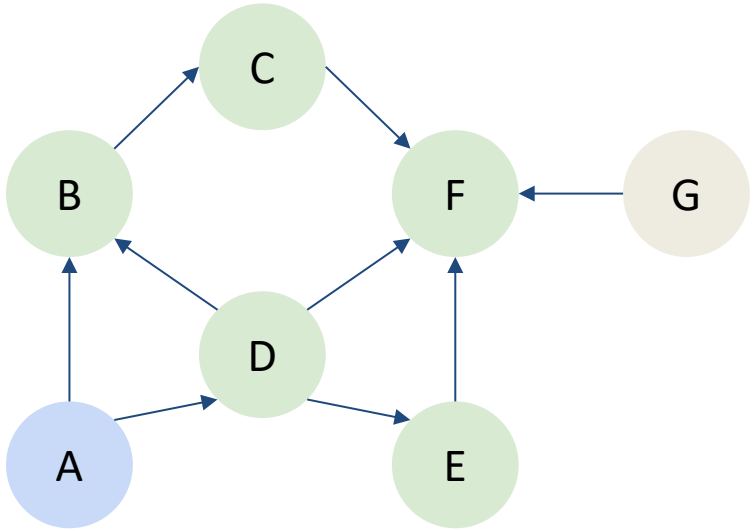
Stack: A, D, E



DFS Pre-Order:
A, B, C, F, D, E

DFS Post-Order:
F, C, B, E

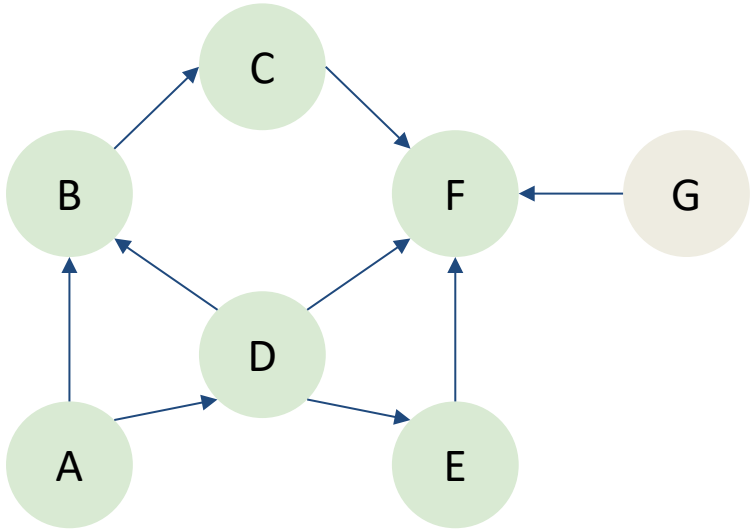
Stack: A, D



DFS Pre-Order:
A, B, C, F, D, E

DFS Post-Order:
F, C, B, E, D

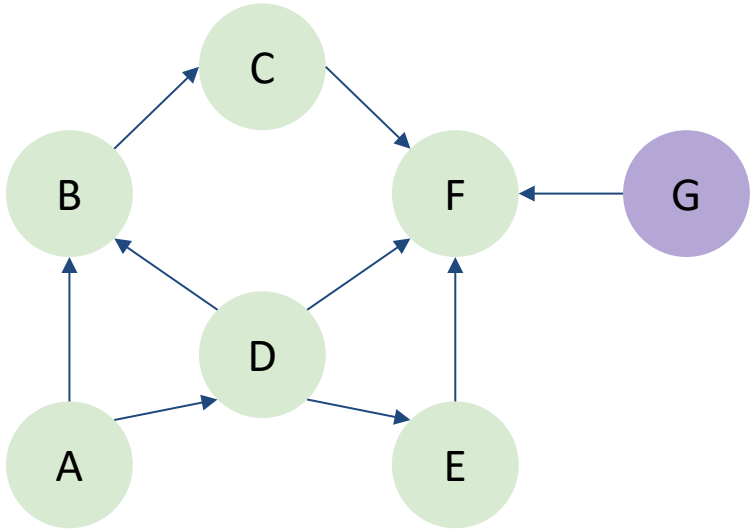
Stack: A,



DFS Pre-Order:
A, B, C, F, D, E

DFS Post-Order:
F, C, B, E, D, A

Stack:



Stack:

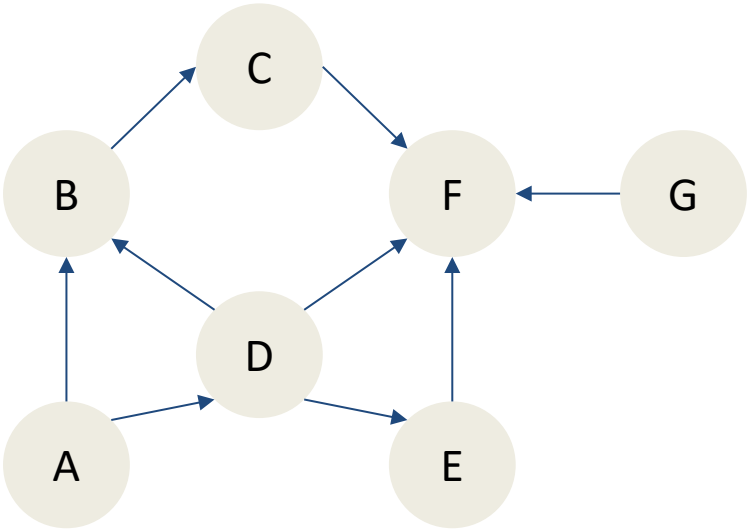
DFS Pre-Order:
A, B, C, F, D, E, G

DFS Post-Order:
F, C, B, E, D, A, G

Toplogical Sort (reverse of DFS Post-Order):
G, A, D, E, B, C, F

* After visiting F, restart on unmarked node G. G would be added to the stack (and forming the last element in both pre-order and post-order traversals)

Q: Graph Traversals (BFS)

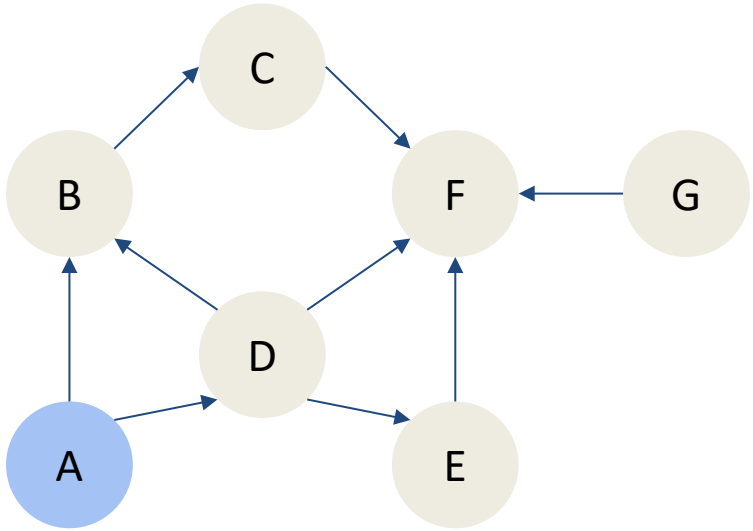


Give the BFS traversal of this directed graph, starting from node A. When there are muliple possible orders of visiting the next node, select the next node in alphabetical order.

BFS:

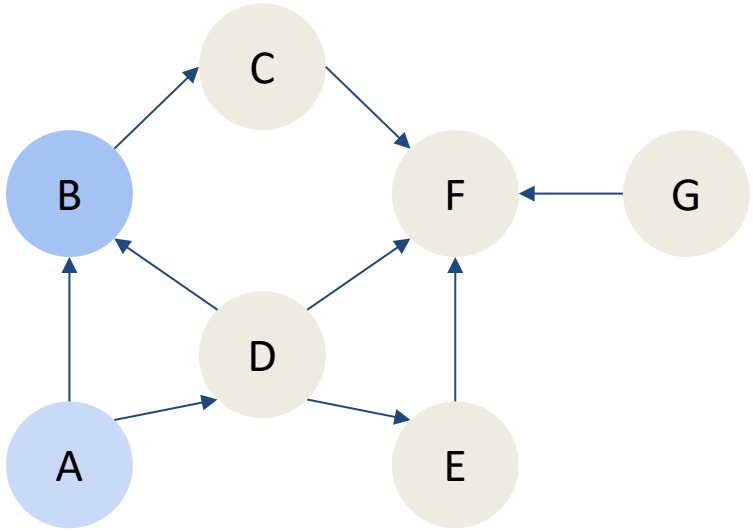
Queue: A

You do NOT need to write out the stack or queue contents in the exam



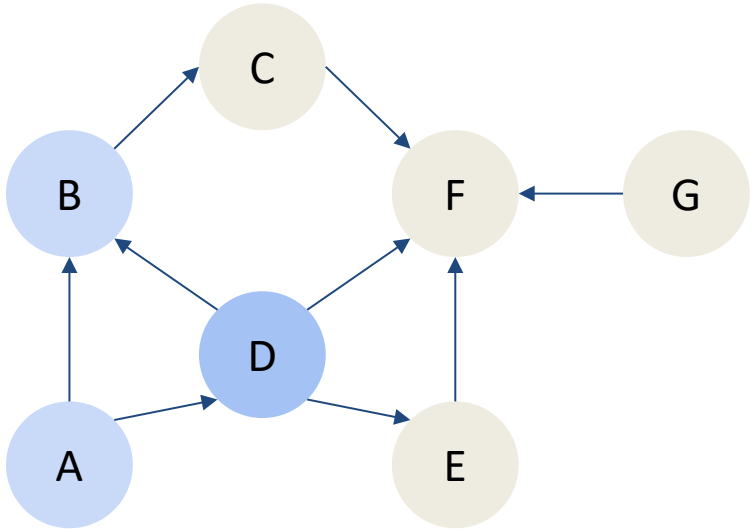
BFS:
A

Queue: B D



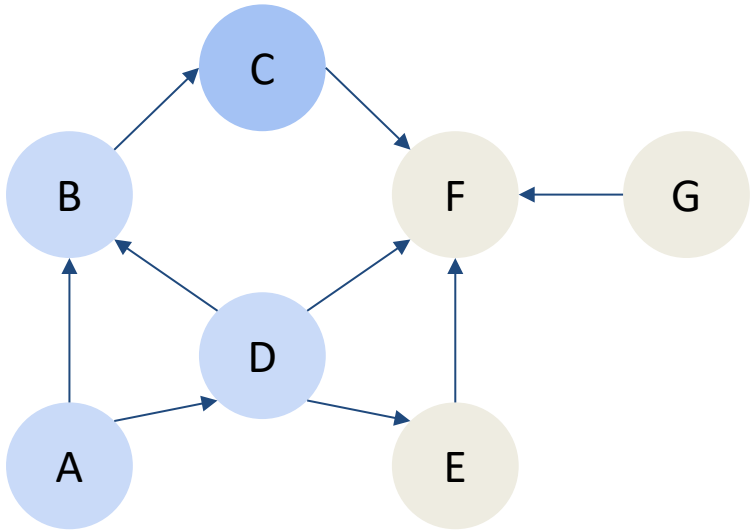
BFS:
A B

Queue: D C



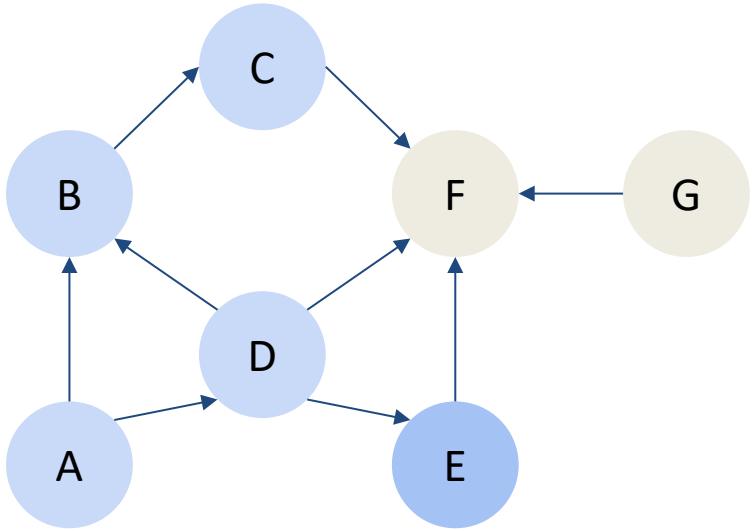
BFS:
A B D

Queue: C E F



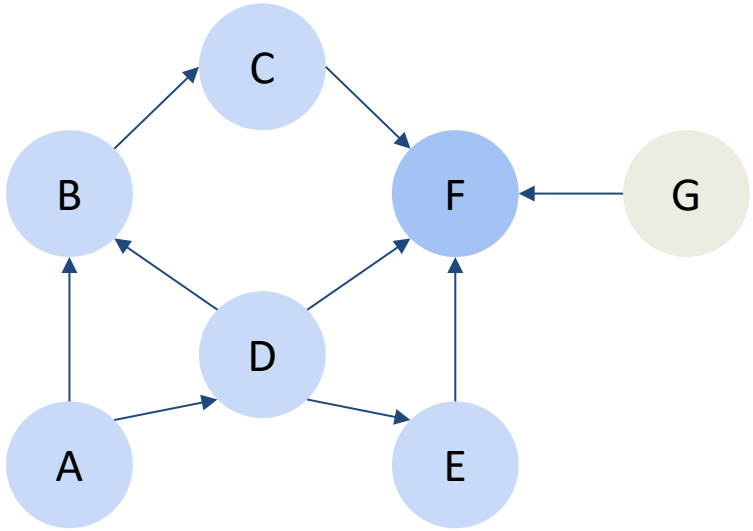
BFS:
A B D C

Queue: E F



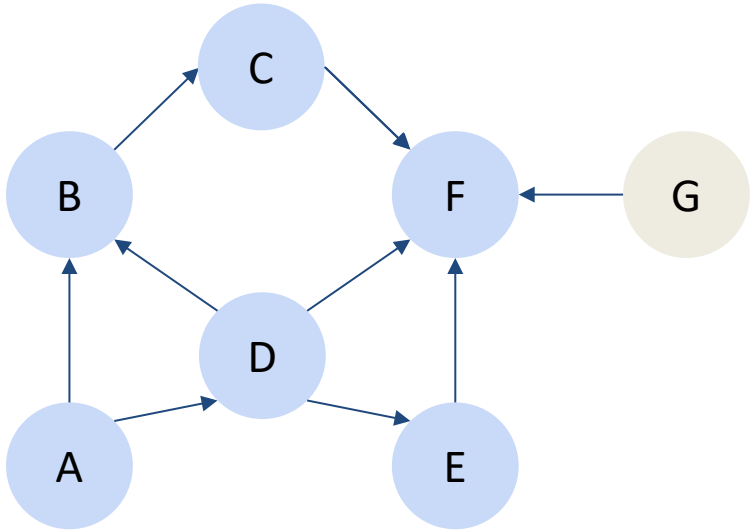
BFS:
A B D C E

Queue: F



BFS:
A B D C E F

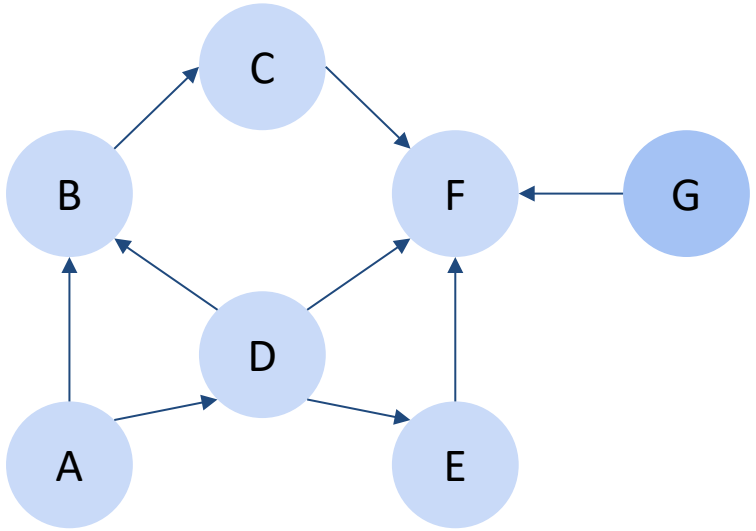
Queue:



BFS:
A B D C E F

Queue: G

Q: Graph Traversals (BFS) ANS

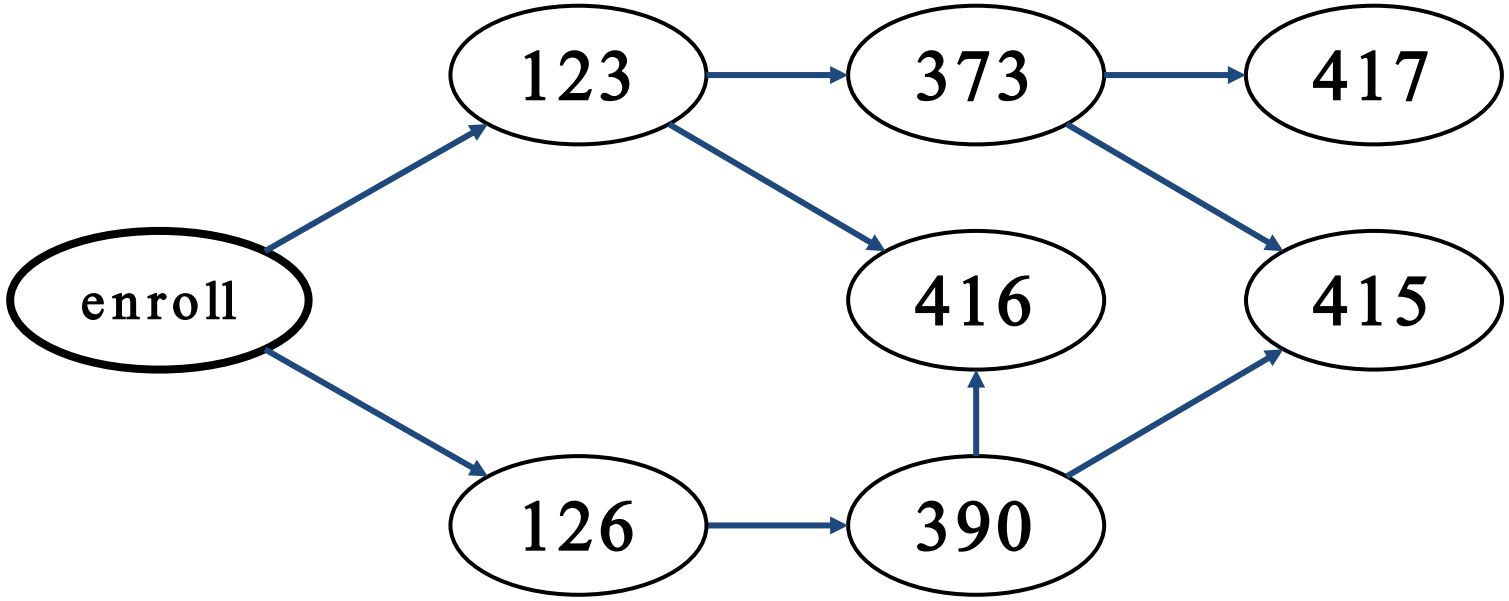


BFS:
A B D C E F G

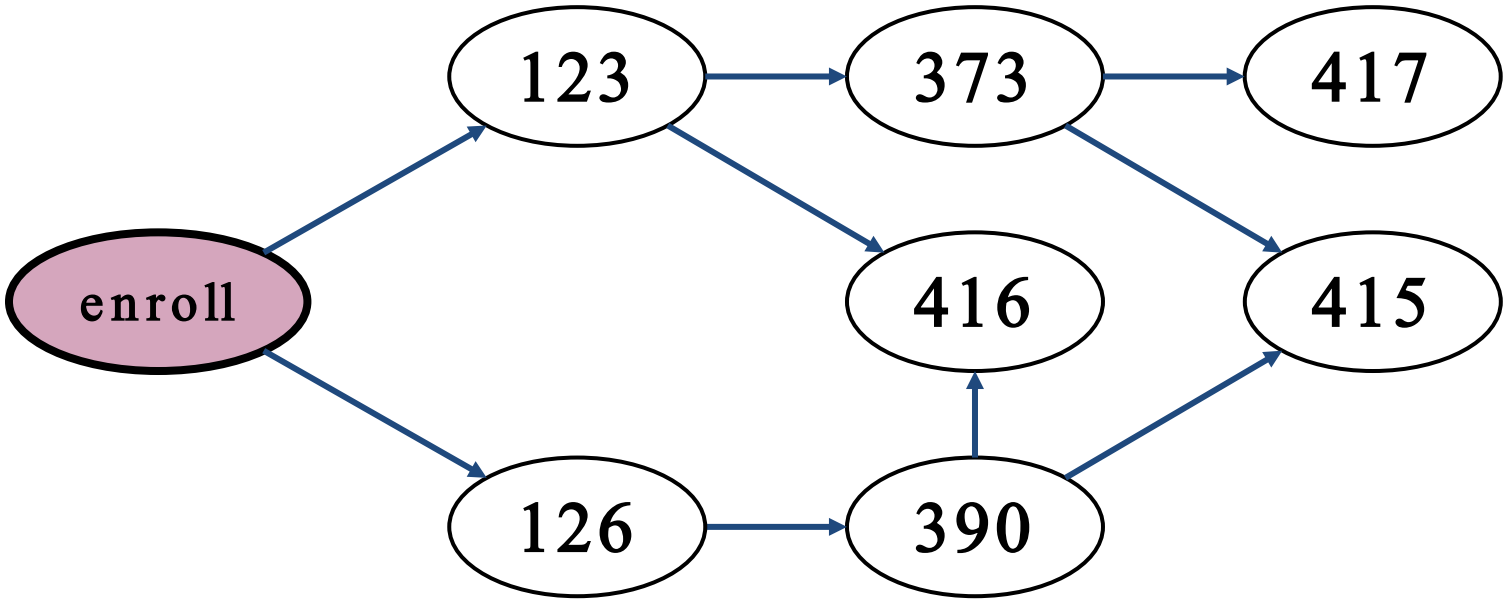
Queue:

Q. Topological Sort

Give the DFS pre-order and post-order traversals, and a topological sort of this directed graph for prerequisite courses, starting from node "enroll".



Q. Topological Sort

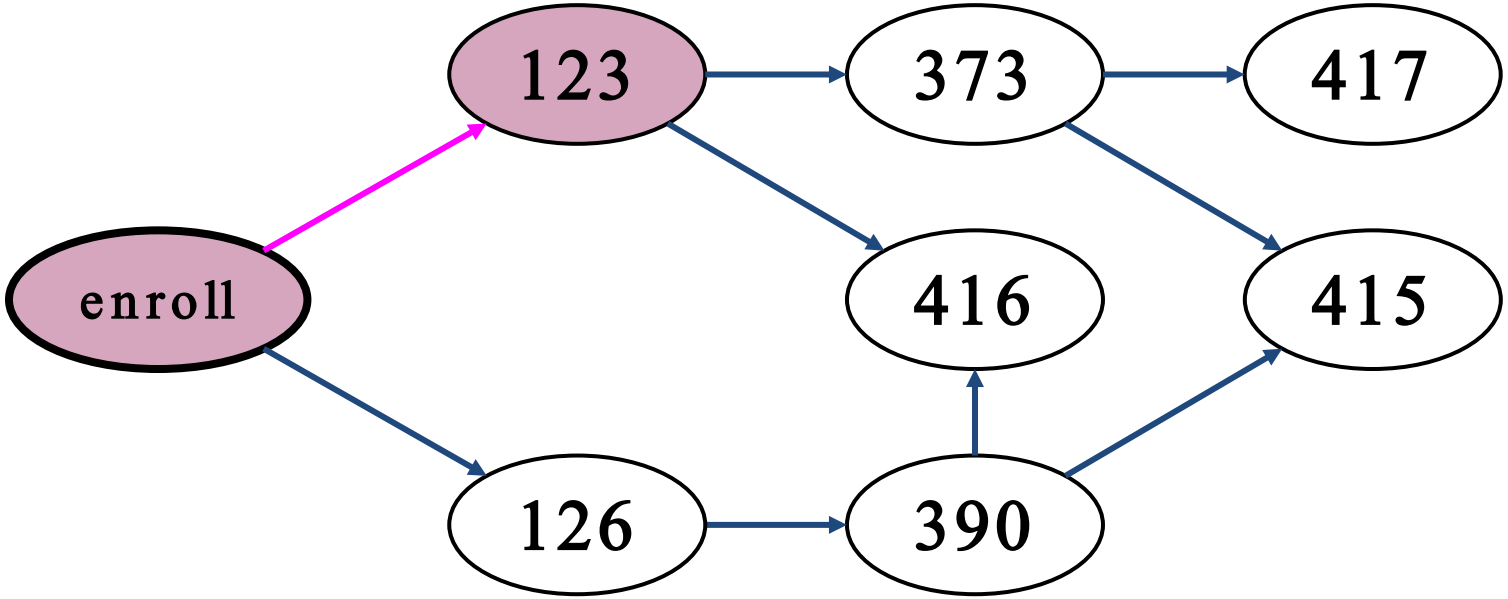


Pre-order

Post-order

Visited							
List							

Q. Topological Sort

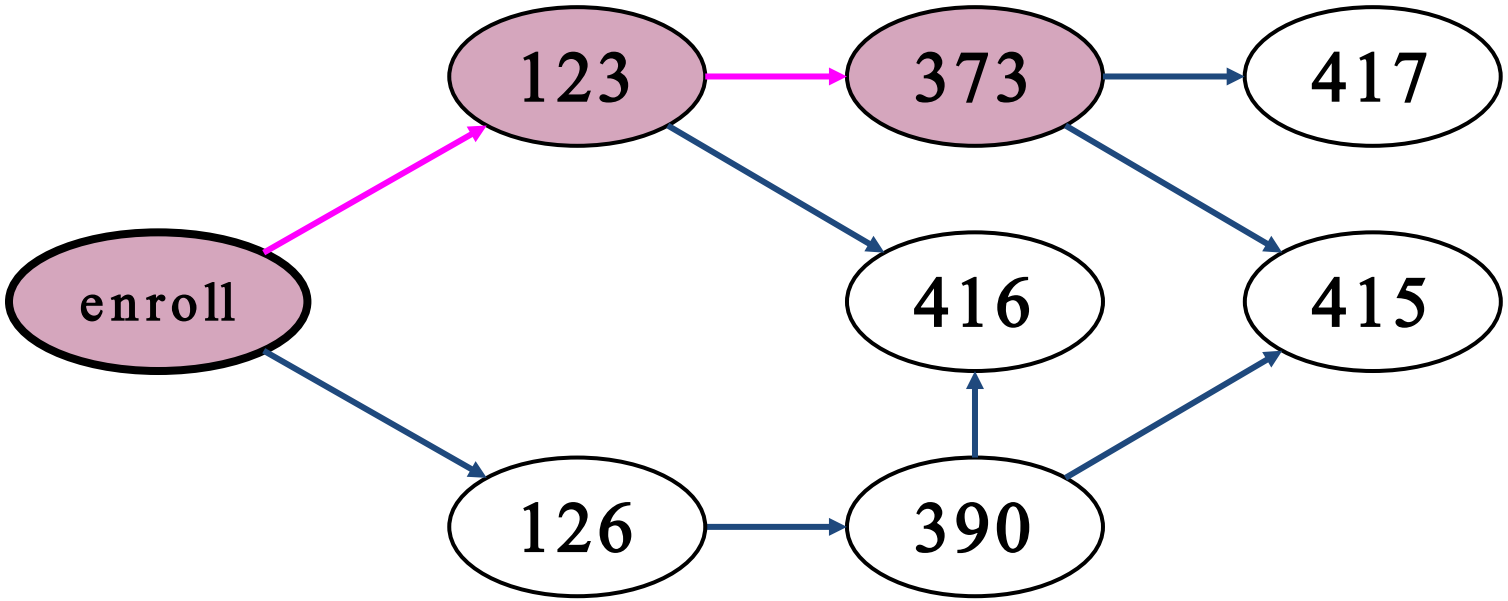


Pre-order

Post-order

Visited	123						
List							

Q. Topological Sort

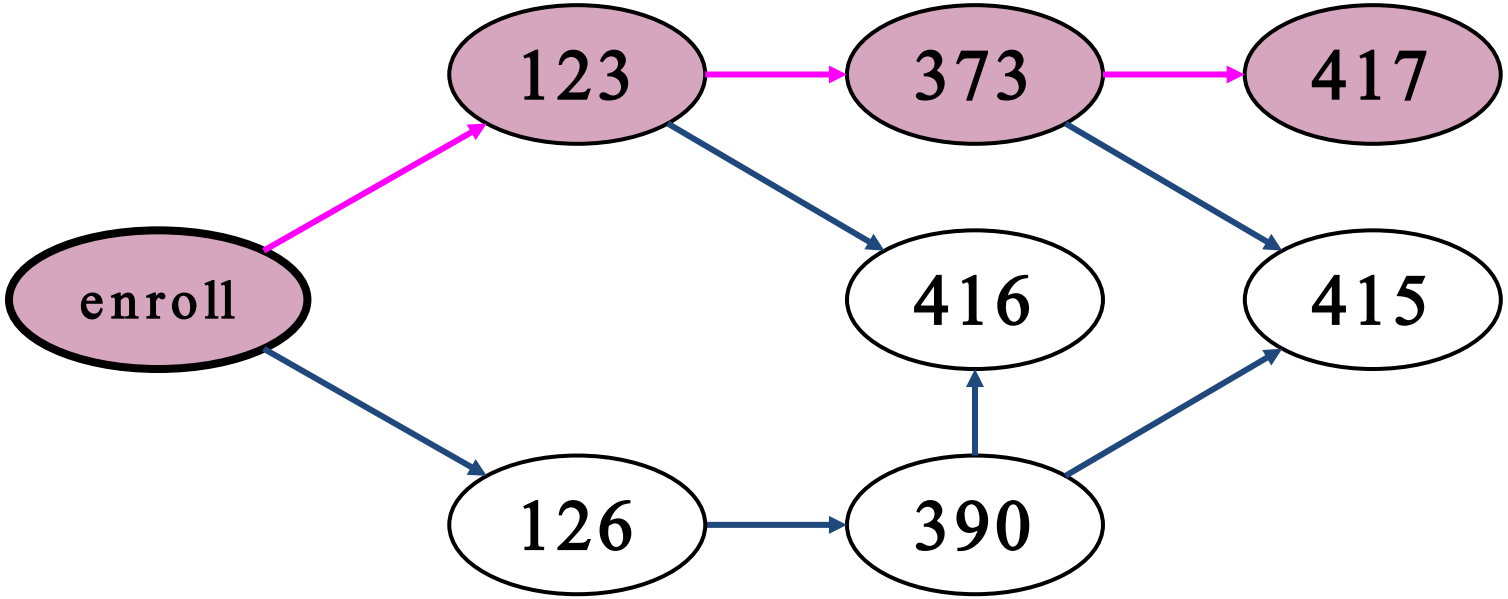


Pre-order

Post-order

Visited	123	373					
List							

Q. Topological Sort

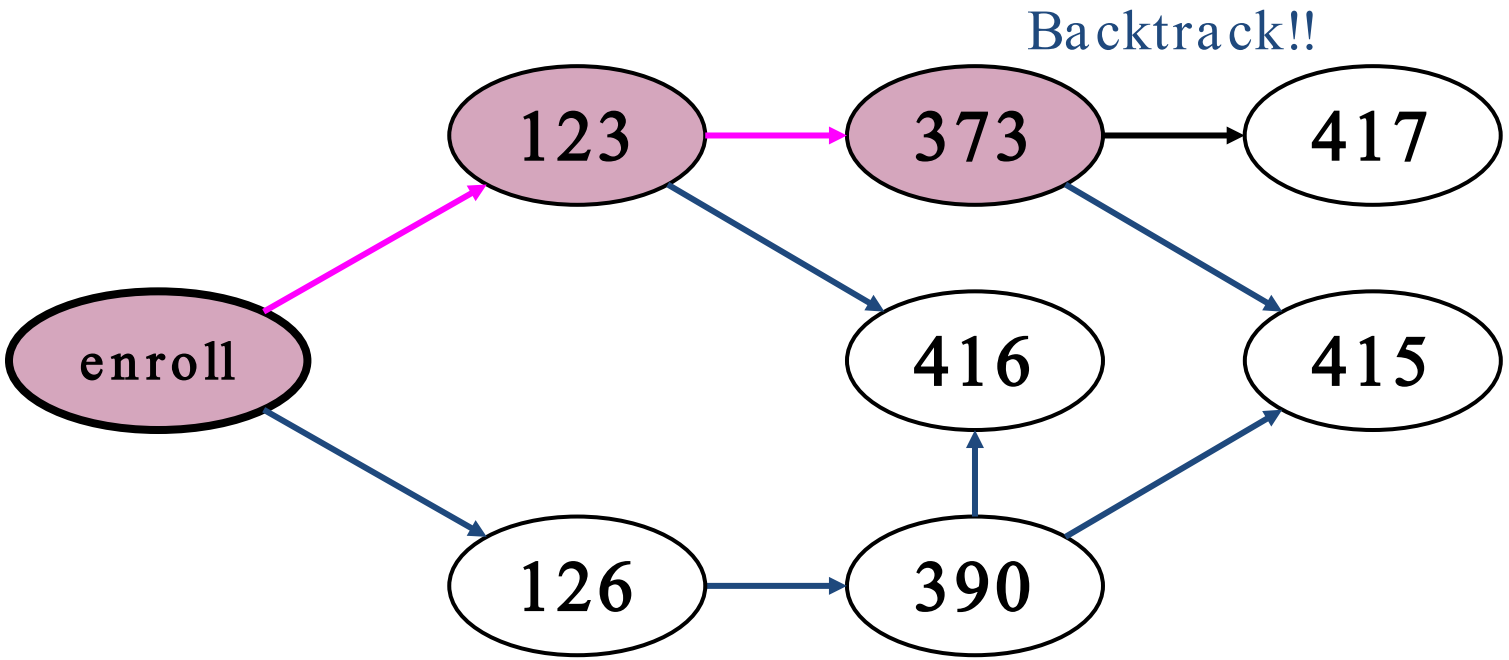


Pre-order

Post-order

Visited	123	373	417				
List							

Q. Topological Sort

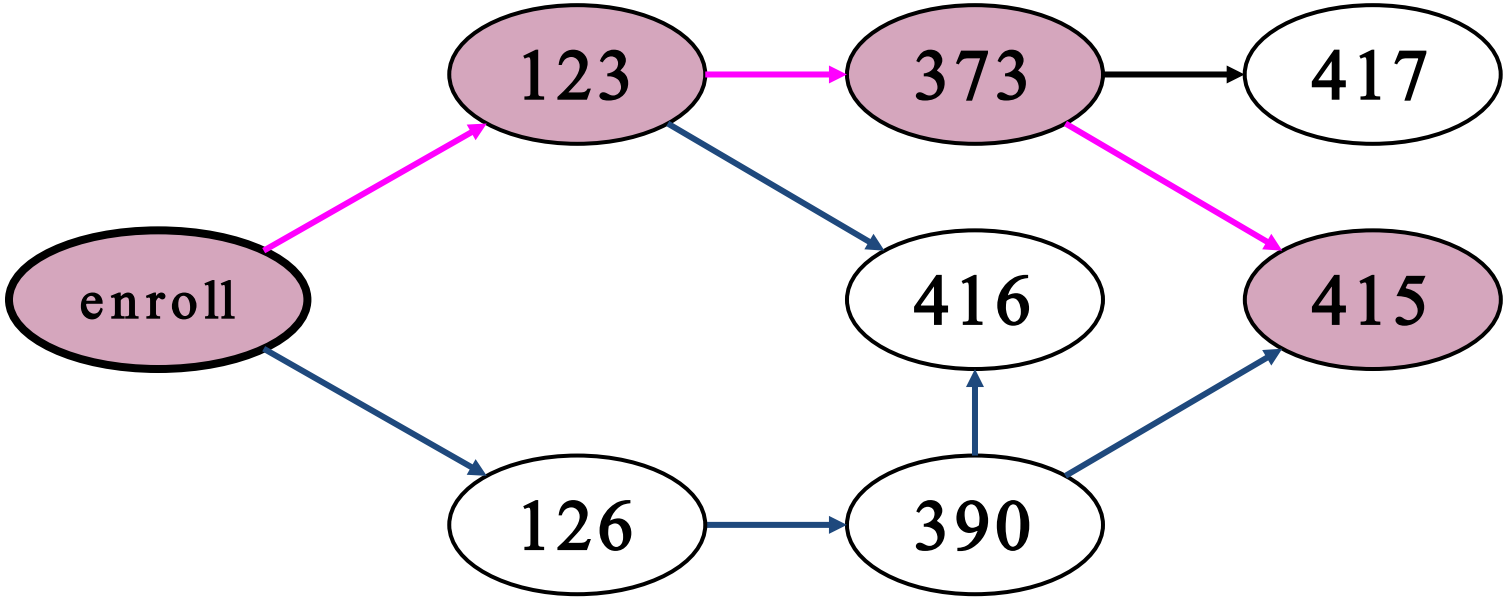


Pre-order

Post-order

Visited	123	373	417				
List	417						

Q. Topological Sort

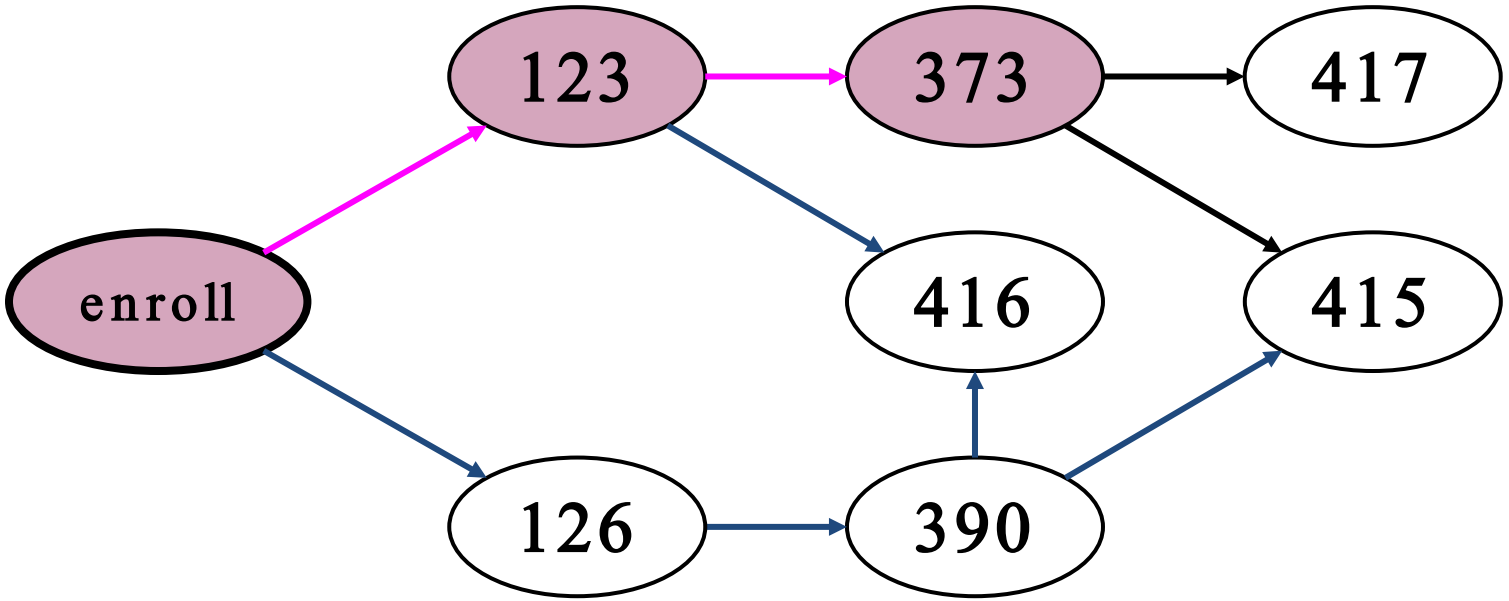


Pre-order

Post-order

Visited	123	373	417	415			
List	417						

Q. Topological Sort



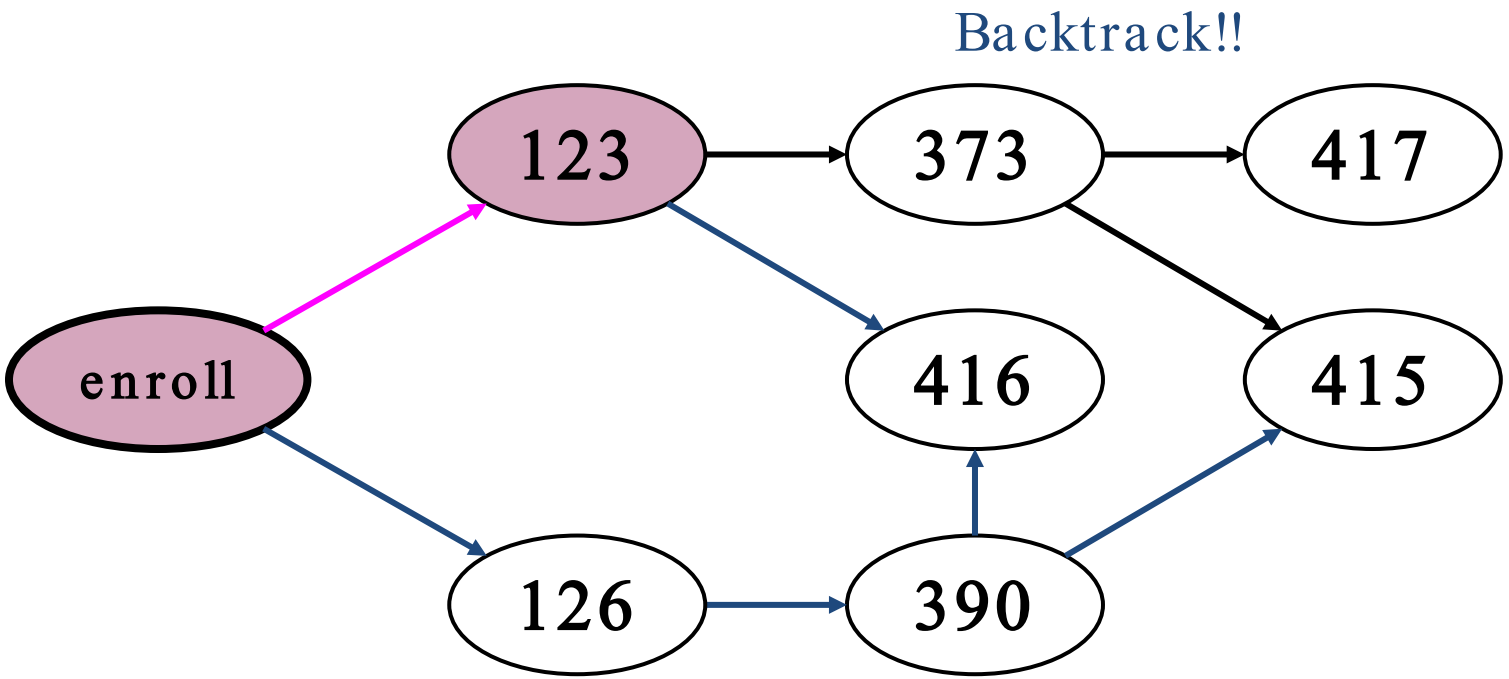
Backtrack!!

Pre-order

Post-order

Visited	123	373	417	415			
List	417	415					

Q. Topological Sort

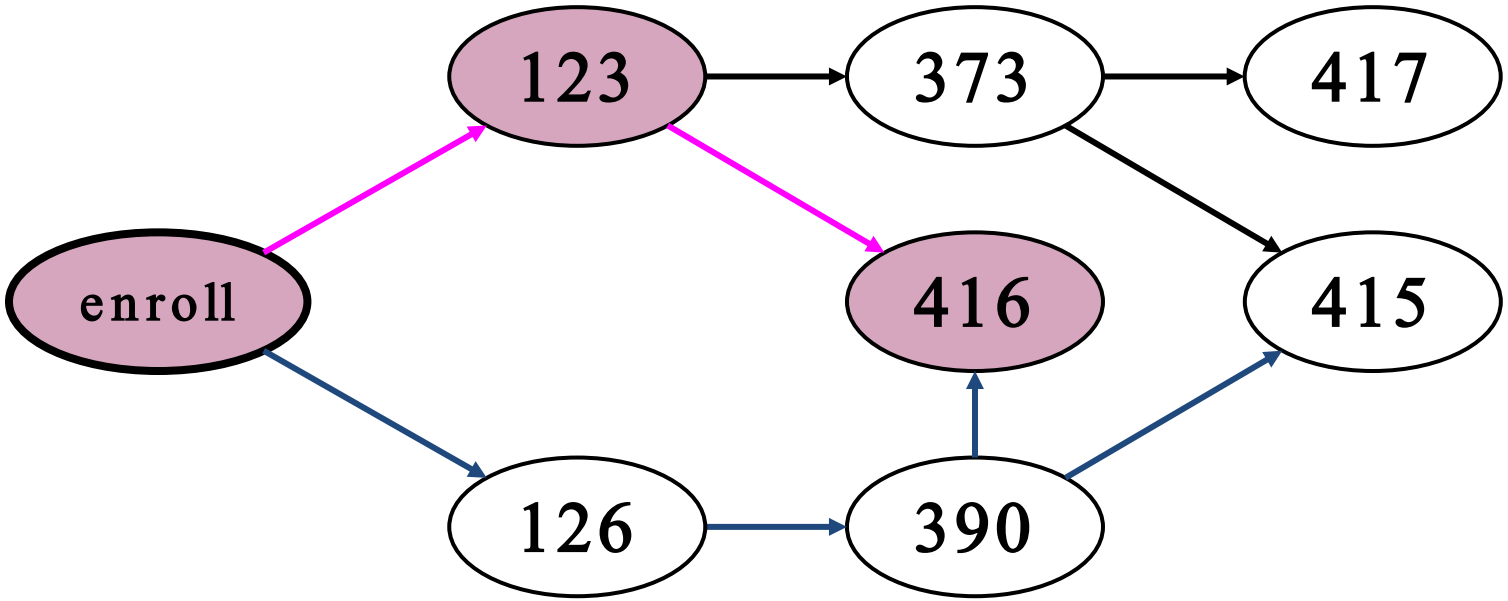


Pre-order

Post-order

Visited	123	373	417	415			
List	417	415	373				

Q. Topological Sort

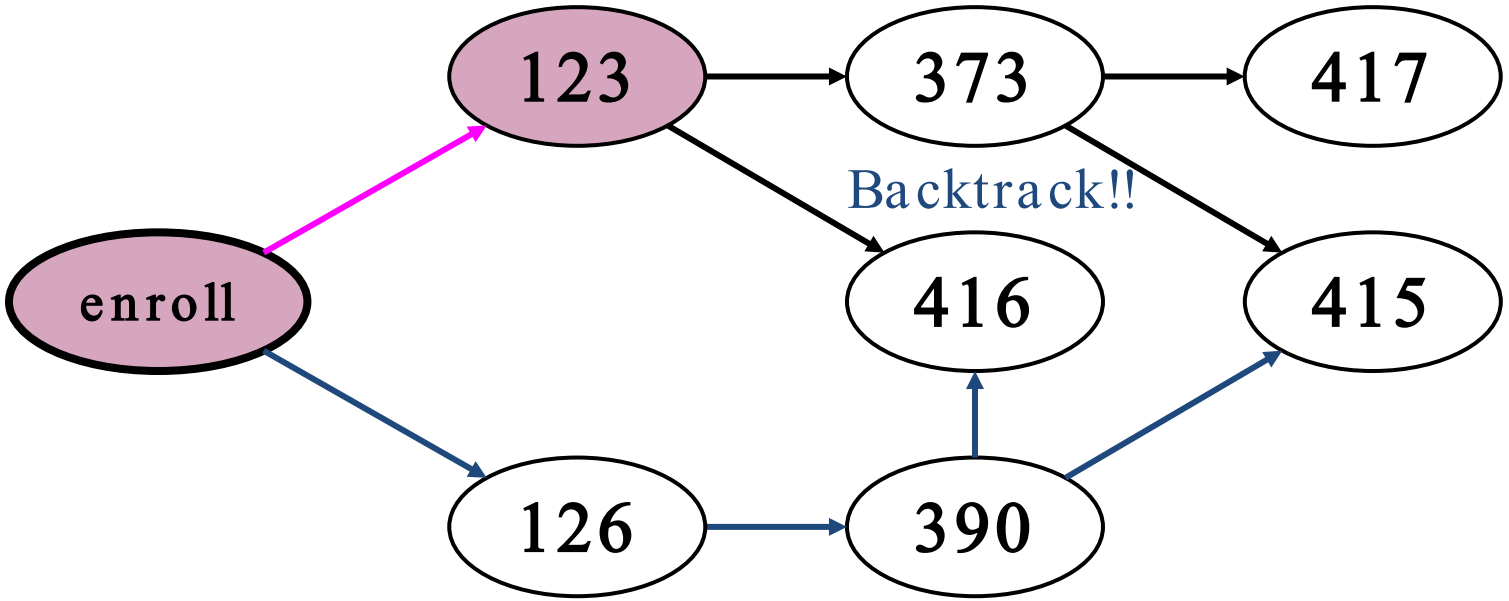


Pre-order

Post-order

Visited	123	373	417	415	416		
List	417	415	373				

Q. Topological Sort

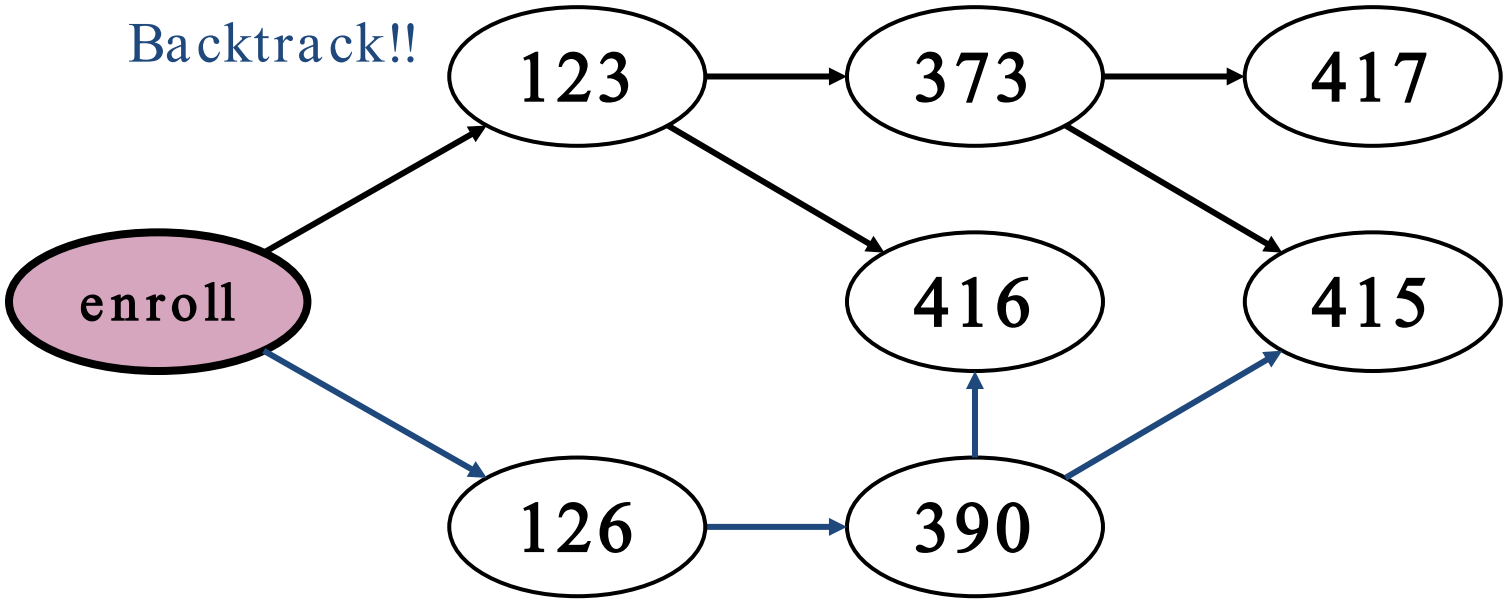


Pre-order

Post-order

Visited	123	373	417	415	416		
List	417	415	373	416			

Q. Topological Sort

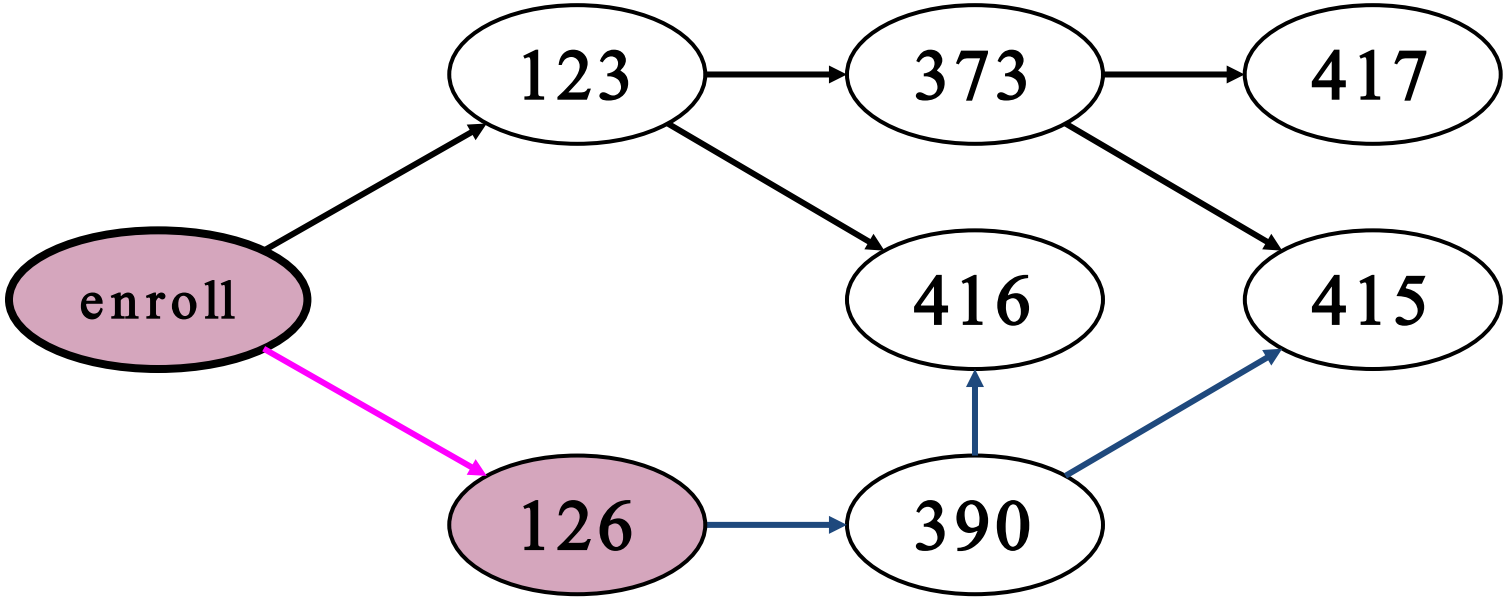


Pre-order

Post-order

Visited	123	373	417	415	416		
List	417	415	373	416	123		

Q. Topological Sort

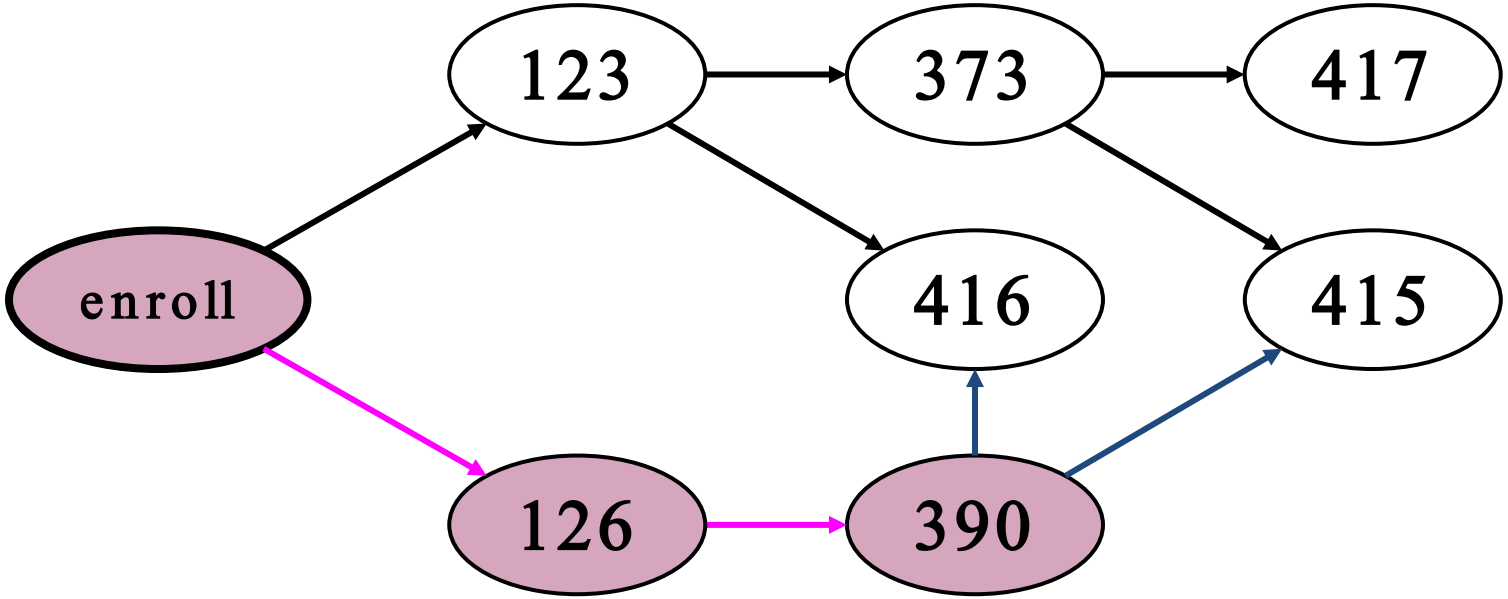


Pre-order

Post-order

Visited	123	373	417	415	416	126	
List	417	415	373	416	123		

Q. Topological Sort

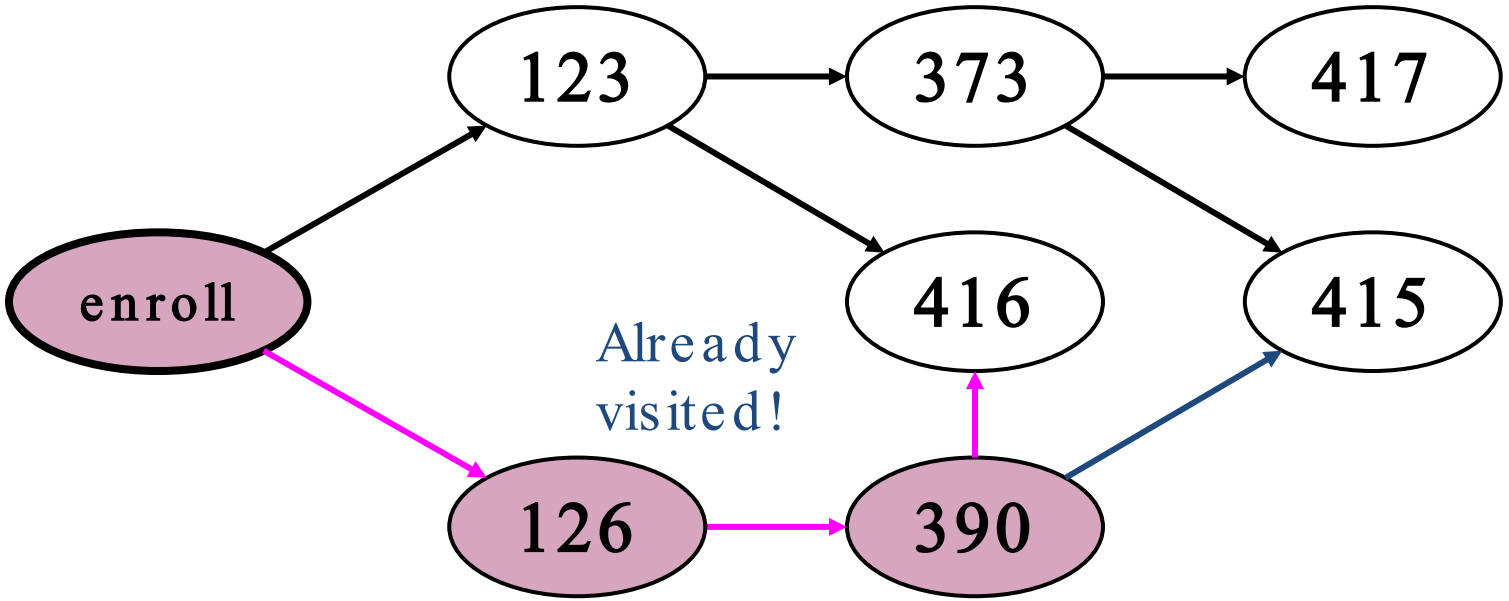


Pre-order

Post-order

Visited	123	373	417	415	416	126	390
List	417	415	373	416	123		

Q. Topological Sort

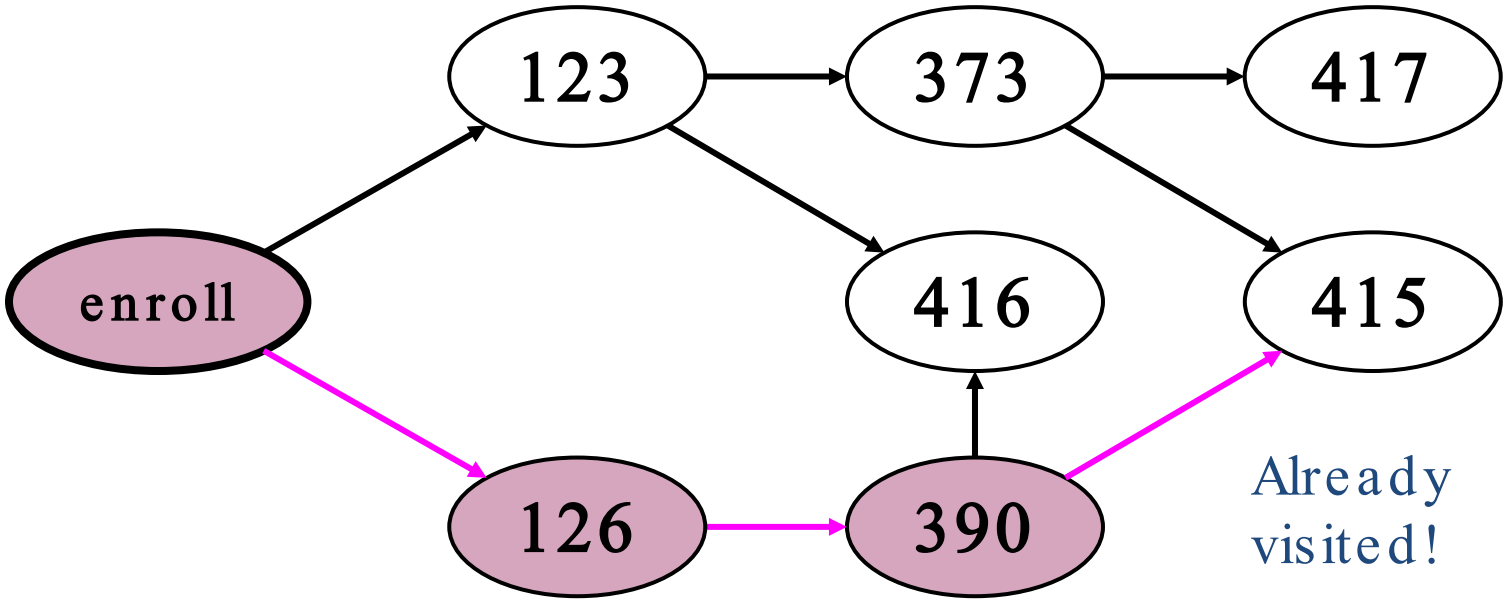


Pre-order

Post-order

Visited	123	373	417	415	416	126	390
List	417	415	373	416	123		

Q. Topological Sort

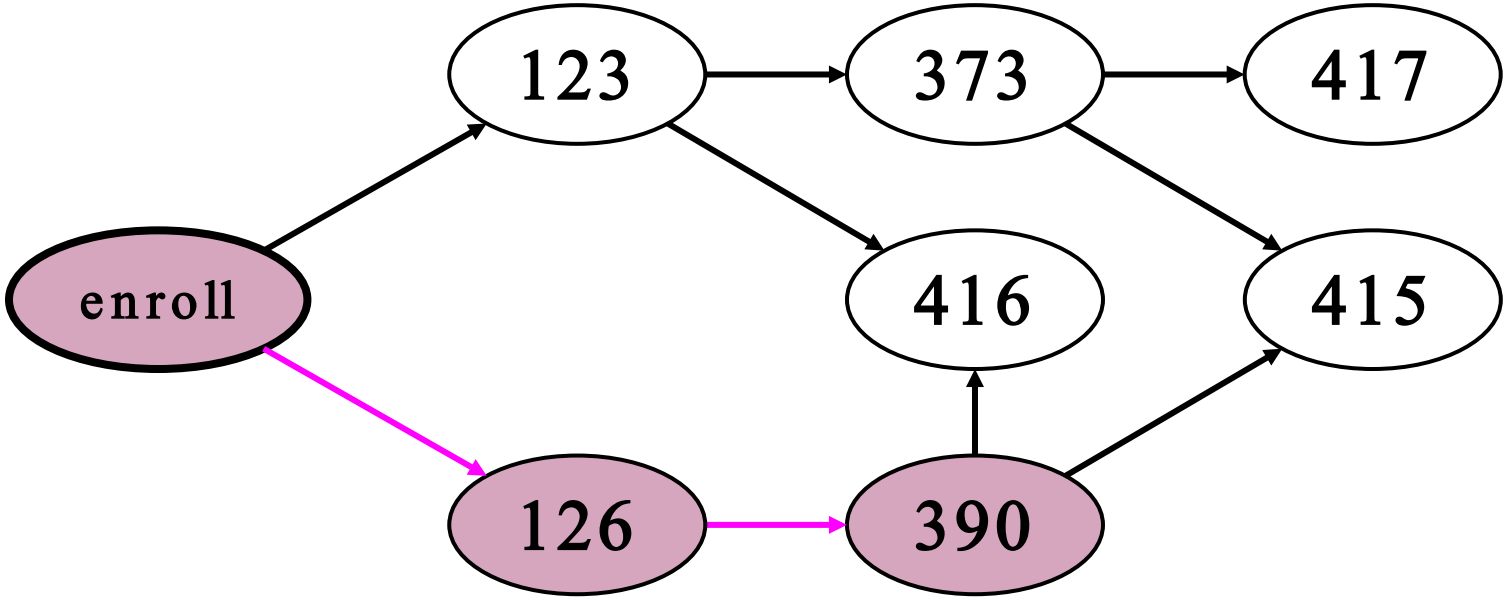


Pre-order

Post-order

Visited	123	373	417	415	416	126	390
List	417	415	373	416	123		

Q. Topological Sort

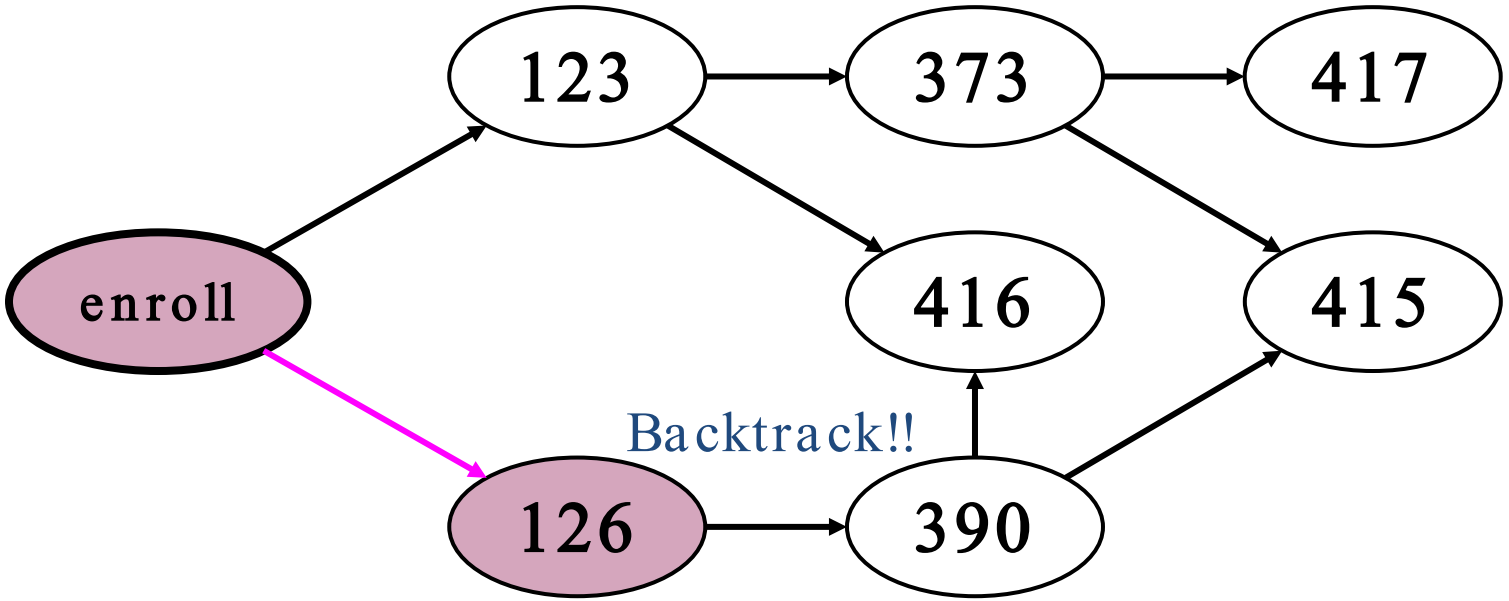


Pre-order

Post-order

Visited	123	373	417	415	416	126	390
List	417	415	373	416	123		

Q. Topological Sort

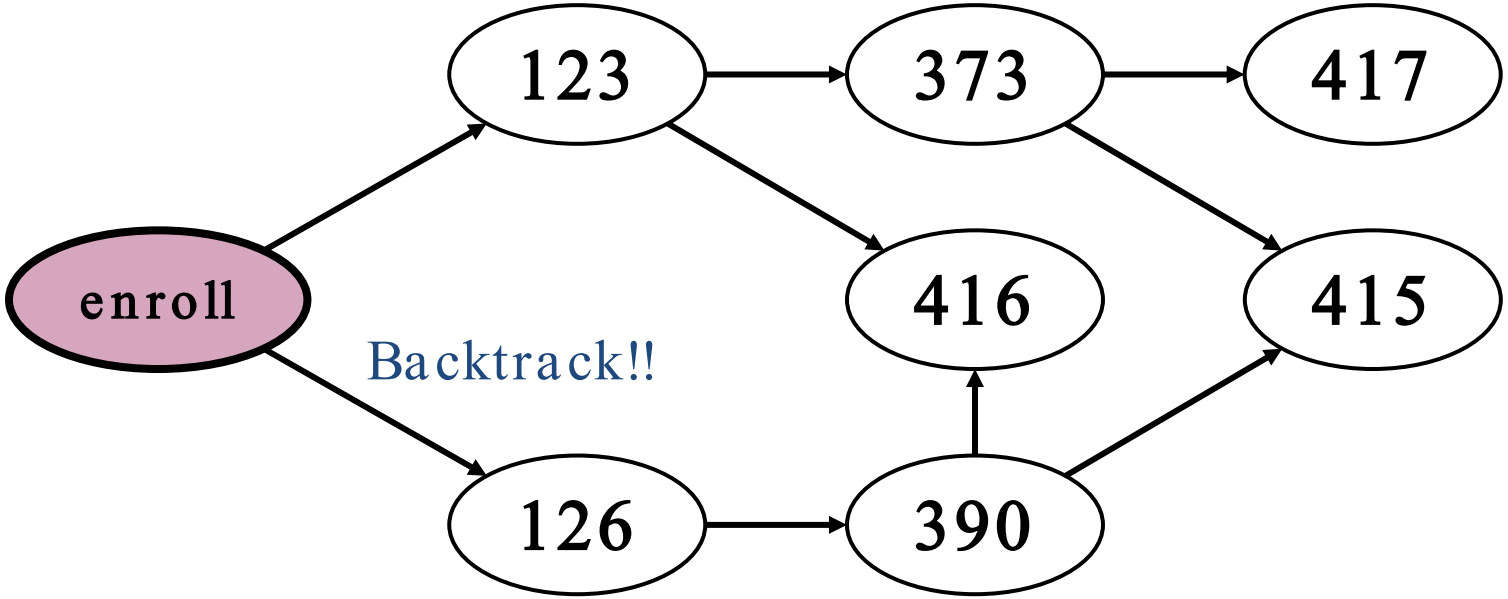


Pre-order

Post-order

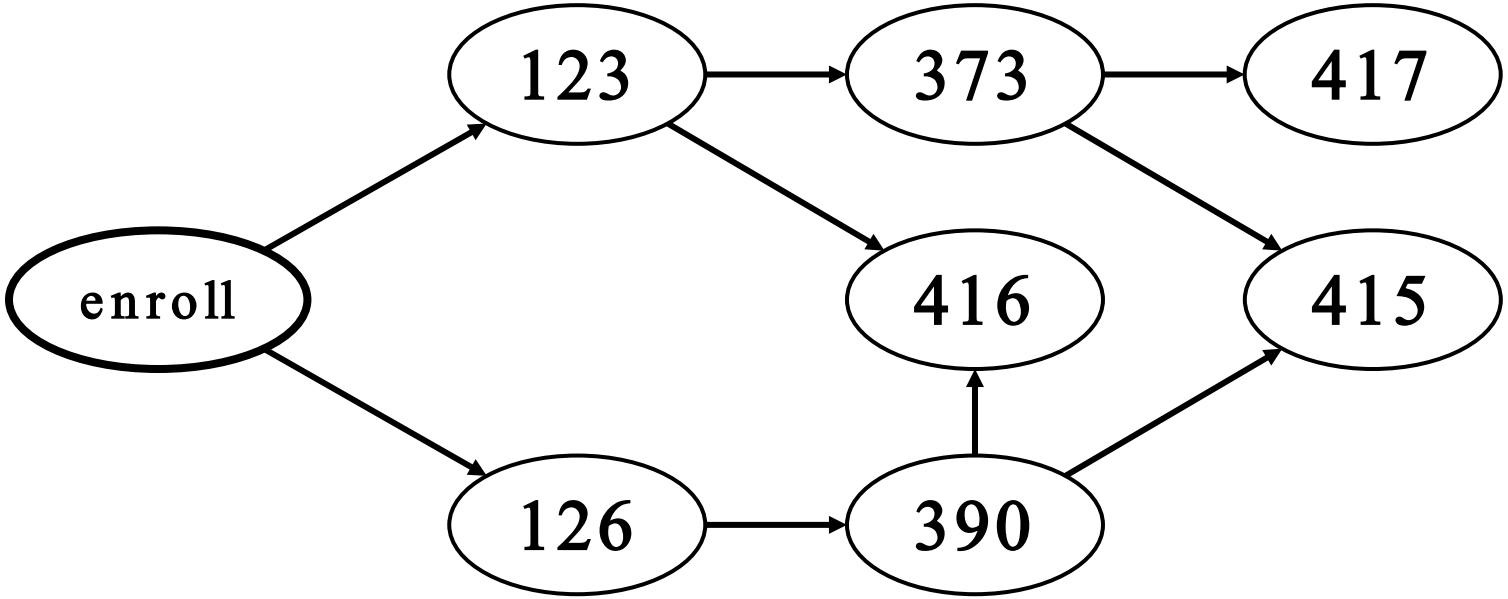
Visited	123	373	417	415	416	126	390
List	417	415	373	416	123	390	

Q. Topological Sort



Pre-order	**Visited**	123	373	417	415	416	126	390
Post-order	**List**	417	415	373	416	123	390	126

Q. Topological Sort

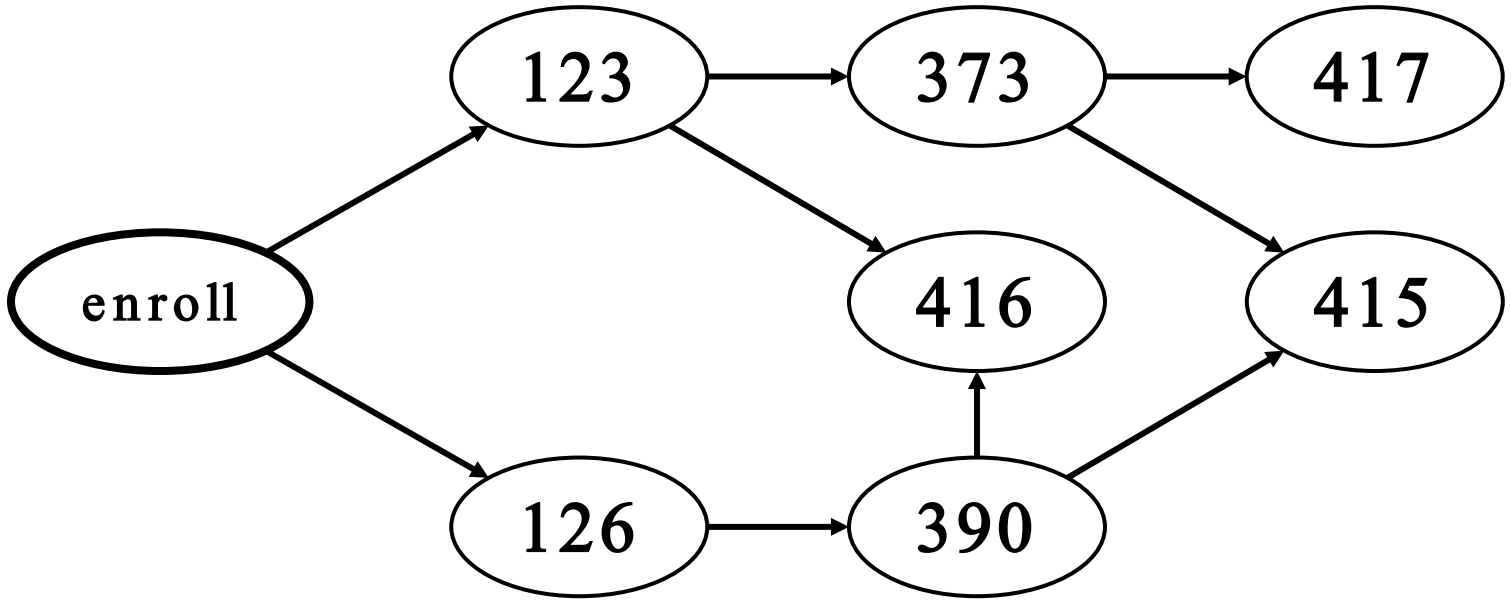


Pre-order

Post-order

Visited	123	373	417	415	416	126	390
List	417	415	373	416	123	390	126

Q. Topological Sort Final ANS



Topological order

[enroll, 126, 390, 123, 416, 373, 415, 417]
(Initial node "enroll" is omitted from the table, but you can also add it)

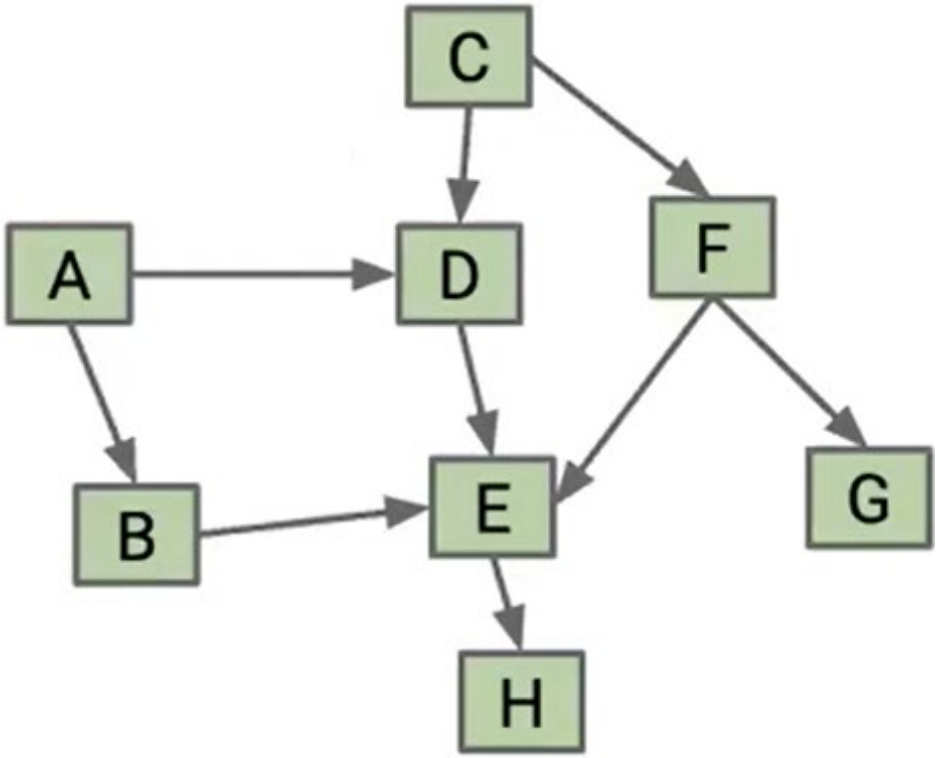
Pre-order

Post-order

Visited	123	373	417	415	416	126	390
List	417	415	373	416	123	390	126

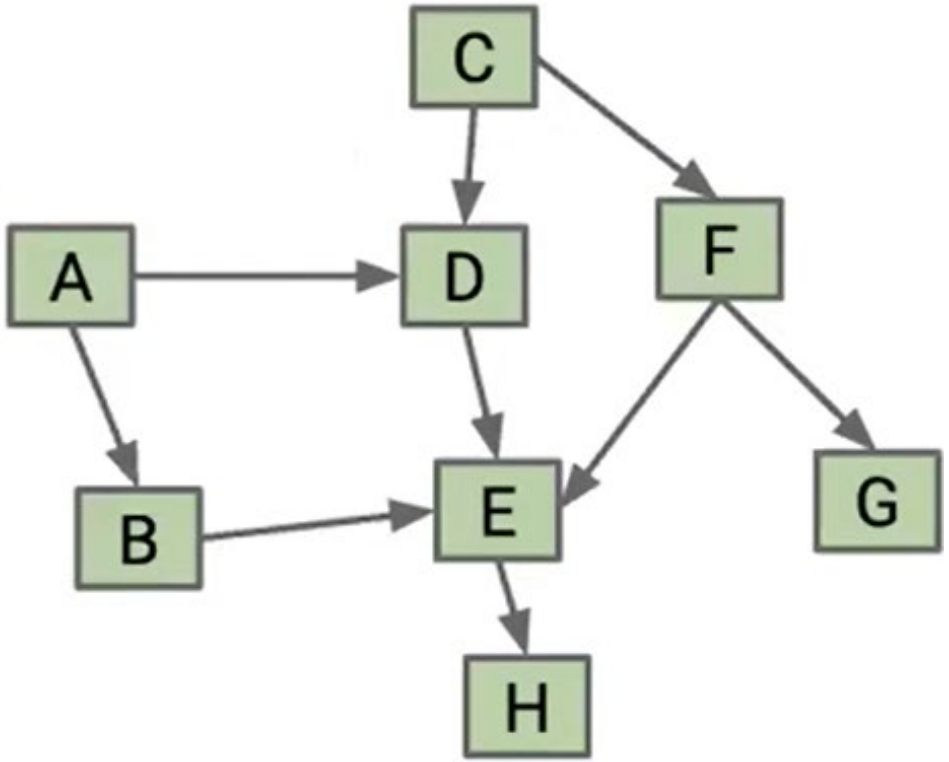
Q. Graph Traversal (Directed Graph)

Give the BFS, DFS pre-order and post-order traversals, and a topological sort of this directed graph, starting from either A or C. When there are muliple possible orders of visiting the next node, select the next node in alphabetical order.



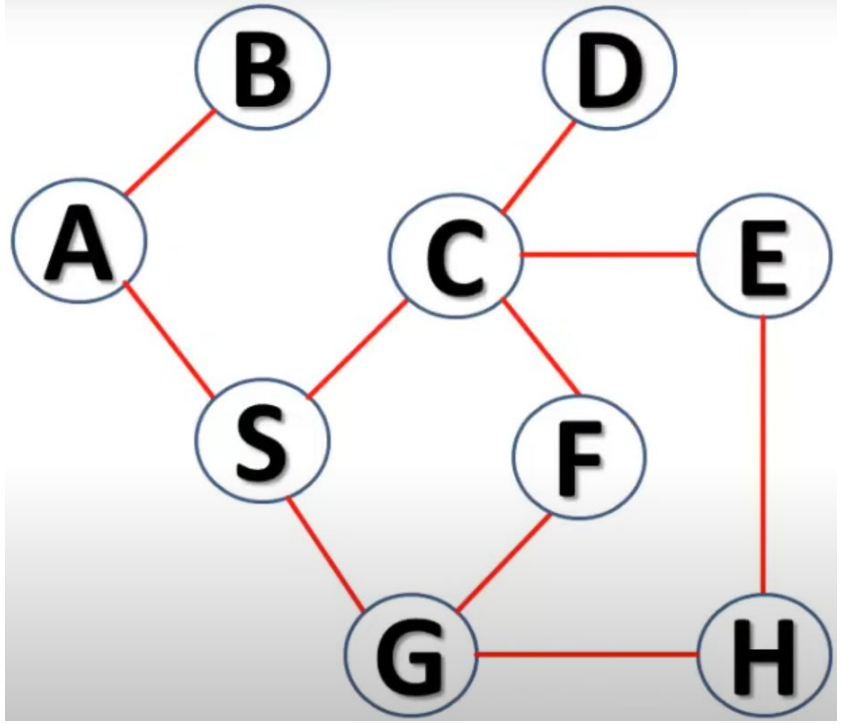
Q. Graph Traversal (Directed Graph) ANS

- Starting from node A:
  - Pre-order traversal: (A, B, E, H, D, C, F, G)
  - Post-order traversal: (H, E, B, D, A, G, F, C)
  - Topological Sort: (C, F, G, A, D, B, E, H)
  - BFS: (A, B, D, E, H, C, F, G)
- Starting from node C, ‘
  - Pre-order traversal: (C, D, E, H, F, G, A, B)
  - Post-order traversal: (H, E, B, D, A, G, F, C)
  - Topological Sort: (C, F, G, A, D, B, E, H)
  - BFS: (C, D, F, E, G, H, A, B)



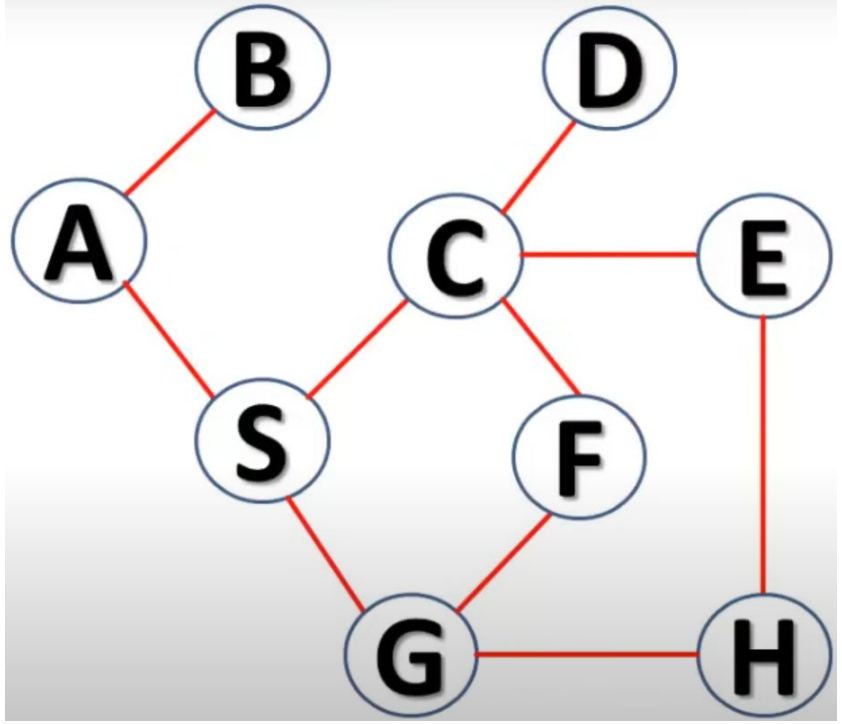
Q. Graph Traversal (Undirected Graph)

Give the BFS, DFS pre-order and post-order traversals of this undirected graph, starting from either A. When there are muliple possible orders of visiting the next node, select the next node in alphabetical order.



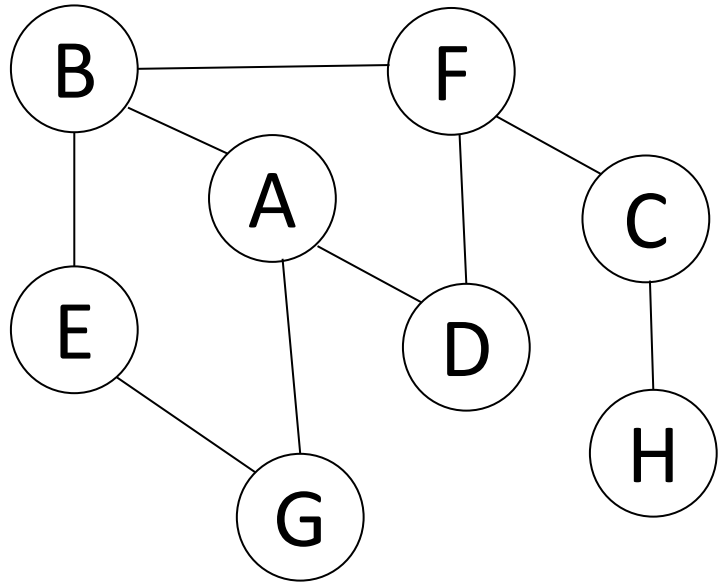
Q. Graph Traversal (Undirected Graph) ANS

- Starting from node A:
  - Pre-order traversal: A B S C D E H G F
  - Post-order traversal: B D F G H E C S A
  - BFS: A B S C G D E F H
  - (Topological Sort: N/A, since it is only for DAG)
- Depth First Search Algorithm, Go GATE IIT
  - https://www.youtube.com/watch?v=iaBEKo5sM7w
  - The video illustrates pre-order traversal with a stack. The post-order traversal is obtained in the order that the nodes are popped off the stack, (c.f., Slide 29 "DFS Traversals and Topological Sort" in Lecture 12-graphs.pdf)



Q. Graph Traversal (Undirected Graph)

Give the BFS, DFS pre-order and post-order traversals of this undirected graph, starting from A. When there are muliple possible orders of visiting the next node, select the next node in alphabetical order.



Q. Graph Traversal (Undirected Graph)

- Starting from node A:
  - Pre-order traversal: A B E G F C H D
  - Post-order traversal: G E B H C F D A
  - BFS: A B D G E F C H
  - (Topological Sort: N/A, since it is only for DAG)
- Graph Traversals - Breadth First and Depth First
  - https://www.youtube.com/watch?v=bIA8HEEUxZI