

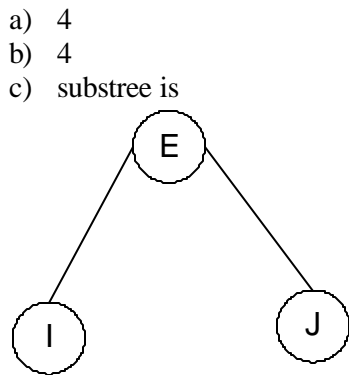
Exercise 6 for Trees & Graphs

1. In Figure 1
 - a) Which node is the root?
 - b) Which nodes are leaves?
 - c) Name the parent node of J;
 - d) List the siblings of H;
 - e) List the left child of node E;

Answer:

- a) A
 - b) G H I J C
 - c) E
 - d) G
 - e) I
2. In Figure 1
 - a) Give the level of node I;
 - b) Give the depth of the tree;
 - c) List the subtree whose root is E.

Answer:



3. Give the pre-order, in-order, post-order, level-order tree traversal sequences for the expression tree in Figure 2.

Answer:

pre-order: - * * ab + cd e
 in-order: a*b*c+d-e
 post-order: ab*cd +*e-
 level-order: -*e *+ abcd

4. Give the array-based tree representation of Figure 2.

Answer:

NodeNum	item	LeftChild	rightChild
0	-	1	2
1	*	3	4
2	e	-1	-1
3	*	5	6
4	+	7	8
5	a	-1	-1
6	b	-1	-1
7	c	-1	-1
8	d	-1	-1
9	?	?	?

5. Show that in a binary tree of N nodes, there are $N+1$ *NULL* links representing children.

Answer:

There are N nodes in the binary tree. Each node has two links representing children, so there are $2N$ links representing children. Each node but the root has one incoming link from its parent, which accounts for $N-1$ links. The rest are *NULL* links. So $2N - (N-1) = N+1$ *NULL* links representing children.

6. Finding a topological ordering for the graph in Figure 3.

Answer:

s G D A H t
s G H D A t
s G D H A t
s G D H t A
s G H A t A

7. Finding the shortest path from A to all other vertices for the graph in Figure 4.

Answer:

A → B:5
A → C :3
A → B → G:6
A → B → G → E:7
A → B → G → E → D:9
A → B → G → E → F :8

8. Give the adjacency list and adjacency matrix for the undirected graph in Figure 5.

Answer:

adjacency list

A	→	B	→	C					
B	→	A	→	D	→	E	→	I	
C	→	A	→	J					
D	→	B	→	G	→	H			
E	→	B	→	I	→	J			
G	→	D	→	H					
H	→	D	→	G	→	J			
I	→	B	→	E					
J	→	E	→	C	→	H			

adjacency matrix

	A	B	C	D	E	G	H	I	J
A	0	1	1	0	0	0	0	0	0
B	1	0	0	1	1	0	0	1	0
C	1	0	0	0	0	0	0	0	1
D	0	1	0	0	0	1	1	0	0
E	0	1	0	0	0	0	0	1	1
G	0	0	0	1	0	0	1	0	0
H	0	0	0	1	0	1	0	0	1
I	0	1	0	0	1	0	0	0	0
J	0	0	1	0	1	0	1	0	0

9. Following the stack implementation of DFS and the queue implementation of BFS (see lecture notes), draw a table for each procedure to show the detailed operations of DFS and BFS for the graph in Figure 5. The start point is A.

Answer:

the stack implementation of DFS

Visit	Stack
A	A
B	AB
D	ABD
G	ABDG
H	ABDGH
J	ABDGHJ
C	ABDGHJC
backtrack	ABDGHJ
E	ABDGHJE
I	ABDGHJEI
backtrack	ABDGHJE
backtrack	ABDGHJ
backtrack	ABDGH
backtrack	ABDG
backtrack	ABD
backtrack	AB
backtrack	A
	empty

the queue implementation of BFS

Visit	Queue (front to back)
A	A
	empty
B	B
C	BC
D	CD
I	CDI
E	CDIE
J	DIEJ
G	IEJG
H	IEJGH
	EJGH
	JGH
	GH
	H
	empty

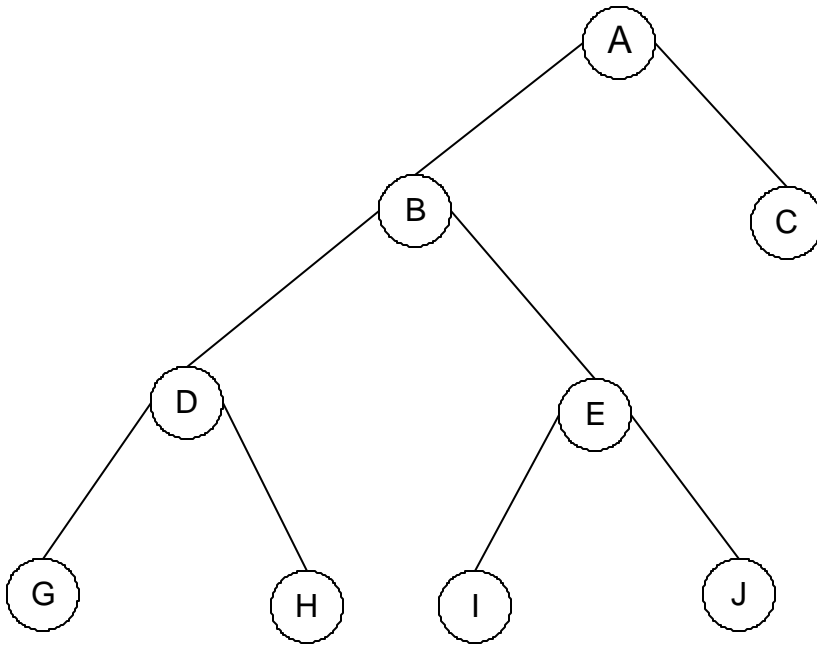


Figure 1

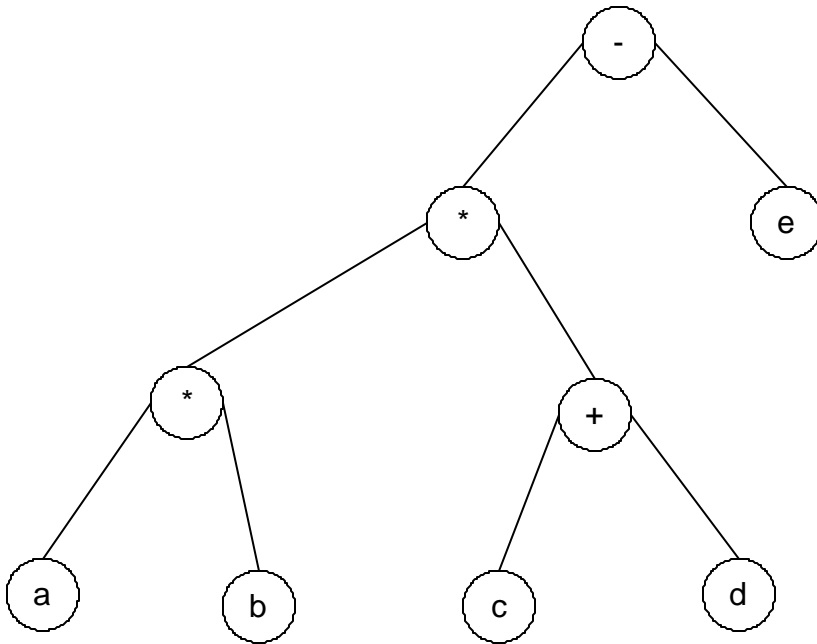


Figure 2

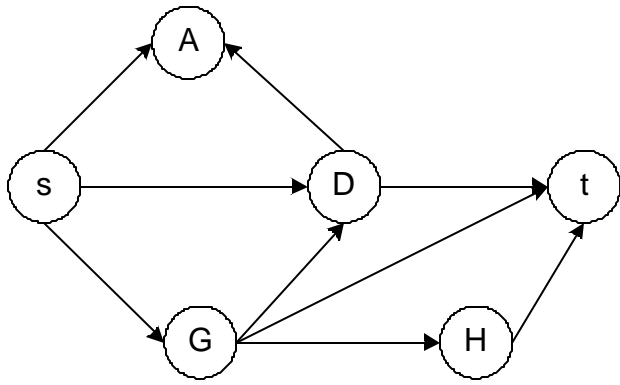


Figure 3

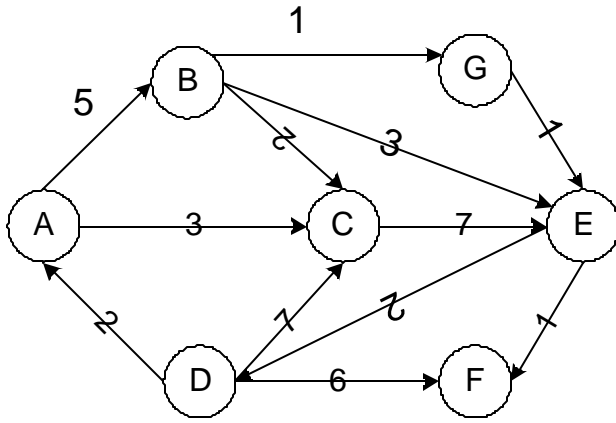


Figure 4

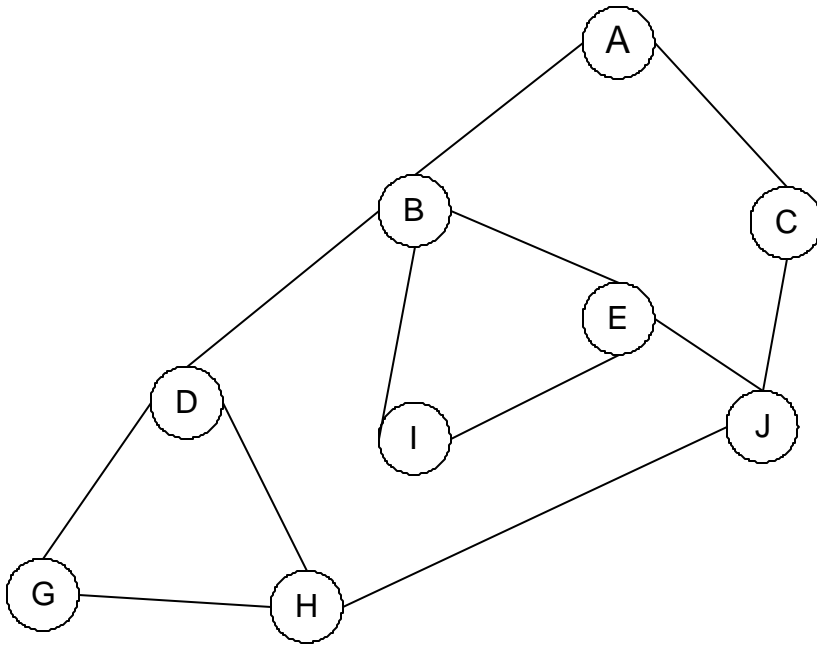


Figure 5

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