

PE424001 Algorithm and Data Structure Revision

Q1. (10 Marks) Answer the following questions using Figure 1

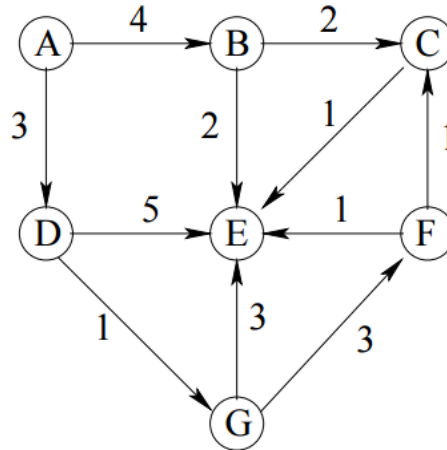


Figure 1 A directed graph

- Construct the corresponding adjacency matrix of Figure 1 (2 Marks)
- What is the main disadvantage of using matrix to form the graph relationship? (1 Mark)
- Execute Dijkstra's algorithm on the graph of Figure 1 starting at vertex A. It is noted that each vertex **MUST** be visited at least once. (3 Marks)
- What is the shortest path from A to F. Show the route. (1 Marks)

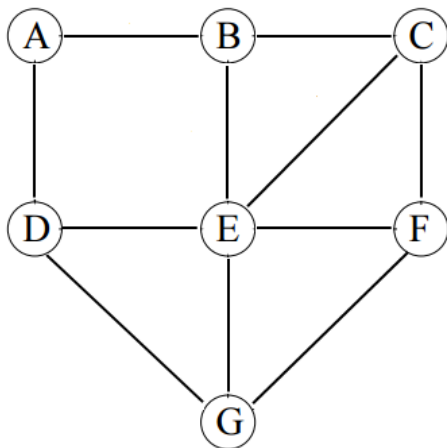


Figure 2 An undirected graph

- An undirected version is shown in Figure 2. Use Depth-First search traverse the graph (from node A) and illustrate the steps using proper data structure. (3 Marks)

Q1 answer key

a)

	A	B	C	D	E	F	G
A	0	4	0	3	0	0	0
B	0	0	2	0	2	0	0
C	0	0	0	0	1	0	0
D	0	0	0	0	5	0	1
E	0	0	0	0	0	0	0
F	0	0	1	0	1	0	0
G	0	0	0	0	3	3	0

b) It will consume lots of memory if there are lots of ‘0’s

c)

	A	B	C	D	E	F	G
A	0	4(A)	-	3(A)	-	-	-
D	0	4(A)	-	3A	8(D)	-	4(D)
G	0	4(A)	-	3(A)	7(G)	7(G)	4(D)
B	0	4(A)	6(B)	3(A)	6(B)	7(G)	4(D)
C	0	4(A)	6(B)	3(A)	6(B)	7(G)	4(D)
E	0	4(A)	6(B)	3(A)	6(B)	7(G)	4(D)

d) From a), trace back the route from A to F which gives A→D→G→F

e)

Output A and Insert B, D

B
D

Output B and Insert C, E

C
E
D

Output C and Insert E,F

E
F
E
D

Output E, Insert D,F,G

D
F
G
F
E
D

Output D, Insert G

G
F
G
F
E
D

Output G, Insert F

F
F
G
F
E
D

Output F, Stop

Final route: A B C E D G F

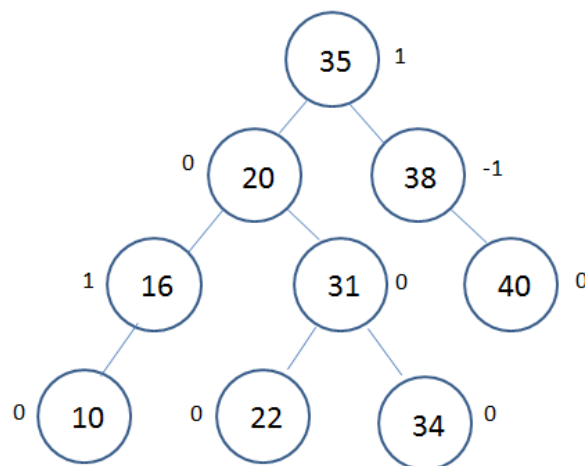
Q2. (9 Marks) Given the following data sequence.

[35, 20, 38, 16, 31, 40, 10, 22, 34]

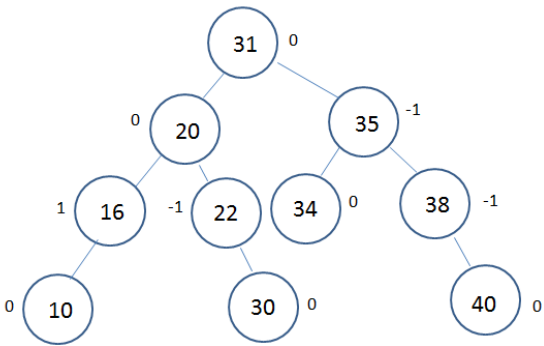
- Draw the binary search tree formed by entering the data in the order and assign a balancing factor in each node. (4 Marks)
- Using the tree above, give the preorder scan of the nodes. (1 Marks)
- Using the tree above, give the inorder scan the nodes. (1 Marks)
- Using the tree above, give the postorder scan the nodes. (1 Marks)
- Reform the tree into AVL tree after inserting node 30 and put the balancing factor in each node. (2 Marks)

Q2 answer key

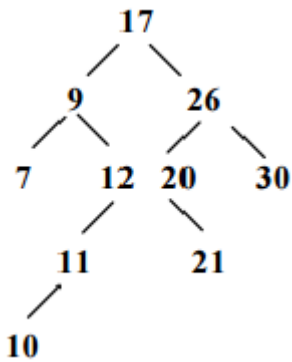
a)



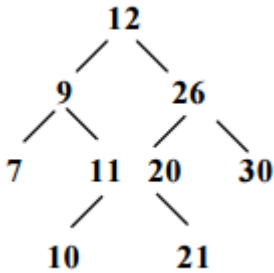
- b) Preorder scan: 35 20 16 10 31 22 34 38 40
- c) Inorder scan: 10 16 20 22 31 34 35 38 40
- d) Postorder scan: 10 16 22 34 31 20 40 38 35
- e)



Q3 Construct a Binary Search Tree (BST) by inserting the following keys (from left to right): The tree initially is empty. key ={17, 9, 26, 12, 11, 7, 30, 20, 21, 10} (2.5 Marks)



- b) By using the BST from question Q3b, draw the BST after the key 17 is deleted (1 Marks)



Q4. a) Convert $2*3/(2-1)+5*3$ into Postfix form

Answer:

Expression	Stack	Output
2	Empty	2
*	*	2
3	*	23
/	/	23*
(/(23*
2	/(23*2
-	/(-	23*2
1	/(-	23*21
)	/	23*21-
+	+	23*21-/
5	+	23*21-/5
*	++	23*21-/53
3	++	23*21-/53
	Empty	23*21-/53*+

b) Evaluate the following expression, showing the state of the stack at each step.

$6\ 5\ * \ 7\ 3\ - \ 4\ 8\ + \ * \ +$

Answer:

6
6 5
30
30 7
30 7 3
30 4
30 4 4
30 4 4 8
30 4 12
30 48
78

Q5 Given the frequency of the following symbols:

	a	b	c	d	e	f	g
Frequency	37	18	29	13	30	17	6

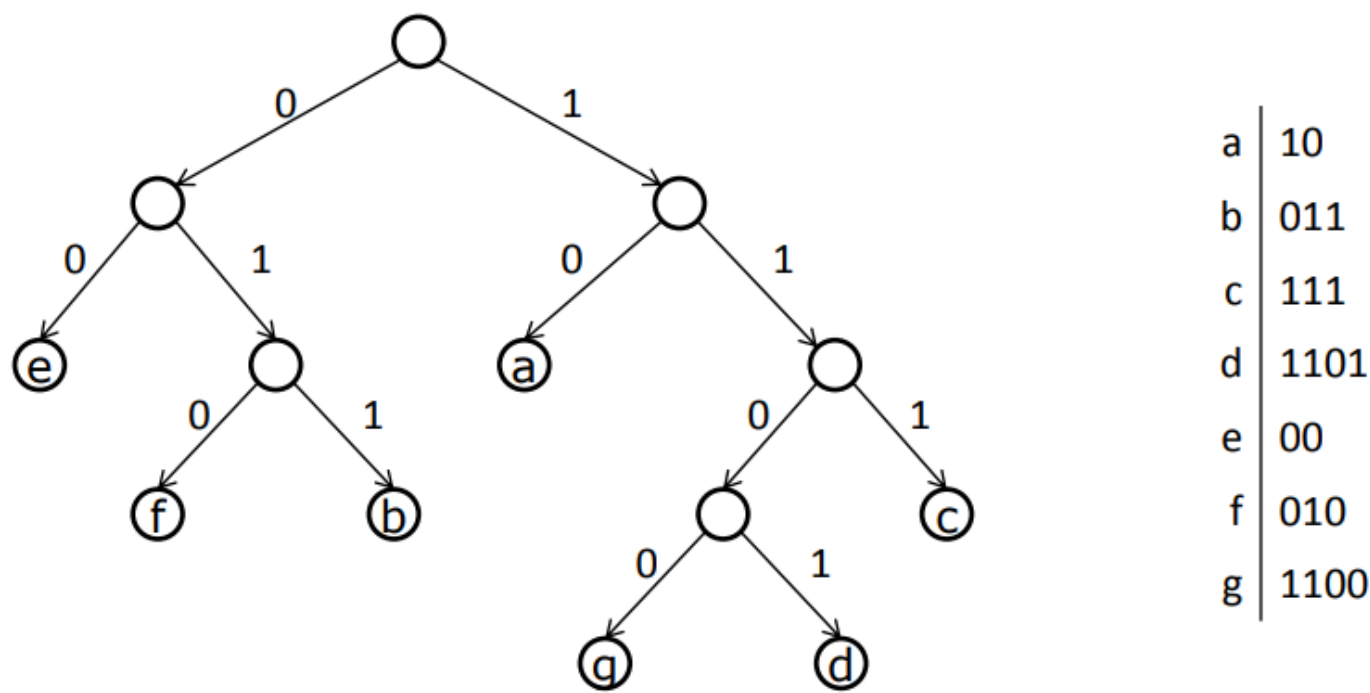
- a) What is the total bits if we use fixed-length coding?
- b) Construct a Huffman tree and write down the final code words of each symbol.
- c) What is the total bits in part b) and How much you save (in %)?
- d) Based on part b) result, decode the message 1101110111000010

Answer:
a)

Total size is:

$(37 + 18 + 29 + 13 + 30 + 17 + 6) \times 3 = 450 \text{ bits}$

b)



c)

Total size is:

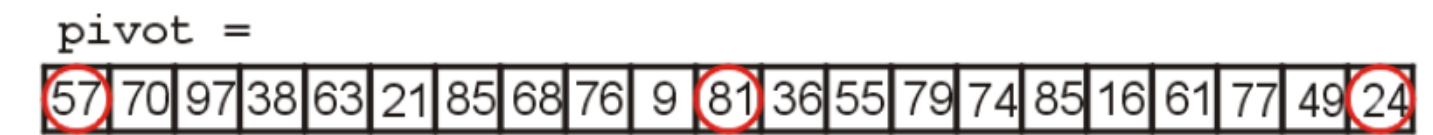
$37 \times 2 + 18 \times 3 + 29 \times 3 + 13 \times 4 + 30 \times 2 + 17 \times 3 + 6 \times 4 = 402 \text{ bits}$

A savings of approximately 11%

e) ddgea

6) Perform Quicksort of the following sequence and write down the first partition numbers on left and right hand side of the pivot value.

Pivot value= 57



Answer:

