Q1 Academic Honesty

0 Points

It is a violation of the Academic Integrity Code to look at any reference material other than your textbook and lecture notes, or to give inappropriate help to someone or to receive unauthorized aid by someone in person or electronically via messaging apps such as WhatsApp. Academic Integrity is expected of all students of Hacettepe University at all times, whether in the presence or absence of members of the faculty. Do NOT sign nor take this exam if you do not agree with the honor code.

Understanding this, I declare I shall not give, use or receive unauthorized aid in this examination.

Signature (Specify your name and surname as your signature)

Mehmet Taha USTA MTUSTA

While answering the following questions, please consider the content that we discussed in our lectures unless stated otherwise.

Q2

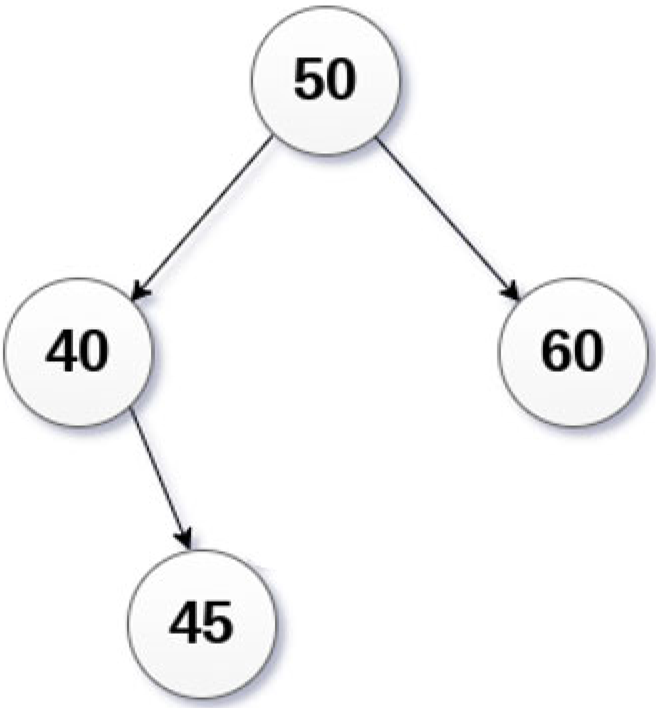
12 Points

For each of the below AVL trees answer the question below:

Q2.1

4 Points

a)After deletion of the node 60 from the AVL tree shown below, what will be the root of the new tree?

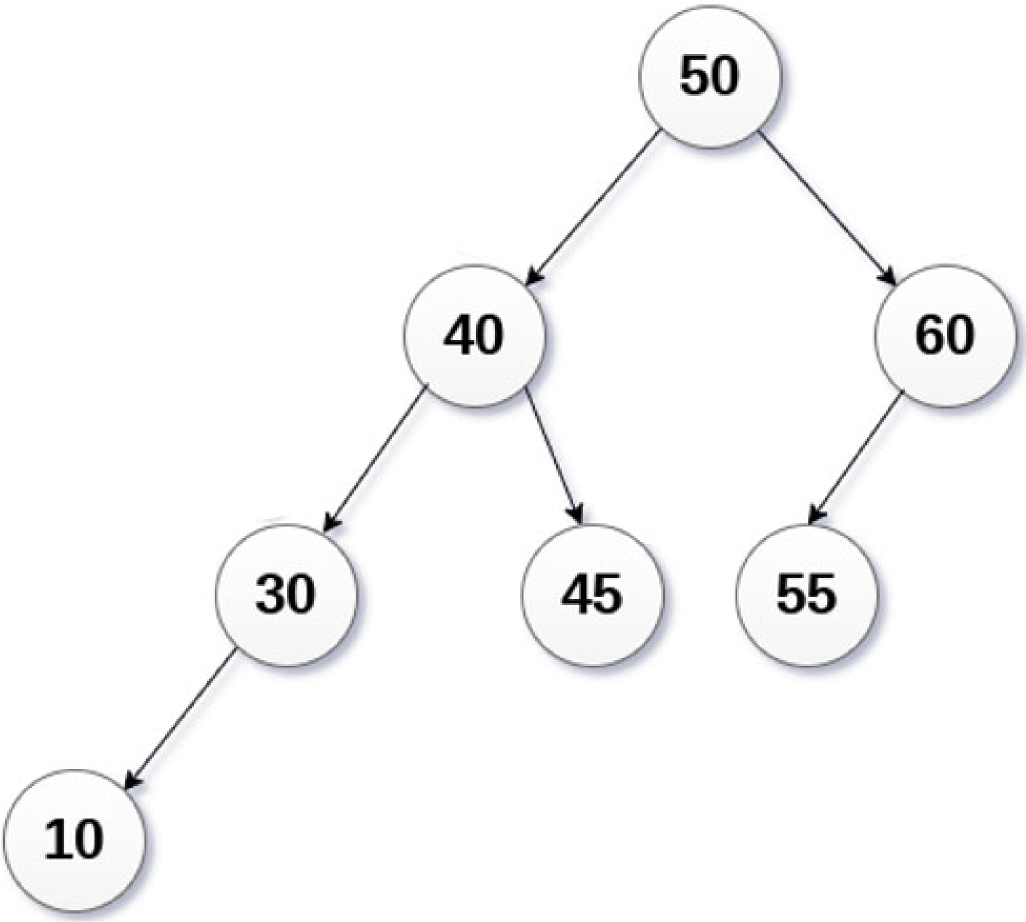


45

Q2.2

4 Points

b)After deletion of the node 55 from the AVL tree shown below, what will be the right child of 40 in the new tree?

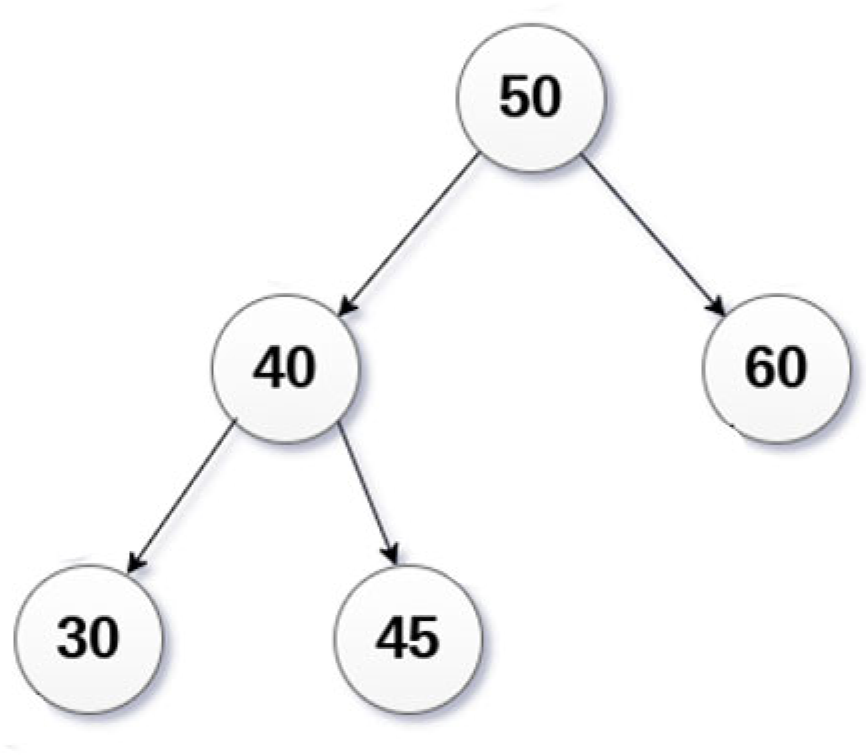


50

Q2.3

4 Points

c)After deletion of the node 60 from the AVL tree shown below, what will be the parent of 45 in the new tree?



50

Q3

12 Points

We would like to store 10 integer values. Answer below questions.

Q3.1

4 Points

If we use an array based linked list where array size is 15, what will be the size of the total structure in bytes? (do NOT include the first and free index holders) Assume integers and pointers are 4 bytes.

100

Q3.2

4 Points

If I use a complete tree structure and use minimum space representation possible, what will be the size of the total structure in bytes? Assume integers and pointers are 4 bytes.

120

Q3.3

4 Points

If I use a singly linked list, what will be the size of the total structure in bytes? (do NOT include the head pointer) Assume integers and pointers are 4 bytes.

80

Q4

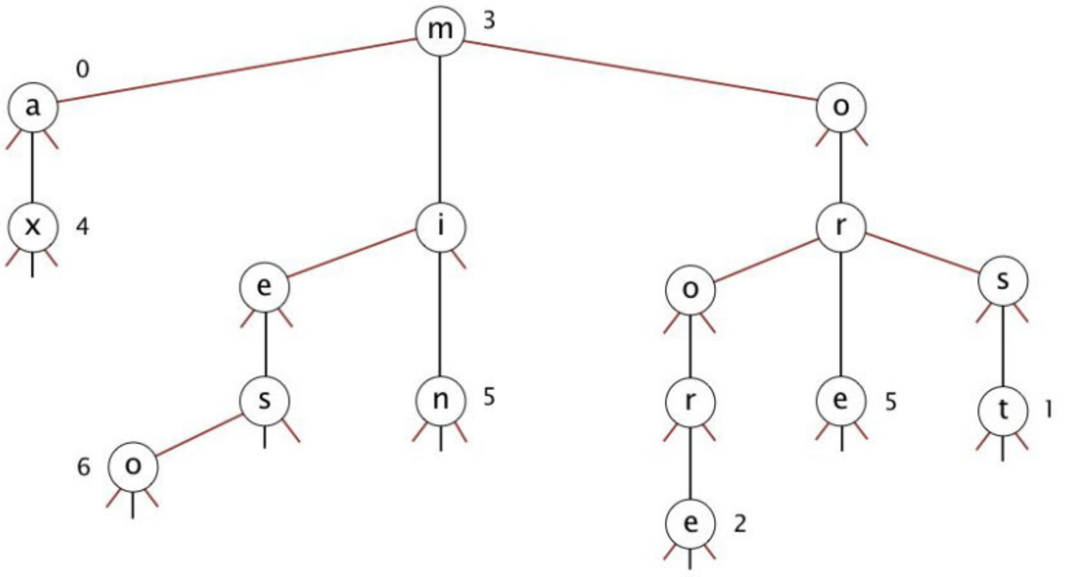
11 Points

A Ternary Search Trie (TST) is a special trie data structure where the child nodes of a standard trie are ordered as follows:

- The left pointer points to the node whose value is less than the value in the current node.
- The middle pointer points to the node whose value is equal to the value in the current node.
- The right pointer points to the node whose value is greater than the value in the current node.

Search in a TST follows the links corresponding to each character in the key such that

- If less, take the left link; if greater, take the right link.
- If equal, take the middle link and move to the next key character.



A TST is shown above. Values are indicated with a number next to the node to represent a string symbol table.

Q4.1

5 Points

Choose all the strings that the TST contains. (no partial credit)

☑ a

☑ ax

☑ ore

☑ oore

☑ ost

Q4.2

6 Points

Choose all the strings that the TST contains. (no partial credit)

☑ m

□ max

☑ meo

☑ min

□ more

□ most

Q5

10 Points

Build a hash table using separate chaining method. For hash function use h(x)= x mod 9 for a table size of 9.

key values: 19 13 1 12 22 24 7 16 35 10

Once you have the hash table, For the access pattern: 5 24 7 25 35 21 1 19

Give the probe time for each access pattern below (leave a single space in between). Note: accessing the index array is counted as one probe.

2 1 1 1 1 1 1 2 1 2

Give the average probe time. (use dot (.) not comma (,) for floating point numbers)

1.3

Q6

25 Points

For each of the following three-string symbol table implementations, indicate how characters and strings are stored by picking the best match from among three choices:

For the definition of a Ternary Search Trie (TST) refer to Q4

Q6.1

5 Points

Neither characters nor strings are stored explicitly

○ Hash table (linear probing)

● R-way trie

○ TST

Q6.2

5 Points

Characters are stored explicitly but strings are not

○ Hash table (linear probing)

○ R-way trie

● TST

Q6.3

5 Points

Strings (and characters) are stored explicitly

● Hash table (linear probing)

○ R-way trie

○ TST

Q6.4

5 Points

Suppose a million random strings, each of length 10, over a 256-character alphabet are inserted into a symbol table. Which one would consume the most space?

○ Hash table (linear probing)

◉ R-way trie

○ TST

Q6.5

5 Points

As before suppose a million random strings, each of length 10, over a 256-character alphabet are inserted into a symbol table. Which one would consume the least space?

◉ Hash table (linear probing)

○ R-way trie

○ TST

Q7

10 Points

A d-max-heap is like an ordinary binary max-heap, except that nodes have d children instead of 2.

Q7.1

5 Points

Describe how a d-max-heap can be represented in an array A[1. . . n]. In particular, for the internal (non-leaf) node of the d-max-heap stored in any location A[i], consider the positions in A[] hold its child nodes. Assuming the indices start at 0, select the ones that are correct. (no partial credit)

☐ *1* st child is at A[d*i−d+1]

☑ *2* nd child is at A[d*(i-1)+1]

☐ *d* th child is at A[d*i]

☑ *k* th child is at A[d*k+i]

Q7.2

5 Points

What is the height of the heap to be the number of nodes on the longest path from the root to a leaf. In terms of n and d, what is the height of a d-max-heap of n elements?

○ $\log_n d$

○ $\log_2 n$

● $\log_d n$

○ $\ln n$

Q8 Graph

10 Points

Suppose you have a graph and any pair of vertices are chosen as start and goal. There are many paths from the start vertex to the goal vertex. You also know that they tend to be rather long. Suppose that you want to implement a program that searches for a path and returns the first one it can find. You have no need for finding the optimal path in any sense, just any path will do. Would you want to use BFS or DFS as the basis for your program? Justify your answer in at most two sentences.

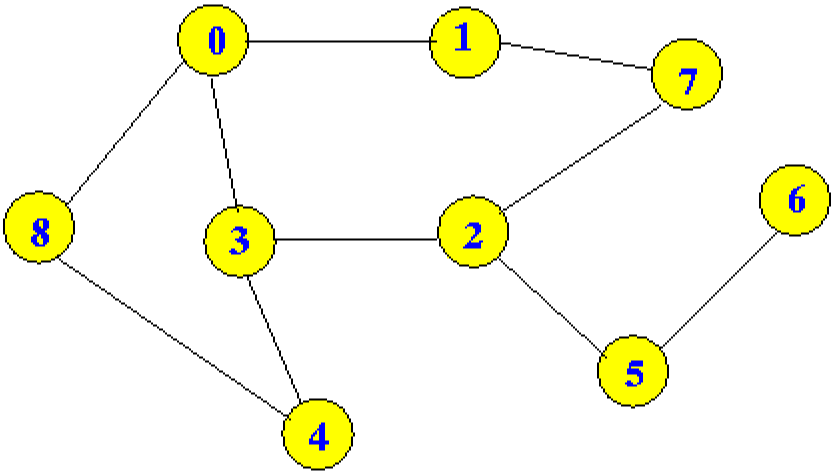
I want to use DFS.

Graph also has vertices with multiple long paths leading to the goal vertices.
Therefore, the dfs algorithm works better than the BFS algorithm in finding proper path.

Q9

10 Points

Given the graph below, if the adjacent vertices of a vertex are kept in a priority queue using the min-heap structure, what will be the visit order of the below graph when doing BFS starting from 0 vertex?



Give your answer below, putting a space in each number

0 1 3 8 7 2 4 5 6

Final Exam

● GRADED

STUDENT

MEHMET TAHA USTA

TOTAL POINTS

67 / 100 pts

QUESTION 1

Academic Honesty **0** / 0 pts

QUESTION 2

(no title) **12** / 12 pts

2.1 (no title) **4** / 4 pts

2.2	(no title)		**4** / 4 pts
2.3	(no title)		**4** / 4 pts
QUESTION 3			
	(no title)		**4** / 12 pts
3.1	(no title)		**0** / 4 pts
3.2	(no title)		**0** / 4 pts
3.3	(no title)		**4** / 4 pts
QUESTION 4			
	(no title)		**11** / 11 pts
4.1	(no title)		**5** / 5 pts
4.2	(no title)		**6** / 6 pts
QUESTION 5			
	(no title)		**0** / 10 pts
QUESTION 6			
	(no title)		**25** / 25 pts
6.1	(no title)		**5** / 5 pts
6.2	(no title)		**5** / 5 pts
6.3	(no title)		**5** / 5 pts
6.4	(no title)		**5** / 5 pts
6.5	(no title)		**5** / 5 pts
QUESTION 7			
	(no title)		**5** / 10 pts
7.1	(no title)		**0** / 5 pts
7.2	(no title)		**5** / 5 pts
QUESTION 8			
	Graph	R	**0** / 10 pts
QUESTION 9			
	(no title)		**10** / 10 pts