CS214 Final Exam (For Practice)

Important Topics:

- **Doubly** Linked Lists
- Stack **Push** Function.
- Stack **Pop** Function.
- **Enqueue** Function.
- **Dequeue** Function.
- **Circular Queue** Tracking.
- Traverse tree using **Pre-order**, **In-order** and **Post-order**.
- Construct **BST**.
- BST **Insert** Function.
- BST **Search** Function.
- BST **Traversal** Functions.
- BST **Delete** Function.
- Construct **AVL** Tree.

1- MCQs (10 marks)

1- In a linked list implementation of a stack, what does the top pointer store?
A) First node
B) Last inserted node
C) Random node
D) Size of stack

2- What happens to front and rear in a queue implemented using a linked list, after deleting the only element in the queue?
A) Both become NULL
B) Front only becomes NULL
C) Rear only becomes NULL
D) Nothing changes

3- What happens when a new element is added to a full circular queue?
A) Overwrites first element
B) Queue grows automatically
C) Overflow occurs
D) Element is ignored

4- What will be the output of the following circular queue code?السؤال ناقص

5- In a dequeue, which of the following is true? السؤال ناقص

6- What will be the value of front and rear after inserting two elements into an initially empty queue implemented using an array?
A) front=0, rear=1
B) front=1, rear=2
C) front=0, rear=0
D) front=1, rear=1

7- Which of the following rotations is used in an AVL tree when a node is inserted into the left subtree of the right child?
A) LL rotation
B) RR rotation
C) LR rotation
D) RL rotation

8- A tree is said to be a/an ____ if all levels are filled except possibly the last level.
A) Full tree
B) Complete tree
C) Skewed tree
D) AVL tree

9- What will be the output of the post-order traversal after inserting 40, 20, 60, 10 into a BST?
A) 10, 20, 60, 40
B) 10, 60, 20, 40
C) 20, 10, 60, 40
D) 40, 20, 10, 60

10- What is the balance factor of the root node after inserting 30, 20, 10 in an empty AVL tree?
A) 2
B) -2
C) 1
D) 0

11- A[4]=50. What is the left child of A[1]? Consider the array representation of a binary tree: A[0]=10, A[1]=20, A[2]=30, A[3]=40
A) A[2]
B) A[3]
C) A[4]
D) None

12- height, and depth of node (0070)? Based on the tree above, which of the following statements accurately describes the degree? السؤال ناقص

13- If a stack is implemented using an array of size 5, which of the following statements is correct regarding the properties of the stack?
A) Dynamic size
B) Fixed size
C) Infinite size
D) No size limit

14- According to the following Binary Search Tree. What is the sequence of elements displayed after performing an inorder traversal of the given tree?
A) Sorted order
B) Reverse order
C) Random order
D) Level order

15- What is the correct statement regarding the deletion of the node with the value 30 from the given tree?
A) Node always deleted directly
B) Node replaced or removed based on children

C) Cannot be deleted
D) Tree becomes empty

16- What is the correct statement regarding the insertion of a new node with the value 15 into the last tree?
A) Insert anywhere
B) Insert randomly
C) Insert based on BST rules
D) Replace root

17- What is the primary principle of stack data structure?
A) FIFO
B) LIFO
C) LILO
D) Random access

18- Which of the following is a disadvantage of using a doubly linked list compared to a singly linked list?
A) Less memory usage
B) More memory usage
C) Faster search
D) No pointers needed

19- Which of the following correctly describes the imbalance in the given tree? السؤال ناقص
A) LL
B) RR
C) LR
D) RL

20- What will be the result of pushing three elements into an empty stack and then popping two of them?
A) One element remains
B) Stack becomes empty
C) Stack overflow
D) Error

21- What will happen if you attempt to pop an element from an empty stack?
A) Return null/error
B) Return 0
C) Crash always
D) Nothing

22- ____ is a random-access data structure.
A) Stack
B) Queue
C) Array
D) Linked list

23- In a binary search tree, the left child of a node contains a value __ than the parent node, and the right child contains a value __ than the parent node.
A) greater, smaller
B) smaller, greater
C) equal, equal
D) random, random

24- What procedure is executed to re-establish balance in an AVL tree after an insertion?
A) Traversal
B) Rotation
C) Sorting
D) Deletion

25- What is the allowed range of the balance factor for any node in an AVL tree?
A) -2 to 2
B) -1 to 1
C) 0 to 1
D) 1 to 2

26- Which of the following best describes the operation of a queue?
A) First-In-First-Out
B) Last-In-First-Out
C) Random Access
D) Priority Based

27- When implementing a stack using a linked list, where are new elements typically inserted to maintain efficiency?
A) At the beginning of the linked list
B) At the end of the linked list
C) At the middle of the linked list
D) Randomly

28- What is the outcome of performing an “in-order” traversal on a Binary Search Tree?
A) Nodes are visited in ascending order
B) Nodes are visited in descending order
C) Root is visited last
D) Leaves are visited first

29- An “input-restricted deque” places a limitation on which operation?
A) Deletion is restricted to one end only
B) Insertion is restricted to one end only
C) Access is restricted to the middle
D) It cannot be traversed

30- In the context of deleting a node from a singly linked list, why is the “old” pointer necessary when deleting an intermediate node?
A) To update the link of the previous node
B) To store the data of the deleted node
C) To reset the head pointer
D) To check for underflow

1) What is the time complexity of deleting an element from an array?
   a) O(1) b) O(log n) c) O(n) d) O(n log n)

2) Which of the following represents the in-order traversal of a binary tree?
   a) Left -> Root -> Right b) Left -> Right -> Root
   c) Right -> Left -> Root d) Right -> Root -> Left

3) What is a circular linked list?
   a) A linked list where all nodes are connected in a circular manner.
   b) A linked list where the last node points to the first node.
   c) A linked list where the first node points to the last node.
   d) A linked list where all nodes point to themselves.

4) In a stack, where does a pop operation remove an element from?
   a) At the start of the stack
   b) In the middle of the stack
   c) At the end of the stack
   d) Based on the value of the element

5) In a doubly linked list structure, how many pointers are there in each node?
   a) 1 b) 2 c) 3 d) No pointers

6) What is the advantage of a linked list over an array?
   a) Faster access time.
   b) Less memory usage
   c) Elements can be inserted or removed without reallocation or reorganization of the entire structure.
   d) All of the above

7) Which data structure is used for implementing recursion?
   a) Array b) Linked list c) Queue d) Stack

8) Which of the following is a correct definition of Stack?
   a) A data structure that follows the LIFO (Last In First Out) strategy
   b) A data structure that follows the FIFO (First In First Out) strategy
   c) A data structure that follows both LIFO and FIFO strategies
   d) A data structure that doesn't follow LIFO or FIFO.

9) 3) Which of the following is the disadvantage of the array structure?
   a) Elements can be accessed sequentially
   b) Index of the first element in an array can be negative
   c) Stack and Queue data structures can be implemented through an array
   d) Wastage of memory if the inserted elements are lesser than the allocated size

10) In an input-restricted dequeue, where does the new element is placed?
   a) At the start of the queue
   b) At the end of the queue
   c) At the start and end of the queue
   d) None of the above

11) Any node is the path from the root to the node is called _____.
   a) Successor node
   b) Ancestor node
   c) Internal node
   d) None of the above

12) A data structure in which elements can be inserted or deleted at/from both ends.
   a) Singe queue
   b) Priority queue
   c) Dequeue
   d) Circular queue

13) Which of the following data structure can provide efficient searching of the elements?
   a) Stack
   b) Doubly linked list
   c) Circular queue
   d) Binary search tree

14) The following numbers are inserted into an empty binary search tree in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree?
   a) 2 b) 3 c) 4 d) 6

15) What is the time complexity to push an element onto a stack?
   a) O(1) b) O(log n) c) O(n) d) O(n log n)

16) _____of a node is the maximum number of links from root to that node.
   a) Height b) Depth c) Degree d) Ancestor

17) Which is the most appropriate data structure for reversing a word?
   a) Tree b) Linked list c) Queue d) Stack

18) A binary search tree whose left subtree and right subtree differ in height by at most 1 unit is called _____.
   a) AVL tree
   b) Complete binary tree
   c) Full binary tree
   d) Strict binary tree

19) What is the need for a circular queue?
   a) Easier computations
   b) Effective usage of memory
   c) Implement LIFO principle in queues
   d) None of the above

20) What is a leaf in a binary search tree?
   a) A node with the highest value
   b) A node with the lowest value
   c) A node with no children
   d) None of the above

2- True/False (MCQS ممكن يدخل ضمن)

1- Deletion in BST is always simpler than insertion.
2- The depth of a tree is the length of the shortest path from root to any leaf.
3- In a stack implemented with linked list, pop() removes the last node of the list.
4- Doubly linked lists support both forward and backward traversal.
5- node's next). Deleting a node in a singly linked list usually requires updating one pointer (the previous
6- In a queue represented as an array, the queue is considered empty if both rear and front are -1.
7- In a queue represented as an array, the queue contains only one element if the rear and front have different values.
8- In a queue represented as a linked list, when adding a new node (except the first element), both front and rear pointers must be updated.
9- In a doubly linked list, when adding a new node to the beginning of the list, the previous pointer of the new node is set to NULL.
10- The primary advantage of a queue over other data structures is easy to navigate and search.

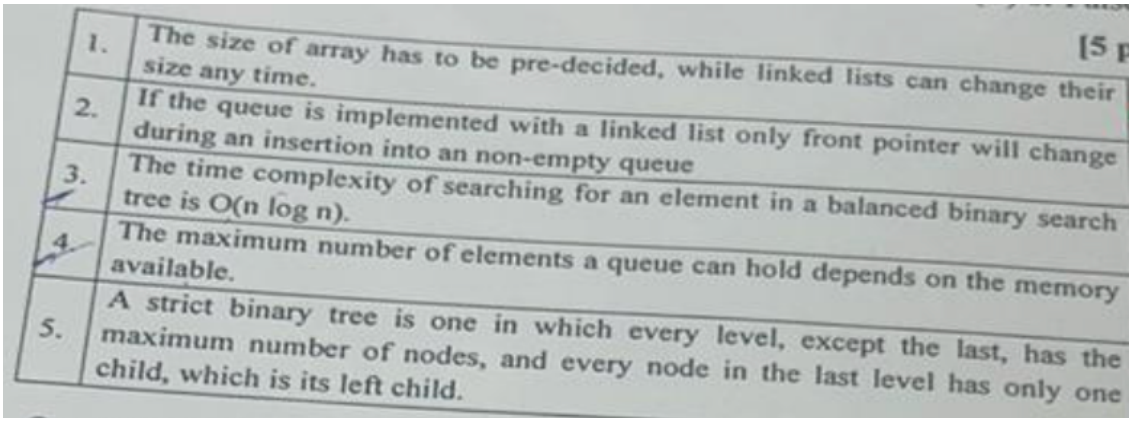
Doubly linked list allows traversal in both forward and reverse direction. [ ]

Delete node with two children from BST by promoting the left child. [ ]

In binary tree, node with no successor is called leaf node. [ ]

Linked list can grow and shrink in size during its lifetime. [ ]

. In circular queue, the queue is reported as full when rear reaches maximum size. [ ]



1.	The size of array has to be pre-decided, while linked lists can change their size any time.
2.	If the queue is implemented with a linked list only front pointer will change during an insertion into an non-empty queue
3.	The time complexity of searching for an element in a balanced binary search tree is O(n log n).
4.	The maximum number of elements a queue can hold depends on the memory available.
5.	A strict binary tree is one in which every level, except the last, has the maximum number of nodes, and every node in the last level has only one child, which is its left child.

3- Write a function. (14 Marks)

a) Function **"Push"** using linked list to add a new node to the stack.
b) Function to **search** for a specific value in the binary search tree and return true if the value is found, false otherwise.
c) Function to **delete** if there's two children.
d) **Destructor** to the queue.

e) Function in the Doubly Linked List Called Add() to **insert** a node After specified number of nodes.
f) Function in Queue implemented as linked list called extract() to **remove** an element from Queue.
g) Function "**Pop**" using linked list and array.

4- Perform, Draw .. Algorithm Questions. (16 marks)

Q1- **Construct an AVL** Tree when inserting the following values, and show the steps (10 marks) مهم جدًا جدًا

a) 20 50 75 98 80 11 13

b) D A T S R U C B O K Y

c) 63 9 19 27 18 108 99 81

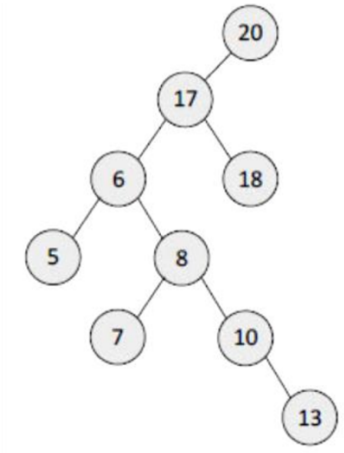
d) 40 20 10 25 30 22 50

Q2- **Construct a Binary Search Tree** of the following elements, then traverse all nodes using **Post-order method**.

a) (Q, S, I, M, U, N, I, V, E, R, S, T, Y).

5- Show Results/Output Questions.

Q1- Traverse the giving tree using **Pre-order**, **In-order** and **Post-order**. مهم



Inorder : 5, 6, 7, 8, 10, 13, 17, 18, 20

Prorder : 20, 17, 6, 5, 8, 7, 10, 13, 18

Postorder : 5, 7, 13, 10, 8, 6, 18, 17, 20

Q2- **Circular Queue** Tracking (10 marks) مهم

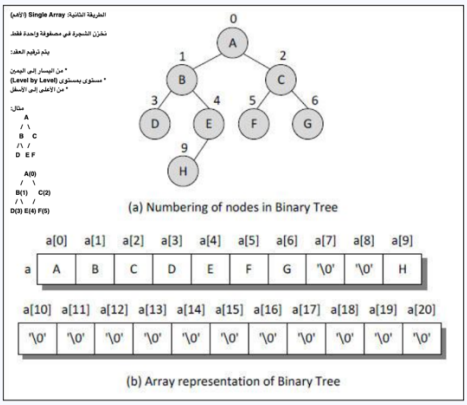
Assume a Circular Queue of **Size = 5** (Initially Empty). Trace the values of `Front` and `Rear` after each operation.

Operation	Front	Rear
Initial	-1	-1
Enque(10)		
Enque(20)		
Enque(30)		
Enque(40)		
Deque()		
Enque(25)		
Deque()		
Enque(35)		

Q3- **Array Representation** of Binary Tree. مو أكيد يجي

CONT.

- A binary tree can also be represented using one single array.
- Nodes are numbered from left to right level by level from top to bottom.



ARRAY REPRESENTATION OF BINARY TREES

- When a binary tree is represented by arrays three separate arrays are required.
  - One array stores the data fields of the trees.
  - The other two arrays represent the left child and right child of the nodes.

Arrays 3 :الطريقة الأولى
نستخدم 3 مصفوفات:

Data[] → تخزن القيم
Left[] → تخزن موقع الابن الأيسر
Right[] → تخزن موقع الابن الأيمن

```
  A
 /\
B  C
```

Data = [A, B, C]
Left = [1, -1, -1]
Right = [2, -1, -1]

arr	A	B	C	D	E	F	G	'\0'	'\0'	H
lc	1	3	5	-1	9	-1	-1	-1	-1	-1
rc	2	4	6	-1	-1	-1	-1	-1	-1	-1