INDIAN INSTITUTE OF TECHNOLOGY ROPAR

GE 103: Introduction to Computing and Data Structures
First Semester of Academic Year 2024-2025
End Semester Examination

Duration: 3 Hours [2:30 PM – 5:30 PM] Max Points: 50 Date: 6-MAY-2024

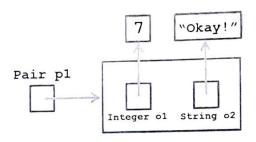
Instructions:

- There are 14 questions in the exam. All of the questions are mandatory.
- The points for each question are mentioned next to the question.
- Answer each question in the space provided for that question only.
- Structure your answer such that it does not go beyond the space allocated.
- No clarifications will be entertained during the examination. If you feel that a question is not clear, state your assumptions while answering.

	1	2	3	4	5	6	7	8
Maximum Points	3	<u>3</u>	4	4	<u>5.</u>	2	4	4
Obtained Points	0	1.5	0	2	4 -		4	2
Maximum Points	9	10	11	12	13	14	То	otal
	3	3	4	4	3	4	23.5	
Obtained Points	0,5	0	4	0	1.5	3		

Please Turn Over.

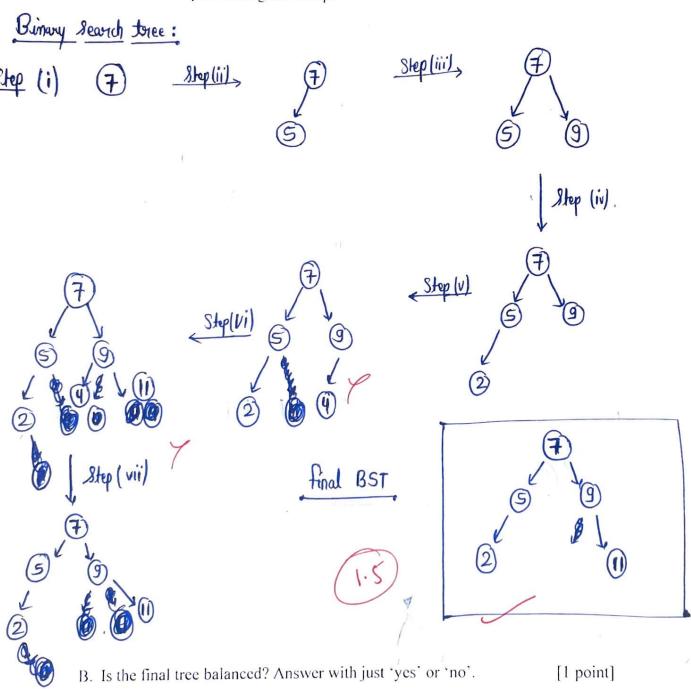
- Q1. The below diagram shows an object p1 of the Pair class containing two value one for each member variable associated with the object. Write the Object Oriented Python code corresponding to the diagram shown below. The following may be taken into account:
 - A. You need to declare a class called Pair, with two member variables, as shown below.
 - B. Include a constructor function.



Q2. Binary Search Trees

ame

A. Draw the resulting Binary Search Tree at <u>each</u> step after inserting and deleting the nodes in the following order – (i) insert 7, (ii) insert 5, (iii) insert 9, (iv) insert 2, (v) insert 4, (vi) insert 11, (vii) delete 4. Assume an empty tree at the beginning. Show the tree after performing each step. [2 points]

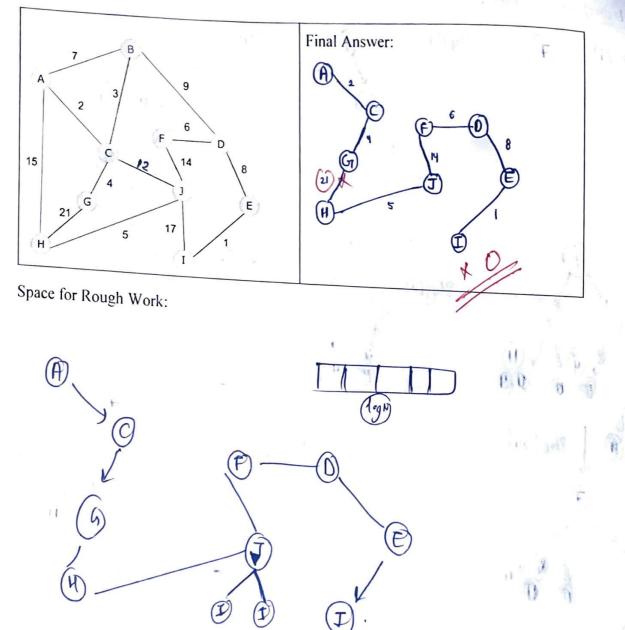


- No



Q3. Draw the minimum spanning tree that is generated after applying Prim's algorithm to the graph below. Start with node A. Only draw the final minimum spanning tree, no explanation is required.

[4 points]



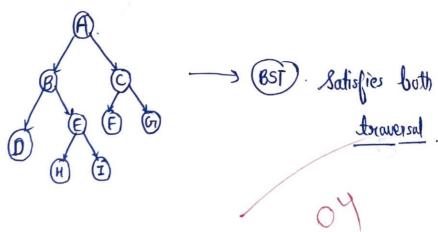
Q4. Write down the expression of the worst coperations. No explanation is necessary. [1 \times 4 =	ase Big O complexity for the following 4 points					
A. Contains function: returns true or fals object is a member of a list.	e depending on whether a particular					
a. Sorted list implemented as an array						
b. Sorted list implemented as a single Answer:						
B. Insert function: add an object to the li	st in the appropriate place.					
a. Unsorted list implemented as an array. Answer: n logh.						
b. Sorted list implemented as an array. Allswer.						
Q5. Circle the correct answer. Only one answer correct per question. [1 \times 5 = 5 points]						
a) Which of the following functions grows the	(b) 2 ⁿ					
a. nlogn	$\frac{O}{d}$. n^2					
c. logn						
b) For a linked list implementation of a queue, if both front and rear have identical valid node values, the size of the queue is:						
a. 0	(b) 1					
c. 2	d. the answer cannot be determined					
c) For the linked implementation of a stack, where are the push and pop operations performed?						
a. Push in front of first element, pop the first element	b) Push after last element, pop the last element					
c. Push after last element, pop the	d. Push after first element, pop the					
first element	first element					
d) Which of the following does the binary heap implement?						
(a) Binary search tree	b. Priority queue					
c. Stack	d. None of the above					
e) Which of the following would require the	most extra space, on average?					
a. Bubble sort	(b) Merge sort					
c. Quick sort	d. Selection sort					

Q6. List two applications each for Stacks and Queues. [2 points]

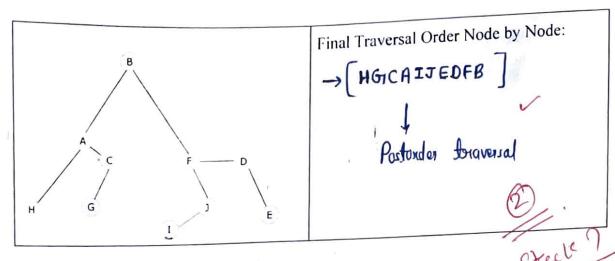
Stack (Application 1)	Stack (Application 2)				
LIFO and FIFO discipline	Implemented				
is wed					
1 Used to Calls functions.	2 Infix to postfin Conversion				
Queue (Application 1)	Queue (Application 2)				
1 parenthesis Machining.	2) Memory and storage applications.				

Q7. Consider the results of the following binary tree traversals: (i) Inorder = DBHEIAFCG, and (ii) Preorder = ABDEHICFG.

Construct a single corresponding binary tree that satisfies both these traversal sequences. [4 points]



Q8. Consider the following graph. Draw the postorder traversal of the following binary tree, starting at node B. Show all the steps, and the contents of the stack at each step. [4 points]



Stepwise Answer:

Postorder: Left Subtree - Right subtree - Root

Step () Visit the left subtree of $B \rightarrow A$ then left substree $Af A \rightarrow H$ So, first node is (H)

Step 2 Then Visit sight subtries of $A \rightarrow C$ then left subtries of $C \rightarrow G$ So, Second node is G.

Step @ Then follow reverse browersal So, @ and A and stree third and fourth node. Then Visit Right Subtree of B -> F.

Step (1) Visit tell subtrace of $J \to I$. So J is the fifth node. Then reverse traversal. So J is sixth node.

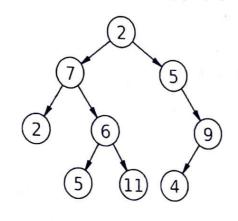
Step \odot . Visit right Subtree of $F \rightarrow 0$, then visif sight Subtree $0 \rightarrow \bigcirc$. So \bigcirc is the Severith mode.

Step. 6. Then follow reverse traversal. So, D, P and B core.

the eighth, ninth and tenth node. of Post order 7

traversal.

Q9. Given the definition of binary tree discussed in class, write the pseudocode for a <u>recursive</u> function named SumLeaf(), that takes the root of a binary tree, and returns the sum of all the leaf nodes. For example, if you pass the root of the following binary tree, the function should return 2 + 5 + 11 + 4 = 22. [3 points]



Defination: Binary tree are the trees which have atmost two child nodes in structure.

" O and I also Can possible to be Binary tree.

Def Sum leaf ():

return Pass.

else :

return false.

If Sum leaf \$ 22 or Sum leaf > 22:

In this line we all sum led () which is Called recursion.

else:

Die neturn false.

Print (Sumleaf ())

Q10. Postfix notation

A. Write the following arithmetic expression in postfix notation: 5 + 3 * (2 + 4) Use the BODMAS (<u>Brackets</u>, <u>Order</u>, <u>Division</u>, <u>Multiplication</u>, <u>Addition</u>, <u>Subtraction</u>) rule for determining the order of operations. [1 point]

Griven: 2+4 3+5Postlya

notation

* (+42)+35

B. Next, use a stack to evaluate the above postfix expression. Show the push and pop operations used for each input character step by step, and the resulting stack after each step. [2 points]

By using stack: Consider given Infix as stack

en:

Step () We apply pop operations for each input sharacter.

and make the stake empty.

Step (2) Then apply push appenation.

For 5 and fill into stake.

Step (3) Similarly For 3, +, 2, 4, +, × apply push operation and

We abtain a partial natation.

Q11. Linked Lists:

(a) What is a linked list data structure? Explain with the help of a pictorial representation. [2 points]

Ans linked lists are linear data structure which is used to stone memory and data. In which we can easily add an or delete the memory and data.

In Linked lists the insortion and deletion of memory of very easy rather than arrays.

men data and Random access is not allowed.

Pictorial

separesentation

Pata

Pointer

Pointer

Pointer

Pointer

(b) Give one advantage and one disadvantage of the linked list data structure over an array. [2 points]

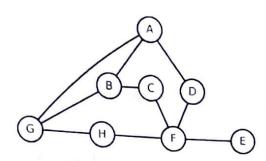
Advantage: Inscrition and deletion of new data is very easy in linked lists.

but in array we have to displace all data to inscrit and delete new data which is difficult.

Disadvantage: In linked a lists randow access is not allowed.

But in average it is random access is allowed.

Q12. Given the following graph:



Explain and show the steps for breadth-first search traversal using the stack data structure, starting from node A.

[4 points]

Breadth - I first Search browerral (BFS):

ADBGHFCE

Using queue data structure: In queue we use FIFO discipline. oxder

Step 10 let's A. be the first node in queue.

Step 2 Then we Visist all the nodes with which is Connected to A because they are in queue after A

Step 3 Then We Visit nodes After (G -> P) -> C->

to low, queue.

Q13. Mutability:

- (a) Give an example to illustrate the difference between mutable and immutable data types in Python. [2 points]
- Mutable: These data types are the data types in which we can able to do shange in the initial Value.

ex: In lists.

2 Immutable: ex: Dictionaries.

D = ["a", "b"]

(b) How does the mutability of function arguments affect the behavior of functions in

Ans. The mutability of function affect the behaviour of functions.

because we am able to change the value of,

that function according to our need So if affects.

the behavior of functions in python.

A. List and explain the different access modifiers available in Python with an example. [2 points] (ii) private (iii) protected. (i) Public access Modifiers: Variables in python are public Public all 9 = " wy an " private: They can't access directly but we can access ex: We use "__ , double underscore. indinectly. (3) perotected: In this we able to access only the class generated _ 1 -> Single Undersome. p ex: Mee B. What is inheritance property in the Python OOP paradigm? List two advantages of the inheritance property. [2 points] inhexidance peroperty in python cop Paradigm is that Hins We can alle to make new class of from one class which is Called Subdass of the given class the peroperty of inheritance in 1) This helps us to Salve any peroblem in easy Way. We can make the Subclass from one class.