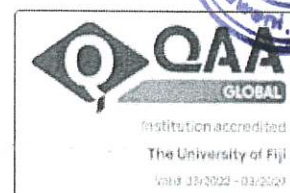




The University of Fiji
(An Entity of Arya Pratinidhi Sabha of Fiji)



SCHOOL OF SCIENCE AND TECHNOLOGY
Semester 1, 2024

FINAL EXAMINATION PAPER

ITC215: DATA STRUCTURES AND ALGORITHMS

Important Instructions to Students:

1. Read the questions and instructions carefully and answer the questions.
2. You are allowed an **extra 10 minutes of reading time** (during this time, you are not allowed to write with a pen) and **180 minutes (3 Hours) to complete this paper**.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask the supervisor. Write your name, course code, and student identification number in the answer booklet and in the attendance sheet.
5. **This Final Course Examination Paper is worth 100 marks and contributes 50% of the total course assessments.** Students must **at least score 40%** in this final exam to pass the course.
6. This paper contains two (2) sections A and B. All questions are compulsory to answer.
7. Write all your answers legibly. The marker has the right to award a zero for answers that are not legible.
8. This is a **Closed Book Examination**. The University views plagiarism, cheating, and dishonest practice as serious offenses and if found, offenders are penalized.

Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-7	Short Answer Questions	90	162 minutes
B	1	Long Answer Questions	10	18 minutes
		TOTAL	100	180 Minutes

All questions within this section are compulsory.

Question 1: Java Primer [13 Marks]

- A. Inspect the code fragment given below and label all the different components of this code fragment. **[1 Mark]**

```
public class MyFirstJavaProgram
{
    public static void main(String []args)
    {
        System.out.println("Hello World");
    }
}
```

- B. Write a declaration for each of the following base types: **[2 Marks]**
- boolean
 - char
 - byte
 - short
 - int
 - long
 - float
 - double
- C. List and briefly describe the 3 access control modifiers in Java. **[1.5 Marks]**
- D. List the differences between a method and a constructor. **[1 Mark]**
- E. Briefly describe the following Modifiers: **[1.5 Marks]**
- The Static Modifier
 - The Abstract Modifier
 - The Final Modifier
- F. Give the type and value of each of the following Java expressions. If an expression will not compile, write illegal under type and put an X in value. You must fill in every entry. Entries left blank will be marked incorrect. **[3.5 Marks]**

Expression	Type	Value
(7 / 2) * 2.0		
(7 / 2.0) * 2		
!(!!false && !!true)		
"A1.1" + "B2.2"		
(1 < 2 = 3)		
1 + 2.2 + "1.1" + "a"		
Integer.parseInt("123")		
Integer.parseInt("123ABC")		

G. Give three examples of life-critical software applications. **[1.5 Marks]**

H. Explain in your own terms what you mean by Data Structures and what are some examples of it. **[1 Mark]**

Question 2: Arrays and Linked Lists [10 Marks]

- A. Define what an array is, how would you initialize and declare values into. Assume the data type in consideration is double and you have the following values: 1.2, 3.40, 89.01, 56.1, 78.5, 0.9898, 32.9, 12.1 and 99.12. **[2 Marks]**
- B. For the above set of data, write lines of code that will allow the program to show the total of all the numbers [] array using a for loop. **[2 Marks]**
- C. What are Linked Lists? What are the different types of Linked Lists available? How is a Linked List different from an Array? **[2 Marks]**
- D. Write a line of code that implements a Linked List named "Animals". **[1 Mark]**
- E. There are two types of add() methods in Linked Lists. Differentiate between them. **[1 Mark]**
- F. Add the following cars to the Linked List object: Mazda, Toyota, BMW, Hyundai, and Kia. Use a foreach loop to print out the items in the list. **[2 Marks]**

Question 3: Algorithm Analysis and Recursion [15 Marks]

- A. How would you generally test running time of an algorithm? **[1 Mark]**
- B. To calculate how efficient an algorithm is we need to first of all understand what the primitive operations. Elaborate on the primitive operations that are considered for analyzing the performance of complex algorithms. **[2 Marks]**
- C. Identify the seven functions for algorithm analysis with their appropriate formulas. **[3.5 Marks]**
- D. Elaborate on the five logarithm rules. **[2.5 Marks]**
- E. What is Recursion in Java? **[1 Mark]**
- F. Write a recursive function that prints the numbers 1...n in descending order: **[2 Marks]**

```
public void descending (int n)
{
}
}
```


G. Study the below code. Identify what would be the output and explain your thought process.

[3 Marks]

```
public class RecursionExample {
    public static void main(String[] args) {
        int number = 10;
        int result = factorial(number);
        System.out.println("Factorial of " + number + " is: " + result);
    }
    // Recursive factorial method
    public static int factorial(int n) {
        // Base case: when n is 0 or 1, return 1
        if (n == 0 || n == 1) {
            return 1;
        } else {
            // Recursive case: n * factorial of (n-1)
            return n * factorial(n - 1);
        }
    }
}
```

Question 4: Stacks, Queues, and Dequeues [14 Marks]

- Suppose an initially empty stack S has performed a total of 30 push operations, 15 top operations, and 12 pop operations, 5 of which returned null to indicate an empty stack. What is the current size of S? **[1 Mark]**
- Suppose an initially empty queue Q has performed a total of 32 enqueue operations, 10 first operations, and 15 dequeue operations, 5 of which returned null to indicate an empty queue. What is the current size of Q? **[1 Mark]**
- For the following Stack S of Integers, fill out the return value and the stack contents. **[4 Marks]**

Method	Return Value	Stack Contents
push(8)		
push(1)		
push(5)		
pop()		
size()		
pop()		
pop()		
isEmpty()		
push(1)		
push(2)		
push(4)		
pop()		
push(5)		
pop()		
top()		

D. For the following Queue, determine the return value and contents of Q. [4 Marks]

Method	Return Value	First ← Q ← Last
enqueue(4)		
dequeue()		
size()		
isEmpty()		
enqueue(11)		
enqueue(1)		
enqueue(0)		
first()		
dequeue()		
dequeue()		
dequeue()		
enqueue(3)		
enqueue(6)		
first()		
enqueue(9)		

E. For the following Deque, determine the return value and the output content for D. [4 Marks]

Method	Return Value	D
addFirst(6)		
addLast(3)		
addLast(1)		
first()		
removeFirst()		
first()		
removeFirst()		
addFirst(10)		
isEmpty()		
size()		
removeLast()		
last()		
addFirst(0)		
removeLast()		
addLast(3)		

Question 5: List ADT and Positional List [11 Marks]

A. Differentiate between an Array, Dynamic Arrays, and ArrayList with appropriate examples.

[1.5 Marks]

B. Refer to the below code and explain what the output will be: [1.5 Marks]

```
List<Integer> num = new ArrayList<Integer>();
num.add(0, 99);
```



```

num.add(1, 22);
num.add(2, 67);
System.out.println(num);
List<Integer> val = new ArrayList<Integer>();
val.add(78);
val.add(21);
val.add(54);
val.add(65);
val.add(19);
val.add(8);
num.addAll(2, val);
System.out.println(num);

```

C. For the following List, determine the return value and the output for List content. **[4 Marks]**

Method	Return Value	List Contents
add(0, A)		
add(1, F)		
add(2, H)		
add(4, P)		
get(3)		
remove(0)		
remove(4)		
add(3, J)		
set(1, K)		
set(1, K)		
remove(2)		
get(2)		
isEmpty()		
add(4, Q)		
set(3, M)		

D. For the following Positional List, determine the return value and the output for List content. **[4 Marks]**

Method	Return Value	List Contents
addLast(8)		
first()		
addAfter(p, 5)		
before(q)		
addBefore(q, 3)		
r.getElement()		
after(p)		
addFirst(9)		
remove(last())		
set(p, 7)		
remove(q)		
size()		

isEmpty()		
addFirst(4)		
addLast(2)		

Question 6: Priority Queues and Maps [8 Marks]

- A. For the following Priority Queue, determine the return value and the output for the Queue. [4 Marks]

Method	Return Value	Queue
insert(20, B)		
insert(13, A)		
insert(5, Z)		
min()		
removeMin()		
insert(78, N)		
insert(1, P)		
size()		
removeMin()		
insert(4, Q)		
insert(85, X)		
insert(3, W)		
removeMin()		
removeMin()		
isEmpty()		

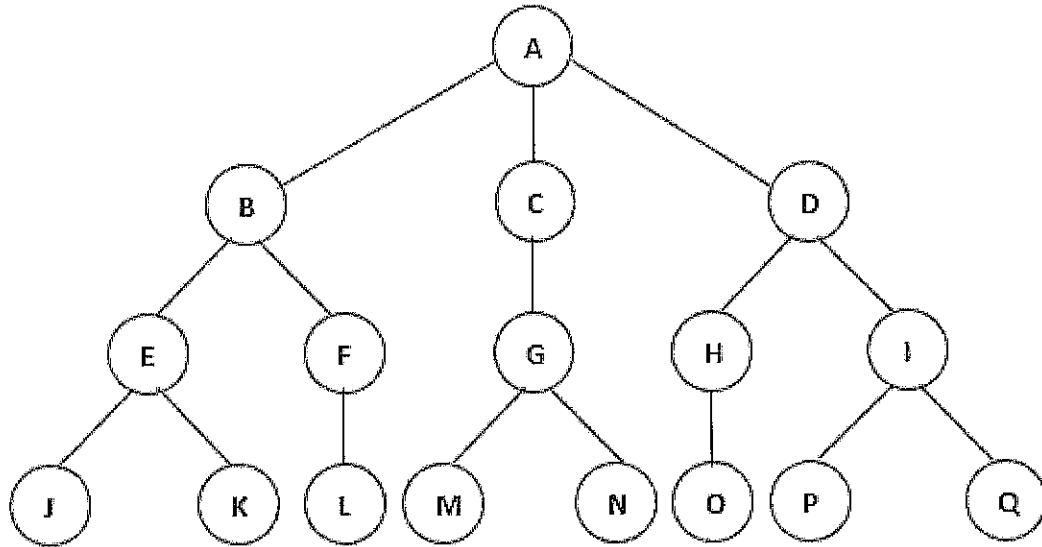
- B. For the following Map, determine the return value and the output for Map. [4 Marks]

Method	Return Value	Map
put(5, A)		
put(7, B)		
put(2, C)		
put(5, B)		
get(7)		
get(5)		
size()		
remove(7)		
remove(2)		
get(2)		
remove(2)		
isEmpty()		
entrySet()		
values()		
keyset()		

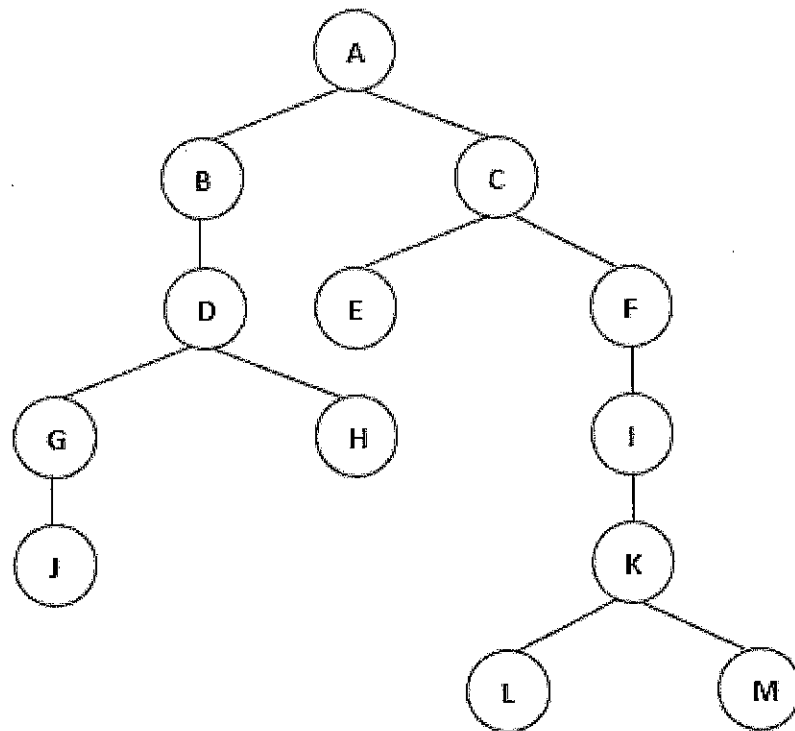
Question 7: Trees [19 Marks]

A. For the following trees, perform In-Order, Pre-Order, and Post-Order traversals. **[6 Marks]**

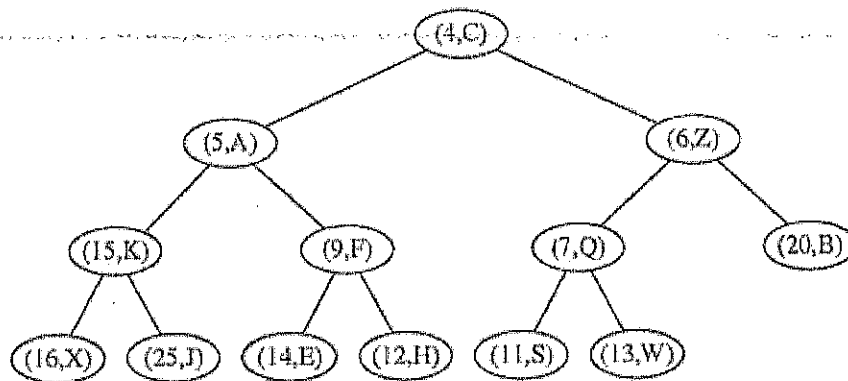
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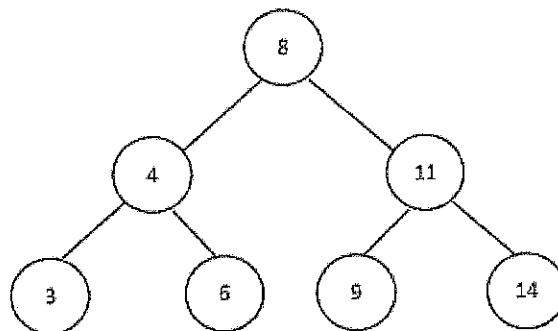
B. For the following Tree, perform Heap Insertion and Heap Deletion. **[4 Marks]**



- I. Insert (8, M)
- II. Delete (25, J)

C. Write Java codes to create a tree structure, constructor, and its respective nodes from the below illustration. Include codes for InOrder, PreOrder, and PostOrder Traversals to present outputs. **[9 Marks]**

I.



II.

