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PAPER CODE	EXAMINER	DEPARTMENT	TEL
CSE210		Computer Science & Software	
		Engineering	

SECOND SEMESTER 2018/2019 RESIT EXAMINATIONS

BACHELOR DEGREE - Year 3

Advanced Object Oriented programming

TIME ALLOWED: 2 Hours

INSTRUCTIONS TO CANDIDATES

- Total marks available are 100. This will count for 50% in the final assessment.
- 2. Answer all FOUR questions.

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- 3. The number in the column on the right indicates the marks for each section.
- 4. Answer should be written in the answer booklet(s) provided.
- 5. The university approved calculator Casio FS82ES/83ES can be used.
- 6. All the answers must be in English.

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Question 1. Consider the following three classes in two different packages, Person, LinkedList and Node. Class Node is an inner class of LinkedList. Answer the following questions.

[25 marks]

```
public class Person{
   private final String name;
   private int age;
   static int maxAge;
   public Person(String name, int age) {
      this.name = name;
      this.age = age;
   }
   public void updateName(String name) {
      this.name = name;
   }
}
public class LinkedList{
  private Node start;
  private Node end;
  public LinkedList() {
     start = null;
     end = null;
   }
  public void addToStart(Person p) {
   start = new Node(p, start);
   if (listEnd == null) {
     end = start;
  }
   public void addToEnd(Person p) {
     // implement your code here
   private class Node{
      private Person p;
      private Node next;
      Node (Person person, Node next) {
          this.person = person;
```

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```
this.next = next;
}

public Person getPerson() {
    return p;
}

public Node next() {
    return next;
}
}
```

a) The maxAge field defined in the Person class has a default scope. Is it visible to the LinkedList and Node classes, respectively?

[2 marks]

b) Are the private fields, start and end, defined in the LinkedList class, visible to the Person and Node classes, respectively?

[2 marks]

c) Will the updateName() method in the Person class be able to update the name of an existing Person instance? Justify your answer.

[4 marks]

d) Modify the constructor of the Person class, so that maxAge can store the maximum age for all Person instances ever created.

[5 marks]

e) Implement the addToEnd() method for the LinkedList class. Existing constructor and methods can be used where appropriate.

[6 marks]

f) A new method called removeFromEnd() can be defined for the LinkedList class, which removes the last node in the list. Write the pseudocode for the method.

[6 marks]

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Question 2. The class ShopQueue implements a bounded queue for a small shop. The queue can accommodate at most 5 guests at any given time. The staff of the shop calls addGuest() method if a guest can be added into the queue. If a guest is serviced, the staff calls the getNextGuest() or remove() method. Assume that the method calls can only be performed one by one. Answer the following questions.

[25 marks]

```
public class ShopQueue {
   private int[] guests = new int[5];
   private int top = 0;
   public int getNextGuest(){
      int first = guests[0];
       for (int i = 0; i + 1 < top; i++) {
          guests[i] = guests[i + 1];
       }
       top--;
       return first;
   }
   public void addGuest(int i) {
       guests[top++] = i;
   public void remove() {
       System.out.println(getNextGuest());
   public static void main(String[] args) {
       ShopQueue sq = new ShopQueue ();
       sq.addGuest(1);
       sq.addGuest(3);
       sq.remove();
}
```

a) Describe the state of the method-call stack during execution of the main () method.

[6 marks]

b) What is meant by class invariant in the context of Java programming?

[2 marks]

c) Is 'top >= 0' a class invariant for the ShopQueue class? Justify your answer.

[3 marks]

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d) Define a checked exception class EmptyQueueException for the ShopQueue by overriding the getMessage() method.

[4 marks]

e) Modify the getNextGuest() method so that it can throw an EmptyQueueException when the queue is empty.

[6 marks]

f) With the modified getNextGuest() method, what other changes would be necessary for the ShopQueue class?

[4 marks]

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Question 3. Consider the MessagePrinter class below and answer the following questions.

[25 marks]

```
class MessagePrinter implements Runnable {
   private String message;
   MessagePrinter(String s) {
      message = s;
   }
   public void run() {
       for (int i = 0; i < 100; i++) {
          for (int j = 0; j < message.length(); <math>j++) {
              System.out.print(message.charAt(j));
          System.out.print("\n");
       }
   }
   public static void main(String[] args) {
      MessagePrinter mp1 = new MessagePrinter("Hello, OOP");
      MessagePrinter mp2 = new MessagePrinter("Goodbye, OOP");
      Thread t1 = new Thread(mp1);
      Thread t2 = new Thread(mp2);
       t1.start();
       t2.start();
}
```

a) In the context of Java multithreading, what is meant by interference?

[4 marks]

b) Discuss in detail how the interference problem may occur in class MessagePrinter.

[5 marks]

c) What change would be needed to the MessagePrinter class to solve the interference problem?

[6 marks]

d) Briefly describe how a running thread may move to other states, i.e., Ready, Sleeping, Waiting, Dead and Blocked.

[5 marks]

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e) In the context of multithreading, what is meant by deadlock?

[3 marks]

f) How to prevent deadlock in Java multi-threading programming?

[2 marks]

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Question 4. Answer the following questions.

[25 Marks]

a) Briefly explain the term 'Generics' in Java and its benefits.

[2 marks]

b) Define a generic interface called PrimitiveFunction. The interface needs to have a method compute(), which accepts a parameter of type X, and returns a type Y.

[4 marks]

c) Define an interface called CompositeFunction as a sub-interface of PrimitiveFunction. The interface needs to define an extra method called name(), which accepts no parameter, and returns a String type.

[4 marks]

d) Implement a class called LengthFunction by implementing the PrimitiveFunction interface. The compute() method computes the length of a given string.

[4 marks]

e) Define a class called Mod5Function by implementing the PrimitiveFunction interface. The compute() method for this class takes an Integer as input and return a Boolean value indicating if result of "modulus 5" is zero.

[4 marks]

f) What is an anonymous class and what is its main advantage?

[2 marks]

g) Consider the class ComposeFunction below, which makes use of an anonymous class. What is the output after the main () method is executed?

[5 marks]

```
public class ComposeFunction {
   public CompositeFunction compose(final PrimitiveFunction<String,
Integer> f1, final PrimitiveFunction<Integer, boolean> f2, final String
name) {
     return new CompositeFunction<String, boolean>() {
        public boolean compute(String s) {
            return f2.compute(f1.compute(s));
        }
        public String name() {
            return name;
        }};
}
```

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```
public static void main(String args[]){
    ComposeFunction f = new ComposeFunction();
    CompositeFunction
CompositeFunction
CompositeFunction
LengthFunction(), new Mod5Function(), "Length&Mod");
    System.out.println(cf.name());
    System.out.println(cf.compute("ILoveProgramming"));
}
```

END OF EXAM PAPER

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