UNIVERSITY OF MORATUWA

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

BSc Engineering Honours Degree
Semester 4 Examination: 2023

CS2833: MODULAR SOFTWARE DEVELOPMENT

Time allowed: 2 Hours July 2023

ADDITIONAL MATERIAL: *None*

INSTRUCTIONS TO CANDIDATES:

1. This paper consists of **4** questions in 5 pages.
2. Answer all **4** questions.
3. Start answering each of the main questions on a new page.
4. The maximum attainable mark for each question is given in brackets.
5. This examination accounts for 60% of the module assessment.
6. This is a closed book examination.

   NB: It is an offence to be in possession of unauthorised material during the examination.
7. Only calculators approved and labelled by the Faculty of Engineering are permitted.
8. Assume reasonable values for any data not given in or with the examination paper. Clearly state such assumptions made on the script.
9. In case of any doubt as to the interpretation of the wording of a question, make suitable assumptions and clearly state them on the script.
10. This paper should be answered only in English.

Parts of Question 1 and Question 2 are based on the following description.

The office of EfficientGov receives and dispatch many Messages in mail every day, which includes very important back-and-forth correspondence between internal officers and various external parties. There is a mailroom to handle all incoming and outgoing mail. The mail-room controller could use the standard postal service, express-courier service, or fax services etc., to deliver/receive the message based on the requirement. Another main task of the mailroom is to keep logs of all incoming and outgoing messages.

The mailroom has a management software which is written in Java with object-oriented programming concepts, and it keep track of various records such as dispatch/receipt time, source, destination, etc.

From the office's perspective, anything that is received in or delivered out is a **Message.** Message can be in the form of **Letter, Package, Email, Call, Fax** etc,.
Every instance which belongs to the Message class must have the following methods,

```
String getContent();
String getSource();
String getDestination();
```

The returned Strings from the above methods would contain comprehensive details in a structured text format, which can be extracted into further sub fields as necessary. However, a **Message** cannot exist without a content attribute, and the content must be assigned to the Message at the object instantiation. You can use a custom constructor for this.
However, there can be a Message instance with only the Content, but no destination or a delivery method assigned yet. Such Messages needs to be eventually converted to a **Letter** or **Email** etc., before sending though the mail room.
Message instance could contain comprehensive source and destination information in local String attributes. However, when the above methods have been called from a certain subclass, they should respond with only the relevant source and destination details. For example, getDestination from **Email** should return only the email address while getDestination from Letter should return the postal address. However, if you request getDestination from the Message instance, it should return the full destination details as well. Also, an additional method getFullDestination should return the complete details about destination in case it gets hidden.

You can assume the content extraction methods are readily available and can be invoked freely in your Java-like pseudo codes.

Question 01. [25 marks]

(a.) Answer the following questions on Java OOP basics.

i. Explain the terms "class" and "object instance" in the context of object-oriented programming. [2 marks]

ii. Describe the purpose and the differences between a "constructor" and a "method". [2 marks]

iii. Consider the following Java code.

int re = 1 + "1/(10-5*2)";

Java finds this code erroneous. At what stage will it be identified by Java and reported as an error? Describe what could be the reason behind the error and using your knowledge about Java language provide explanations for the way Java deals with it. [4 marks]

(b.)

i. Explain the object-oriented programming concept of *inheritance* and its behavior taking examples from the given scenario of the Mailroom. [5 marks]

ii. Write a Java code for the **Message** class. Minor syntax differences are acceptable; however, your code should show proper use of all the key Java constructs. Add code comments. Sample test code in Main function is given below for your reference [6 marks]

```
public class Main{

  public static void main(String[] args){

    Message m1 = new Message("MyMessage");
    Letter m2 = new Letter("My Letter");

    System.out.println(m1.getContent());          //Shows MyMessage
    System.out.println(m2.getContent());          //Shows MyLetter

    m1.setDestination("Addr1, Email1, TP1");
    m2.setDestination("Addr2, Email2, TP2");

    System.out.println(m1.getDestination());     //Shows Addr1, Email1, TP1

    System.out.println(m2.getDestination());     //Shows Addr2,

    m1 = (Message)m2;
    System.out.println(m1.getDestination());     //Shows Addr2,
    System.out.println(m1.getFullDestination()); //Shows Addr2, Email2, TP2
    return;
  }
}
```

iii. Write a Java code for a **Letter** class adhering to all the OOP concepts and Java syntax. Add code comments. [6 marks]

Question 02. [25 marks]

(a) A **Letter** is handed over to a delivery partner with the intention of making tracking information available to all the relevant parties. The following behaviors should be implemented according to the requirements of the delivery partners, which is defined in an *interface* named **Deliverable**. However, the currently implemented **Letter** object method does not match with the method signatures given in the interface.

```
String getDestinationAddress(void);
String getOriginAddress(void);
```

i. Write the Java code for the **Deliverable** interface. [5 marks]

ii. Implement the said interface in a new **DeliverableLetter** class in a suitable way. [5 marks]

(b) **Sender** and **Receiver** are two types of mailroom operators which are specialized in outgoing and incoming messages respectively. Sender and Receiver must create a log-entry upon the message reception/dispatch in the internal reference file, then route the message and the associated reference file to the designated officer. With the speed of back-and-forth communication expected to increase with the introduction of emails, the company plans to implement a new single operator class to handle both Sending and Receiving of emails.
Your colleague who is a novice Java programmer proposes to extend both Sender and Receiver classes to create a new "MailOperator" class.

i. Explain the theoretical concept and practical complexities associated with the said proposal. [6 marks]

ii. Provide a viable method of achieving the requirement. [5 marks]

(c) Briefly explain the concept of *polymorphism* and how it can contribute to minimizing the redundancy and replication of codes. [4 marks]

Question 3 [20 marks]

a) Explain the role of software engineer in the present context of industry needs and people needs. [5 marks]

b) What is a software process? How do we use software processes in the software lifecycle? Explain using a suitable example. [5 marks]

c) Briefly explain the following:

i. Software Prototyping [3 marks]
ii. Software Testing [3 marks]
iii. Batch Processing Systems [2 marks]
iv. Embedded Control Systems [2 marks]

Question 4 [30 marks]

RentaCar is a taxi service company that operates in Colombo and suburb areas. It expects to introduce an online based taxi reservation and customer management system to improve its service performance, quality and reduce operational overheads due to manual operation. You have been hired as the software engineer for this project at RentaCar.

a) Identify 3 key stakeholders of the proposed system. [3 marks]

b) State a functional, non-functional and a domain requirement relevant to the proposed system. Briefly explain for each identified requirement why do you think it is relevant and how to validate the requirement fulfilment. [9 marks]

c) Draw a use-case diagram for the actor customer of the proposed solution. [4 marks]

d) Draw a high-level block and arrow architecture diagram for the proposed system. [5 marks]

e) Draw a UML sequence diagram OR activity flow diagram for the process of reserving a taxi by a customer. Clearly state your assumptions. [5 marks]

f) What is the software process you select to implement this project? Give reasons for your choice. [4 marks]

---------- END OF THE PAPER ----------