Skriftlig eksamen

Programmering af mobile applikationer
Medialogi, 2. semester

Onsdag den 1. juni 2022 kl. 9.00 – 13.00

Navn: _____

Studienr: _____

Aalborg University | BSc in Medialogy | 2nd Semester

Programming Mobile Applications

Ordinary Examination

1 June 2022, 9.00 – 13.00

Instructions

- You have 4 hours to complete this examination.
- Neither electronic devices nor written material are allowed in the examination room.
- This examination consists of 10 questions. Each question is worth 10 marks. You must obtain at least 50 marks to pass.
- Do not write any answers on this question paper—answers written on the question paper will be ignored by the examiner. Write all your answers on the writing paper provided.
- Do not write your answers in pencil and do not use a pen with red or green ink. Use a pen with blue or black ink.
- Hand in no more than one answer to each question.
- Do not turn over until you are told to do so by the invigilator.

Question 1

For each of the following statements, write down whether it is true or false.

a) Modules encapsulate interfaces.
b) Encapsulation and modularity can make code easier to debug when used properly.
c) Using encapsulation, modularity and proper object-oriented design usually makes code shorter.
d) If a module A is dependent on a module B, then a change in B may necessitate a change in A.
e) A module may have more than one interface.
f) A module exhibits high cohesion if it is easy to decompose it into smaller modules.
g) Every programming language must allow programmers to write "GOTO" statements.
h) "Spaghetti code" can arise when a programmer is able to jump from any location in the code directly to any other location in the code.
i) A component is a reusable, replaceable module.
j) A module is a good abstraction if it represents the important features of a thing and hides and ignore irrelevant details.

[1 mark for each correct part]

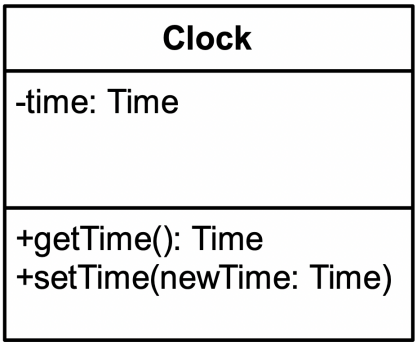
Question 2

a) Suppose we define a class called Clock with the following two public methods:

getTime():Time
setTime(newTime:Time):void

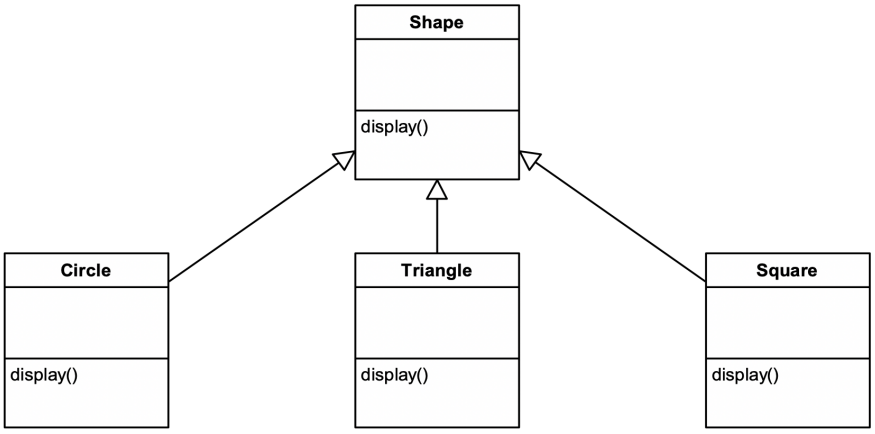
i) What is the *selector* of the first method. [1 mark]
ii) What is the *return type* of the first method? [1 mark]
iii) What is the *argument type* of the second method? [1 mark]
iv) What is the *signature* of the first method? [1 mark]

b) Consider the following UML class diagram:



i) What are the private attributes defined in this class? [1 mark]
ii) What are the public attributes defined in this class? [1 mark]
iii) What private operations are defined in this class? [1 mark]

c) Consider the following UML class diagram:



i) What is the superclass of class Circle? [1 mark]
ii) Does the display() method in Triangle overload the display() method in Shape? [1 mark]
iii) If I declare a pointer of type Shape, can I use it to refer to an object of type Square? [1 mark]

Question 3

Study the following Java program and answer the questions that follow it. Note that the s.charAt(i) String method returns the character at index i in the String, s, using zero-based indexing.

```
1  package pmaexam2022;
2
3  public class Q3 {
4      public static void main(String[] args) {
5          if (args.length == 0) {
6              System.out.println("Usage: java -jar q3.jar <name>");
7              return;
8          }
9          String name = args[0];
10         for(int i = 0; i < name.length(); i++) {
11             if (i%2==0)
12                 System.out.print(name.charAt(i));
13         }
14         System.out.println();
15         System.out.println("DONE");
16     }
```

a) Suppose that this program is compiled to a JAR file called “q3.jar” and run from the command line using the following command:
java -jar q3.jar dave
What will the program write to the console window? [4 marks]

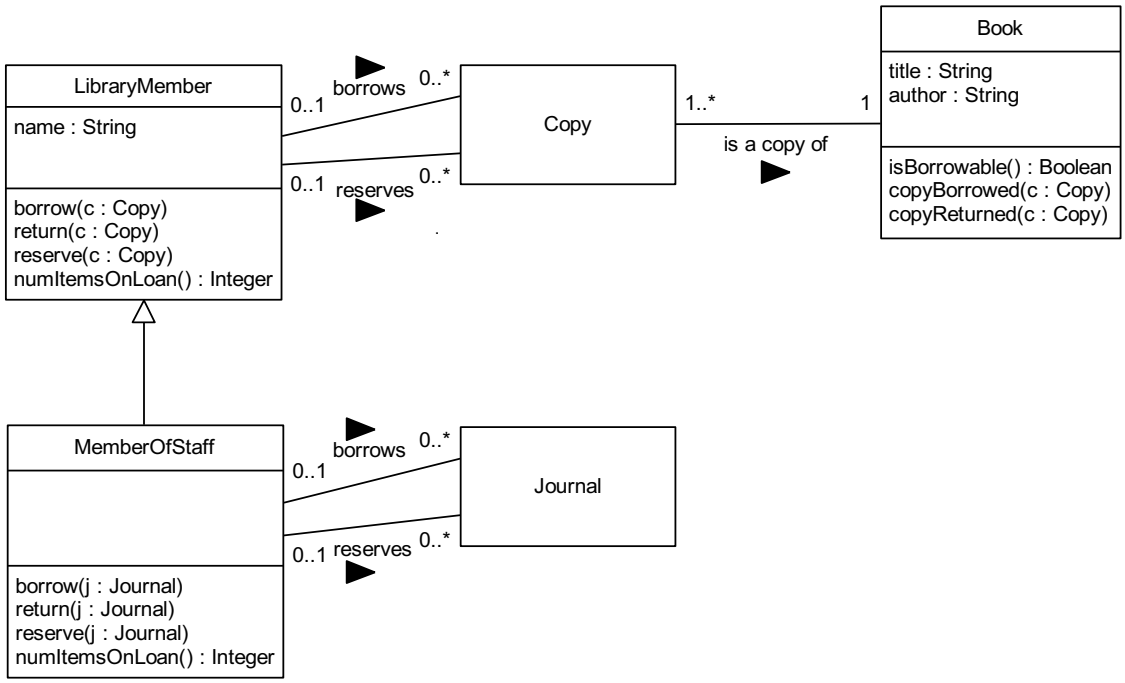
b) What will be written to the console if the same jar file is run using the following command:
java -jar q3.jar
[2 marks]

c) If the opening brace at the end of line 10 and the closing brace at the beginning of line 13 were deleted, would the program still run? Explain your answer. [2 marks]

d) If the word, “static”, were removed from line 4, would the program still run? Explain your answer. [2 marks]

Question 4

Study the following UML diagram and answer the questions that follow it.



a) What kind of UML diagram is this?
b) How many Journal objects are associated with each MemberOfStaff object?
c) How many Copy objects are associated with each Book object?
d) Does the reserve operation in MemberOfStaff override or overload the reserve operation in LibraryMember?
e) Does the numItemsOnLoan operation in MemberOfStaff override or overload the numItemsOnLoan operation in LibraryMember?
f) Do Copy objects reserve LibraryMember objects? How do we know?
g) What attributes does a MemberOfStaff type object have?
h) Can a MemberOfStaff object borrow a Copy object?
i) What is the visibility of the attributes of the Book class?
j) Is MemberOfStaff a superclass of LibraryMember?

[1 mark for each correct part]

Question 5

Study the following code and answer the questions that follow it.

```
1  package pmaexam2022;
2
3  import java.util.ArrayList;
4
5  class A {
6      private int x, y;
7
8      public int getX() {return x;}
9      public int getY() {return y;}
10
11     public void setX(int x) {this.x = x;}
12     public void setY(int y) {this.y = y;}
13
14     public A(int x, int y) {
15         setX(x);
16         setY(y);
17     }
18
19     public String toString() {
20         return "("+getX()+","+getY()+")";
21     }
22 }
23
24 class B extends A {
25     private int z;
26
27     public int getZ() {return z;}
28     public void setZ(int z) {this.z = z;}
29
30     public B(int x, int y, int z) {
31         super(x, y);
32         setZ(z);
33     }
34
35     public String toString() {
36         return "("+getX()+","+getY()+","+getZ()+")";
37     }
38 }
39
40 public class Q5 {
41     public static void main(String[] args) {
42         ArrayList<A> list = new ArrayList<A>();
43         A a = new A(1,2);
44         B b = new B(3,4,5);
45         list.add(a);
46         list.add(b);
47         for(A x : list)
48             System.out.println(x);
49     }
50 }
```

a) When this program is run, what does it print to the console window? [5 marks]

b) What is the purpose of the word, “super”, in line 31? [2 marks]

c) If lines 31 and 32 were swapped, would the program still compile? Explain your answer. [2 marks]

d) Are the variables x and y defined in line 6 visible within the definition of class B? [1 mark]

Question 6

Study the following Java program and answer the questions that follow it.

```
 1 package pmaexam2022;
 2
 3 class C {
 4     final int id;
 5     static int N = 0;
 6
 7     public int getId() {return id;}
 8
 9     public C() {
10         id = ++N;
11     }
12
13     public String toString() {
14         return "C" + getId();
15     }
16 }
17
18 public class Q6 {
19     public static void main(String[] args) {
20         for(int i = 0; i < 4; i++)
21             System.out.println(new C());
22     }
23 }
```

a) What does the program print to the console window when it is run? [4 marks]

b) What would the program print out if the word, “static”, were removed from line 5? [2 marks]

c) Write down what the program would print out if line 10 were changed to
id = N++;
[2 marks]

d) If line 4 were changed to the following:
final int id = 0;
why would the program then not compile, and in which line would the error occur? [2 marks]

Question 7

Study the following code and answer the questions that follow it.

```
1  package pmaexam2022;
2
3  class WordRunnable implements Runnable {
4
5      private String word;
6
7      public void run() {
8          try {
9              while(true) {
10                 System.out.print(word + " ");
11                 Thread.sleep(200);
12             }
13         } catch(InterruptedException e) {
14             System.out.println("\nThread " + Thread.currentThread().getName() + " stopped.");
15         }
16     }
17
18     public WordRunnable(String word) {
19         this.word = word;
20     }
21
22 }
23
24 public class Q7 {
25     public static void main(String[] args) {
26         try {
27             Thread t1 = new Thread(new WordRunnable("I"), "I");
28             Thread t2 = new Thread(new WordRunnable("LOVE"), "LOVE");
29             Thread t3 = new Thread(new WordRunnable("JAVA"), "JAVA");
30             t1.start();
31             t2.start();
32             t3.start();
33             Thread.sleep(1000);
34             t1.interrupt();
35             Thread.sleep(200);
36             t2.interrupt();
37             Thread.sleep(200);
38             t3.interrupt();
39         } catch (InterruptedException e) {
40             System.out.println("Thread "+Thread.currentThread().getName() + " stopped.");
41         }
42     }
43 }
```

a) Write down **two** possible outputs of this program. [4 marks]

b) Which lines can potentially throw an InterruptedException? [4 marks]

c) Under what circumstances would line 40 be executed? [2 marks]

Question 8

Study the following Java code and answer the questions that follow it.

```
14 public class Convert extends JFrame implements ActionListener {
15
16     private JTextField  celsiusTextField =  new JTextField();
17     private JLabel      celsiusLabel =      new JLabel("celsius");
18     private JButton     button =            new JButton("Convert");
19     private JLabel      fahrenheitLabel =   new JLabel("fahrenheit");
20     private JLabel      fahrenheitValue =   new JLabel("?");
21
22     public Convert() {
23         setTitle("Convert");
24         setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
25         GroupLayout layout = new GroupLayout(getContentPane());
26         getContentPane().setLayout(layout);
27         layout.setAutoCreateContainerGaps(true);
28         layout.setAutoCreateGaps(true);
29         layout.setHorizontalGroup(layout.createSequentialGroup()
30                 .addGroup(
31                         layout.createParallelGroup(
32                                 GroupLayout.Alignment.LEADING)
33                                 .addComponent(celsiusTextField)
34                                 .addComponent(fahrenheitValue)
35                                 .addComponent(button)).addGroup(
36                         layout.createParallelGroup(
37                                 GroupLayout.Alignment.LEADING)
38                                 .addComponent(celsiusLabel)
39                                 .addComponent(fahrenheitLabel)));
40         layout.setVerticalGroup(layout.createSequentialGroup()
41                 .addGroup(
42                         layout.createParallelGroup(
43                                 GroupLayout.Alignment.BASELINE)
44                                 .addComponent(celsiusTextField)
45                                 .addComponent(celsiusLabel)).addGroup(
46                         layout.createParallelGroup(
47                                 GroupLayout.Alignment.BASELINE)
48                                 .addComponent(fahrenheitValue)
49                                 .addComponent(fahrenheitLabel))
50                 .addComponent(button));
51         layout.linkSize(celsiusTextField, button, fahrenheitValue);
52         button.addActionListener(this);
53         celsiusTextField.addActionListener(this);
54         setResizable(false);
55         pack();
56         setVisible(true);
57     }
58
59     public void actionPerformed(ActionEvent actionEvent) {
60         try {
61             Double celsius = Double.parseDouble(celsiusTextField.getText());
62             Double fahrenheit = 32 + celsius * 9 / 5;
63             fahrenheitValue.setText(String.format("%.2f", fahrenheit));
64         } catch (NumberFormatException e) {
65             fahrenheitValue.setText("Unknown");
66         }
67     }
68
69     public static void main(String[] args) {
70         SwingUtilities.invokeLater(new Runnable() {
71             public void run() {
72                 new Convert();
73             }
74         });
75     }
76 }
```

Questions are on the next page.

a) What kind of layout manager is used by the GUI?
b) What is the purpose of line 24?
c) What is the purpose of line 27?
d) What kind of event is emitted when the user presses the ENTER button in the text box?
e) What is the purpose of lines 40-50?
f) On what thread is the GUI's run method executed?
g) Why can't we simply construct a Convert object and call its run method from the main thread?
h) Which object serves as an ActionListener?
i) What is the purpose of line 52?
j) Which method can potentially throw a NumberFormatException?

[1 mark for each correct part]

Question 9

a) In Android, which Activity lifecycle callback method is the last method guaranteed to run before an Activity is killed?
b) When you override an Activity lifecycle callback in a subclass of the Activity class, what should always be present as the first line of the definition of the overriding method?
c) In the following code snippet, is the Intent explicit or implicit?

```
Intent intent = new Intent(Intent.ACTION_SEND);
intent.putExtra(Intent.EXTRA_EMAIL, recipientArray);
startActivity(intent);
```

d) If an Activity, *a,* is partially covered by an Activity, *b,* that comes into the foreground, what lifecycle callback is automatically called on Activity *a*?
e) If an Activity has been stopped and the user navigates back to the Activity, which lifecycle callback is automatically called?

[2 marks for each correct part]

Question 10

a) In Android there are three categories of sensor: motion sensors, environmental sensors and position sensors. Give an example of each of these categories of sensor. [3 marks]
b) What is achieved by the following lines of code?

```
private SensorManager mSensorManager;
...
mSensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
```

```
List<Sensor> deviceSensors = mSensorManager.getSensorList(Sensor.TYPE_ALL);
```

[3 marks]
c) In Android, what is the difference between a streaming sensor and a non-streaming sensor? [2 marks]
d) Which two callbacks need to be implemented in order to implement a SensorEventListener? [2 marks]

END OF EXAMINATION