Aalborg University | BSc in Medialogy | 2nd Semester

Programming for Interaction

Re-Examination

23 August 2019

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, state whether it is true or false.

a) The number of potential communication channels between members of a team increases with the square of the size of the team.
b) It is not possible to write efficient computer programs in a language that does not have the equivalent of a "GOTO" statement.
c) Files, functions, classes and packages are all examples of modules.
d) If a module A depends on another module, B, then this implies that a change in A might necessitate a change in B.
e) If a module A depends on another module, B, then we can say that A is a client of B.
f) Modules encapsulate interfaces.
g) The private interface of a module contains the public interface of the module.
h) A module exhibits cohesion if it cannot easily be decomposed into a number of smaller modules.
i) A software component is a module that is reusable and replaceable.
j) Two objects of the same runtime type have the same identity if they have the same state.

[1 mark for each correct part]

Question 2

Suppose we have a class A in which methods with the following signatures are defined:

```
+ a(int): float
- a(float): int
+ a(float, int): double
- a(int, float): int
```

a) Do these methods override each other or do they overload each other? [2 marks]

b) Suppose we define a new class, B, that extends A. Which of the following methods can we provide definitions for in B?

```
- a(int): float
+ a(int): double
+ a(float): int
- a(int, int): float
```

For each method that cannot be defined in B, explain why.
[4 marks]

c) For each of the following signatures, state whether we can add a method with that signature to A.

```
- a(int): int
+ a(float, float): double
- a(int, double): int
+ a(): int
```

For each method that cannot be added to A, explain why.
[4 marks]

Question 3

Write down the output of the following Java program.

```
1  package com.chromamorph.pfiReExam2019;
2
3  public class Q3a {
4      public static void main(String[] args) {
5          int[] a = {1,2,3,4};
6          for(int i : a) System.out.print(i/2+" ");
7          System.out.println();
8          for(int i : a) System.out.print(i/2.0+" ");
9          System.out.println();
10         for(int i : a) if (i%2==0) System.out.print(i/2.0+" ");
11     }
12 }
```

[10 marks]

Question 4

Study the following definitions of four classes and an interface, all defined in the same package. Draw a UML class diagram that describes the associations between the five modules, V, W, X, Y and Z. Your diagram should list the members of each module and give the visibility of each member. Also provide the return type of each operation. [10 marks]

```
public class V implements W {
    X[] xArray;
    public int a(int i) {return 0;}
    public float b(double d) {return 0;}
}

public interface W {
    int a(int i);
    float b(double d);
}

public abstract class X {
    Y y;
    abstract double c(int i);
    float d(int j) {return 0;}
}

public class Y {
    int x,y,z;
}

public class Z extends X {
    double c(int i) {return 0;}
}
```

Question 5

For each of the following three programs, state whether the program will run. If the program will run, write down the output that it prints to the console. If the program will not run, explain why it will not run and how it can be fixed, and state what the program will output after it has been fixed.

a)

```
public class Question5a {
    int x,y;
    public static void main(String[] args) {
        Question5a q = new Question5a();
        System.out.println(q.x+" "+q.y);
    }
}
```

[3 marks]

b)

```
public class Question5b {
    int x;
    public Question5b(int x) {this.x = x;}
    public static void main(String[] args) {
        Question5b p,q;
        p = new Question5b();
        q = new Question5b(2);
        System.out.print(p.x+" "+q.x);
    }
}
```

[3 marks]

c)

```
public class Question5c {
    static class Point {
        int x, y;
        public Point(int x, int y) {
            this.x = x;
            this.y = y;
        }
        public String toString() { return x + " " + y; }
    }
    static class ThreeDPoint extends Point {
        int z;
        public ThreeDPoint(int x, int y, int z) {
            super(x,y);
            this.z = z;
        }
        public String toString() { return super.toString() + " " + z; }
    }
    public static void main(String[] args) {
        System.out.println(new Point(1,2));
        System.out.println(new ThreeDPoint(1,2,3));
    }
}
```

[4 marks]

Question 6

In each of the following three programs, state which lines generate errors and explain why.

a)

```
1 public class Question6a {
2     int c;
3     public static void main(String[] args) {
4         System.out.println(c);
5     }
6 }
```

[3 marks]

b)

```
1 public class Question6b {
2     static class Foo { final int d = 2; }
3     public static void main(String[] args) {
4         System.out.println(new Foo().d = 4);
5     }
6 }
```

[3 marks]

c)

```
 1 public class Question6c {
 2     static abstract class Bar {
 3         int x = 1;
 4         abstract int twoX();
 5         int threeX() {return 3*x;}
 6     }
 7     static class Foo extends Bar {
 8         int twoX() {return 2*x;}
 9     }
10     public static void main(String[] args) {
11         Foo f = new Foo();
12         Bar b = new Bar();
13         System.out.println(f.twoX()+" "+f.threeX());
14         System.out.println(b.twoX()+" "+b.threeX());
15     }
16 }
```

[4 marks]

Question 7

The following program does not necessarily produce the same output every time it is run. Write down two different possible outputs that the following program might generate. [10 marks]

```
public class Question7 {
    static boolean GREEN_LIGHT = false;
    static boolean FINISHED = false;
    static int TOTAL = 5;
    static int DELAY = 500;
    static Random R = new Random();
    public static void main(String[] args) {
        Thread green = new Thread(new Runnable() {
            public void run() {
                while(!FINISHED) {
                    if (GREEN_LIGHT) {
                        System.out.print(--TOTAL+" ");
                        if (TOTAL == 0) {
                            FINISHED = true;
                            System.out.println("Green thread won!");
                            return;
                        }
                    }
                    try {
                        Thread.sleep(R.nextInt(DELAY));
                        GREEN_LIGHT = true;
                    } catch (InterruptedException e) {
                        e.printStackTrace();
                    }
                }
            }
        });
        Thread red = new Thread(new Runnable() {
            public void run() {
                while(!FINISHED) {
                    if (!GREEN_LIGHT) {
                        System.out.print(++TOTAL+" ");
                        if (TOTAL == 10) {
                            FINISHED = true;
                            System.out.println("Red thread won!");
                            return;
                        }
                    }
                    try {
                        Thread.sleep(R.nextInt(DELAY));
                        GREEN_LIGHT = false;
                    } catch (InterruptedException e) {
                        e.printStackTrace();
                    }
                }
            }
        });
        green.start();
        red.start();
    }
}
```

Question 8

Study the following two programs and answer the questions that follow them.

```
10 public class Question8Client {
11     public static void main(String[] args) {
12         try {
13             Socket s = new Socket("localhost",40000);
14             PrintWriter out = new PrintWriter(s.getOutputStream(),true);
15             BufferedReader in = new BufferedReader(new InputStreamReader(s.getInputStream()));
16             out.println("This line has 28 characters.");
17             System.out.println(in.readLine());
18             out.close();
19             in.close();
20             s.close();
21         } catch (UnknownHostException e) {
22             e.printStackTrace();
23         } catch (IOException e) {
24             e.printStackTrace();
25         }
26     }
27 }
```

```
10 public class Question8Server {
11     public static void main(String[] args) {
12         ServerSocket ss = null;
13         Socket cs = null;
14         PrintWriter out = null;
15         BufferedReader in = null;
16         try {
17             ss = new ServerSocket(40000);
18             cs = ss.accept();
19             out = new PrintWriter(cs.getOutputStream(),true);
20             in = new BufferedReader(new InputStreamReader(cs.getInputStream()));
21             String l = in.readLine();
22             System.out.println(l);
23             out.println(l.length());
24             out.close();
25             in.close();
26             cs.close();
27             ss.close();
28         } catch(IOException e) {
29             e.printStackTrace();
30         }
31     }
32 }
```

a) If Question8Server is started and then Question8Client is started, write down what each program prints to its respective console. [4 marks]

b) What happens if Question8Client is started before Client8Server is running? [2 marks]

c) What port number is Question8Server running on? [2 marks]

d) What happens if Question8Server is started but Question8Client is never started? [2 marks]

Question 9

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

```
 9 public class Question9 {
10     public static void main(String[] args) {
11         javax.swing.SwingUtilities.invokeLater(new Runnable() {
12             public void run() {
13                 JFrame frame = new JFrame("BorderLayoutDemo");
14                 frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
15                 Container pane = frame.getContentPane();
16                 pane.add(new JButton("1"), BorderLayout.PAGE_START);
17                 pane.add(new JButton("2"), BorderLayout.CENTER);
18                 pane.add(new JButton("3"), BorderLayout.LINE_START);
19                 pane.add(new JButton("4"), BorderLayout.LINE_END);
20                 pane.add(new JButton("5"), BorderLayout.PAGE_END);
21                 pane.add(new JButton("6"), BorderLayout.PAGE_START);
22                 frame.pack();
23                 frame.setVisible(true);
24             }
25         });
26     }
27 }
```

a) Sketch what the GUI for this program looks like when it is run. [4 marks]
b) What is the purpose of line 14? [2 marks]
c) On which thread is the GUI run? [2 marks]
d) What is the purpose of line 22? [2 marks]

Question 10

Study the following Android class definition and answer the questions that follow it.

```
public class SensorActivity extends Activity implements SensorEventListener {
  private SensorManager mSensorManager;
  private Sensor mLight;

  @Override
  public final void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.main);

    mSensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
    mLight = mSensorManager.getDefaultSensor(Sensor.TYPE_LIGHT);
  }

  @Override
  public final void onAccuracyChanged(Sensor sensor, int accuracy) {
    // Do something here if sensor accuracy changes.
  }

  @Override
  public final void onSensorChanged(SensorEvent event) {
    // The light sensor returns a single value.
    // Many sensors return 3 values, one for each axis.
    float lux = event.values[0];
    // Do something with this sensor value.
  }

  @Override
  protected void onResume() {
    super.onResume();
    mSensorManager.registerListener(this, mLight, SensorManager.SENSOR_DELAY_NORMAL);
  }

  @Override
  protected void onPause() {
    super.onPause();
    mSensorManager.unregisterListener(this);
  }
}
```

a) Which lifecycle callback methods are overridden in this class definition? [2 marks]

b) Does this activity use a streaming sensor or a non-streaming sensor? How do you know? [2 marks]

c) What is the purpose of the line,
`mSensorManager.unregisterListener(this)`
in the onPause method and why is this line present in this particular method? [3 marks]

d) Which object listens for events emitted by the sensor? What does this object do in response to a sensor event being emitted? [3 marks]

END OF EXAMINATION