Aalborg University | BSc in Medialogy | 2nd Semester

Programming for Interaction

Ordinary Examination

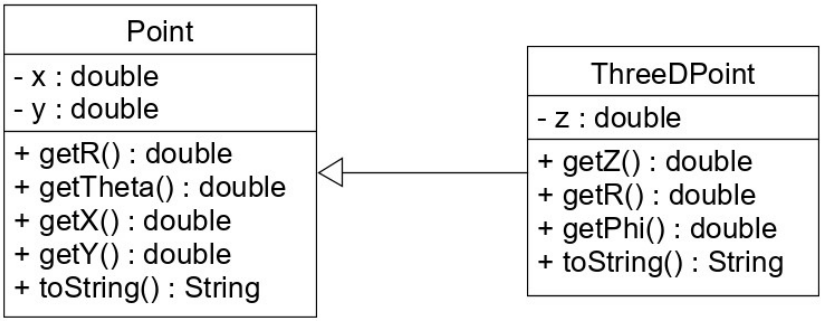
14 June 2019

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

Study the UML class diagram below and answer the questions that follow it.



a) Which of the two classes depends on the other? [1 mark]
b) Which of the two classes is the superclass of the other? [1 mark]
c) Which of the two classes is a specialization of the other? [1 mark]
d) Give an example from the diagram of method overriding. [1 mark]
e) List the operations in the public interface of ThreeDPoint. [2 marks]
f) List the members of the private interface of Point. [2 marks]
g) Can the attribute x, defined in Point, be accessed directly from within ThreeDPoint? [1 mark]
h) Can the attribute z, defined in ThreeDPoint, be accessed directly from within Point? [1 mark]

Question 2

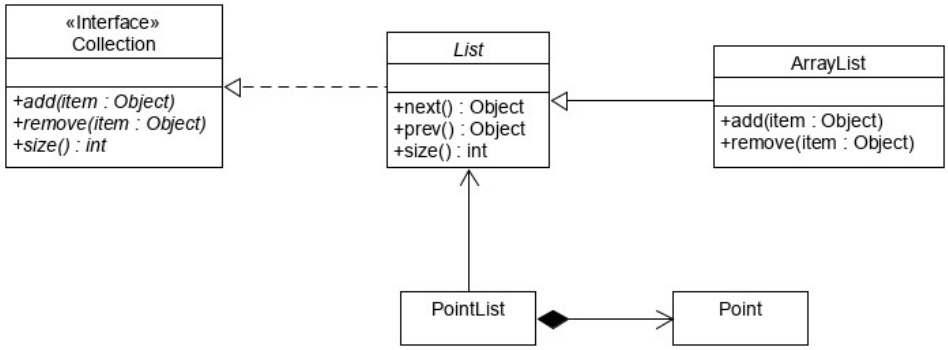
Write down the output of the following program.

```
3  public class Q2 {
4      public static void main(String[] args) {
5          int[] A = {9,4,2,8,7,1,3,5,6,4};
6          int p = 0, r = 7;
7          int x = A[r];
8          int i = p - 1;
9          for(int j = p; j < r; j++) {
10             if (A[j] <= x) {
11                 i++;
12                 int y = A[i];
13                 A[i] = A[j];
14                 A[j] = y;
15             }
16         }
17         int z = A[r];
18         A[r] = A[i+1];
19         A[i+1] = z;
20         for(int y : A) System.out.print(y + " ");
21     }
22 }
```

[10 marks]

Question 3

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



a) Which class in the diagram is an abstract class? [1 mark]
b) List the abstract methods of the abstract class you mentioned in part (a). [1 mark]
c) Give an example from the diagram of two classes related by composition and state which of the two classes contains the other. [2 marks]
d) Give an example from the diagram of two classes related by inheritance and state which of the two classes is the superclass of the other. [2 marks]
e) Explain the meaning of the dashed line with an open arrowhead from List to Collection? [2 mark]
f) Which classes in the diagram can be instantiated? [2 marks]

Question 4

Write down the output of the following Java program.

```
1  package dk.aau.pfiexam2019;
2
3  public class Q4 {
4      public static void main(String[] args) {
5          MyClass p = new MyClass();
6          MyClass q = new MyClass(2);
7          p.x++;
8          System.out.println(p+" "+q);
9          p = q;
10         p.x++;
11         System.out.println(p+" "+q);
12         q = new MyClass();
13         p.x++;
14         System.out.println(p+" "+q);
15         p = q;
16         q = new MyOtherClass();
17         p.x++;
18         System.out.println(p+" "+q);
19         p = new MyOtherClass();
20         q = null;
21         System.out.println(p+" "+q);
22     }
23 }
24
25 class MyClass {
26     int x;
27     public MyClass() {}
28     public MyClass(int x) {this.x = x;}
29     public String toString() {return "" + x;}
30 }
31
32 class MyOtherClass extends MyClass {
33     int y = 1;
34     public String toString() {return super.toString() + " " + y;}
35 }
```

[10 marks]

Question 5

Write down the output of the following Java program.

```
1  package dk.aau.pfiexam2019;
2
3  public class Q5 {
4      public static void main(String[] args) {
5          B b = new B(); C c = new C();
6          D d = new D(); E e = new E(); F f = new F();
7          A[] ar = {b,c,d,e,f};
8          int i = 1;
9          for(A a : ar) {
10             System.out.println(a.f(i) + " " + a.g(i));
11             i++;
12         }
13     }
14 }
15
16 abstract class A {
17     abstract int f(int x);
18     int g(int y) { return 2 * y; }
19 }
20
21 class B extends A { int f(int x) {return 3 * x; }}
22 class C extends B { int g(int z) {return 4 * z; }}
23 class D extends A {
24     int h(int w) {return 5 * w; }
25     int g(int w) {return 2 * h(w); }
26     int f(int w) {return h(w); }
27 }
28 class E extends B {int f(int y) {return super.f(y); }}
29 class F extends D {int h(int v) {return 2 * v; }}
```

[10 marks]

Question 6

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

```
1  package dk.aau.pfiexam2019;
2
3  public class Q6 {
4
5      static void print(Object o) {System.out.println(o);}
6      static Widget[] a = new Widget[4];
7      public static void main(String[] args) {
8          for(int i = 0; i < 4; i++) a[i] = new Widget();
9          for(Widget w : a) print(w);
10     }
11 }
12
13 class Widget {
14     static int n;
15     int id = 0;
16     public Widget() {id = ++n;}
17     public String toString() {return id + ": I'm a very " + (id%2==0?"even":"odd") + " widget!";}
18 }
```

a) What is the output of this program? [4 marks]
b) What would happen if the word, “static”, were removed from line 5? [2 marks]
c) Write down what the output of the program would be if the word, “static”, were removed from line 14 and everything else were kept the same. [2 marks]
d) Write down what the output of the program would be if “++n” in line 16 were changed to “n++” and everything else were kept the same. [2 marks]

Question 7

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

```
1  package dk.aau.pfiexam2019;
2
3  import java.util.Random;
4
5  public class Q7 {
6      static int[] a = {1,2,3};
7      static int[] b = {4,5,6};
8      static int[] c = new int[3];
9      static Thread[] threads = new Thread[3];
10
11     public static void main(String[] args) {
12         for(int i = 0; i < 3; i++) {
13             threads[i] = new Thread(new AddRunnable(i));
14             threads[i].start();
15         }
16         long delay = new Random().nextInt(1000);
17         try {
18             Thread.sleep(delay);
19         } catch (InterruptedException e) {
20             e.printStackTrace();
21         }
22         for(int x : c) System.out.print(x + " ");
23     }
24 }
25
26 class AddRunnable implements Runnable {
27     int i;
28     public AddRunnable(int i) {this.i = i;}
29     public void run() {
30         try {
31             long delay = new Random().nextInt(1000);
32             Thread.sleep(delay);
33         } catch (InterruptedException e) {
34             e.printStackTrace();
35         }
36         Q7.c[i] = Q7.a[i] + Q7.b[i];
37     }
38 }
```

a) Write down three possible outputs of this program. [6 marks]

b) It is possible to insert a single line of code between lines 18 and 19 so that the program is then guaranteed to produce the same output on every execution. Write down this line of code that needs to be inserted and state what the output will be after this modification has been made. [4 marks]

Question 8

Suppose we have defined the following two Java classes, Q8Server and Q8Client, each defined in its own ".java" file:

```
10 public class Q8Server {
11     private static String add(String inputString) {
12         String[] a = inputString.split(" ");
13         double sum = 0;
14         for(String s : a) {
15             double d = Double.parseDouble(s);
16             sum += d;
17         }
18         return "" + sum;
19     }
20
21     public static void main(String[] args) throws IOException{
22         ServerSocket serverSocket = null;
23         Socket clientSocket = null;
24         PrintWriter out = null;
25         BufferedReader in = null;
26         String inputLine;
27         try {
28             serverSocket = new ServerSocket(50000);
29             clientSocket = serverSocket.accept();
30             out = new PrintWriter(clientSocket.getOutputStream(), true);
31             in = new BufferedReader(new InputStreamReader(clientSocket.getInputStream()));
32             while ((inputLine = in.readLine()) != null){
33                 out.println(add(inputLine));
34             }
35         } catch (IOException e) {
36             e.printStackTrace();
37         }
38         out.close();
39         in.close();
40         clientSocket.close();
41         serverSocket.close();
42     }
43 }
```

```
11 public class Q8Client {
12     public static void main(String[] args) throws IOException {
13         String host = "localhost";
14         Scanner sc = null;
15         Socket socket = null;
16         PrintWriter out = null;
17         BufferedReader in = null;
18         try {
19             socket = new Socket(host, 50000);
20             out = new PrintWriter(socket.getOutputStream(),true);
21             in = new BufferedReader(new InputStreamReader(socket.getInputStream()));
22             sc = new Scanner(System.in);
23             String line = null;
24             while (!(line = sc.nextLine()).equals("")) {
25                 out.println(line);
26                 System.out.println("sum: " + in.readLine());
27             }
28         } catch (UnknownHostException e) {
29             System.err.println("Unknown host: "+host);
30         } catch (IOException e) {
31             e.printStackTrace();
32         }
33         sc.close();
34         out.close();
35         in.close();
36         socket.close();
37     }
38 }
```

a) Which of the two programs needs to be started first? [1 mark]

b) Write down the output that is printed to the consoles of Q8Client and Q8Server when the user types "2 3" in the console of Q8Client and then presses enter. [4 marks]

c) What are the IP address and port number assigned to Q8Server? [2 marks]

d) Explain why, in line 21 of Q8Client, the input stream on the socket is first wrapped in an InputStreamReader, which is then wrapped in a BufferedReader. [2 marks]

e) In which line does Q8Server block and wait for a connection request from a client? [1 mark]

Question 9

Study the following code which defines an Android Activity, and answer the questions that follow it.

```
12  public class MainActivity extends AppCompatActivity {
13
14      static int requestCode = 1234567;
15
16      @Override
17      protected void onCreate(Bundle savedInstanceState) {
18          super.onCreate(savedInstanceState);
19          setContentView(R.layout.activity_main);
20      }
21
22      public void respondToButton(View view) {
23          Toast.makeText( context: this, text: "Button was pressed",Toast.LENGTH_LONG).show();
24          Intent intent = new Intent(MediaStore.ACTION_IMAGE_CAPTURE);
25          if (intent.resolveActivity(getPackageManager()) != null) {
26              startActivityForResult(intent, requestCode);
27          }
28      }
29
30      public void onActivityResult(int requestCode, int resultCode, Intent data) {
31          if (requestCode == MainActivity.requestCode && resultCode == RESULT_OK) {
32              Bundle extras = data.getExtras( );
33              Bitmap imageBitmap = (Bitmap) extras.get("data");
34              ImageView imageView = (ImageView)findViewById(R.id.imageView);
35              imageView.setImageBitmap(imageBitmap);
36          }
37      }
38  }
```

a) This code uses an intent to start another activity. Write down the line number of the line in which this intent is instantiated and state whether the intent is implicit or explicit. [1 mark]

b) Which of the three methods defined in the example is a *lifecycle callback*? [1 mark]

c) What is the purpose of the requestCode variable defined in line 14? [2 marks]

d) The following is an excerpt from the XML layout file that defines the layout associated with the MainActivity class defined above:

```
<Button
    android:onClick="respondToButton"
    android:id="@+id/button"
```

   i. When the button referred to in this excerpt is pressed, the respondToButton method is called. When this happens, what object is passed to the respondToButton method as its argument? [1 mark]

   ii. What is the purpose of the button's "android:id" attribute? Explain the meaning of the "@", "+" and "id/" components of the value of this attribute. [2 marks]

e) An intent contains a Bundle object that is accessed through its getExtras() method. Explain what a Bundle is and how it is used in the Java code given above. [2 marks]

f) In line 33, why is the right-hand side of the assignment typecast to a Bitmap? [1 mark]

Question 10

The following code defines an Android activity that uses the light sensor.

```
1  public class MainActivity extends AppCompatActivity implements SensorEventListener {
2      private SensorManager mSensorManager;
3      private Sensor mLight;
4      private TextView accuracyTextView;
5      private TextView sensorValueTextView;
6
7      @Override
8      protected void onCreate(Bundle savedInstanceState) {
9          super.onCreate(savedInstanceState);
10         setContentView(R.layout.activity_main);
11         mSensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
12         mLight = mSensorManager.getDefaultSensor(Sensor.TYPE_LIGHT);
13         accuracyTextView = findViewById(R.id.accuracyTextView);
14         sensorValueTextView = findViewById(R.id.sensorValueTextView);
15     }
16
17     @Override
18     public final void onAccuracyChanged(Sensor sensor, int accuracy) {
19         accuracyTextView.setText(String.format("%d",accuracy));
20     }
21
22     @Override
23     public final void onSensorChanged(SensorEvent event) {
24         sensorValueTextView.setText(String.format("%.3f",event.values[0]));
25     }
26
27     @Override
28     protected void onResume() {
29         super.onResume();
30         mSensorManager.registerListener(this, mLight, SensorManager.SENSOR_DELAY_NORMAL);
31     }
32
33     @Override
34     protected void onPause() {
35         super.onPause();
36         mSensorManager.unregisterListener(this);
37     }
38 }
```

a) Why is it important to unregister the sensor listener in the onPause method?
b) Why is it necessary to register the sensor listener in the onResume method?
c) In which line of code is the sensor sampling rate set?
d) When setting the sampling rate of a sensor, should you generally use the fastest rate you can or the slowest rate that is sufficient? Why?
e) Which object in the code above serves as the SensorEventListener?

[2 marks for each correct part]

END OF EXAMINATION