Programming for Interaction

Re- Examination

18 August 2017

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 15 questions. Each question is worth 5 marks, apart from question 15, which is worth 10 marks.
- 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 turn over until you are told to do so by the invigilator.

Question 1

Which of the following statements are true? (At least one of the statements is true.)

a) A module is an identifiable part of a system. Functions, classes and packages are all examples of modules.

b) A module exhibits low cohesion when it is difficult to decompose it into smaller modules.

c) A system exhibits low coupling when there is not much dependency between the modules from which it is composed.

d) A class may implement many different interfaces; and an interface may be implemented by many different classes.

Question 2

Which of the following statements are true? (At least one of the statements is true.)

a) Using getter and setter methods instead of making instance variables public helps to preserve encapsulation and allows developers to improve an implementation without changing the public interface of a module.

b) Method overriding occurs when a method in a class has the same signature as a method defined in one of its superclasses.

c) Method overloading occurs when two or more of a class's methods have the same selector.

d) A variable is said to be polymorphic if it can refer to objects of any of two or more runtime classes.
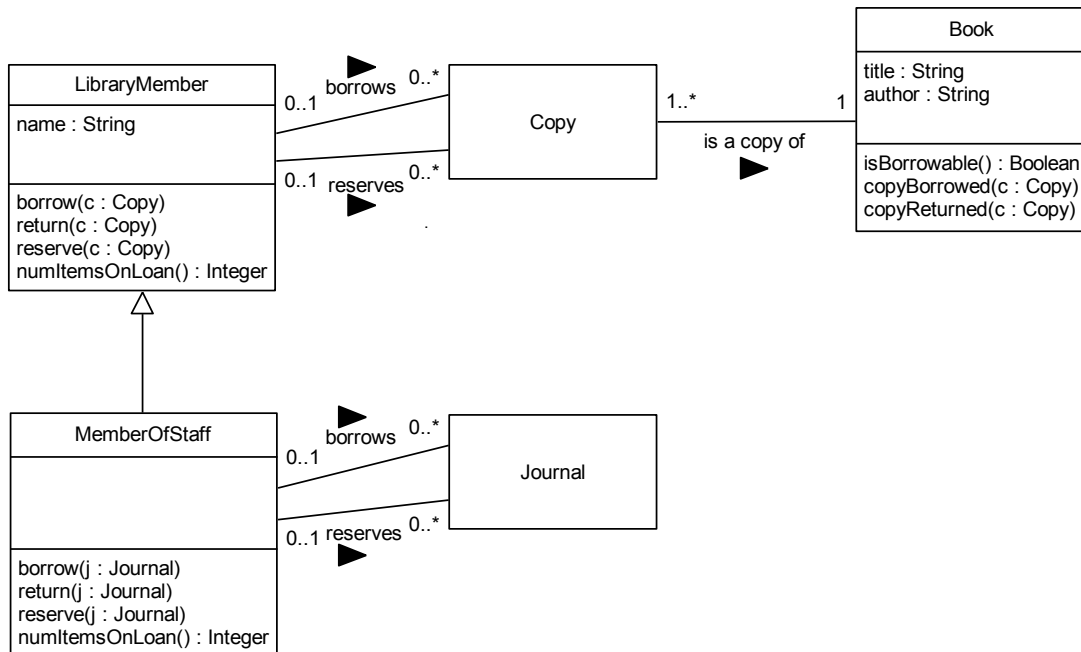
Question 3

What is the output of the following Java program?

```
1    public class Question3 {
2        static int s = 4;
3        static int n = 0;
4        int i;
5
6        public Question3 () { i = n++; }
7
8        public static void main(String[] args) {
9            Question3[] a = new Question3[s];
10           for (int i = s-1; i >= 0; i--)
11               a[i] = new Question3();
12           for(Question3 q : a)
13               System.out.println(q.i);
14       }
15   }
```

Question 4
Study the following UML class diagram and answer the questions that follow it.

(a) What is the maximum number of Copy objects that a LibraryMember can borrow?

(b) How many Book objects is each Copy object associated with?

(c) Is the borrow method in the LibraryMember class overridden in the MemberOfStaff class?

(d) Is the reserve method in the MemberOfStaff class overloaded?

(e) What is the return type of the isBorrowable method defined in the Book class?

Question 5

Write down the output of the following Java program. [5 marks]

```java
public class Question5 {

    double x;
    int i;

    public Question5() {
        x = 1;
        i = 2;
    }
    public String toString() {
        return x + " " + i;
    }

    public static void main(String[] args) {
        Question5 p = new Question5();
        Question5 q = p;
        q.x = p.i * 3;
        Question5 r = q;
        q = new Question5();
        r.i *= 2;
        System.out.println(p);
        System.out.println(q);
        System.out.println(r);

    }
}
```

Question 6

Study the following Java code and answer the question that follows it.

```java
public class Question6 {
    static interface Sum {
        double sum(double x, double y); // returns sum of x and y
    }

    static interface Product {
        double product(double x, double y); // returns product of x and y
    }

    static interface Quotient {
        double quotient(double x, double y); // returns x/y
    }

    static class A implements Sum, Product {
        public double sum(double x, double y) { return x + y; }
        public double product(double x, double y) { return x * y; }
    }

    static class B implements Sum, Quotient {
        public double sum(double x, double y) { return x + y; }
        public double quotient(double x, double y) { return x / y; }
    }

    static class C implements Product, Quotient {
        public double product(double x, double y) { return x * y; }
        public double quotient(double x, double y) { return x / y; }
    }

    static class D extends A {
        public double sum(double x, double y) { x += y; return x; }
    }

    static class E extends B {
        public double quotient(double x, double y) { x /= y; return x; }
    }

    static class F extends C {
        public double product(double x, double y) { x *= y; return x; }
    }

    public static void main(String[] args) {
        A a = new A();
        B b = new B();
        C c = new C();
        D d = new D();
        E e = new E();
        F f = new F();

        A[] as = {a, b, c ,d, e, f};
        B[] bs = {a, b, c ,d, e, f};
        C[] cs = {a, b, c ,d, e, f};
        Sum[] sums = {a, b, c ,d, e, f};
        Product[] products = {a, b, c ,d, e, f};
        Quotient[] quotients = {a, b, c, d, e, f};

    }
}
```

In lines 49 to 54, six arrays are declared and each is initialized to contain the six objects constructed in lines 42 to 47. However, this program will not compile because each of these six arrays is defined to contain one or more objects that it cannot contain due to a type mismatch. For example, the array, **as**, in line 49 cannot contain the objects **b**, **c**, **e** or **f**. These objects would therefore need to be removed from the definition of **as** in order to correct this error.

For each of the arrays in lines 50-54, write down the objects that need to be removed from the array in order to correct the error(s) in that line of the code.

Question 7

Write down the output of the following Java program.

```java
1    public class Question7 {
2        static int i = 0;
3        int j, k, l, m;
4
5        public Question7() {
6            k = i++;
7            l = ++i;
8            m = j++;
9        }
10
11       public String toString() {
12           return k + " " + l + " " + m;
13       }
14
15       public static void main(String[] args) {
16           for(int i = 0; i < 3; i++)
17               System.out.println(new Question7());
18       }
19   }
```

Question 8

Study the following UML class diagram and answer the questions that follow it.
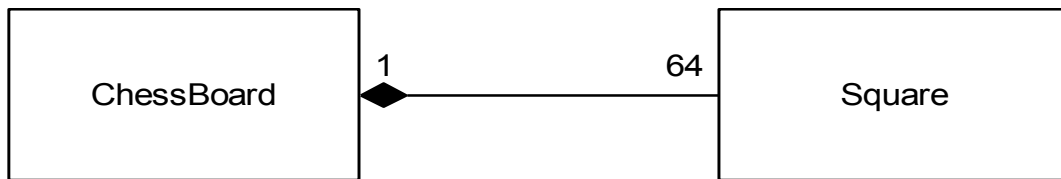
(a) Is this an instance of composition or is it an instance of aggregation?

(b) Which of the two classes is the container (or "whole") class?

(c) If a Square object is deleted, is the ChessBoard object associated with it also deleted?

(d) Can a Square object be associated with more than one ChessBoard object?

(e) If a ChessBoard object is deleted, are the Square objects associated with it also deleted?

Question 9

Write down the output of the following program.

```
1   public class Question9 {
2       static void print(String s) {
3           System.out.println(s);
4       }
5
6       public static void main(String[] args) {
7           for(int j = 10, i = 0; i*j < 25; i++, j--)
8               switch(i*j) {
9               case 21 : print("twenty-one");
10              case 16 : print("sixteen");
11              default: print(""+(i*j));
12              }
13       }
14  }
```

Question 10

Write down the output of the following program.

```
1   public class Question10 {
2       public static void main(String[] args) {
3           double i = 5;
4           int j = 2;
5
6           System.out.println(i+j);
7           System.out.println(""+i+j);
8           System.out.println(i+j+"");
9           System.out.println(""+(i+j));
10          System.out.println(i+""+j);
11      }
12  }
```

Question 11

Write down the output of the following program.

```
1   public class Question11 {
2       static int j = 6;
3
4       static class FooException extends Exception {
5           private static final long serialVersionUID = 1L;
6           public FooException() { super(); }
7           public FooException(String s) {super(s);}
8       }
9
10      static void throwFoo(String s) throws FooException {
11          j = 4;
12          throw new FooException(s);
13      }
14
15      static void print(String s) {
16          System.out.println(s);
17      }
18
19      public static void main(String[] args) {
20          boolean finished = false;
21          while (!finished)
22              try {
23                  for(int i = j; i >= 0; i--) {
24                      if (i < 2 && j > 5)
25                          throwFoo(""+i);
26                      else
27                          print(""+i);
28                      finished = (i == 0);
29                  }
30              } catch(FooException e) {
31                  print(e.getMessage());
32              }
33      }
34  }
```

Question 12

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

```java
1   public class Question12 {
2       public static void print(int i) {
3           System.out.print(Thread.currentThread().getName() + ":" + i + " ");
4       }
5
6       public static void main(String[] args) {
7           Thread thread1 = new Thread(new Runnable() {
8               public void run() {
9                   try {
10                      for(int i = 0; ; i+=3) {
11                          Thread.sleep(100);
12                          Question12.print(i);
13                      }
14                  } catch (InterruptedException e) {
15                      return;
16                  }
17              }
18          }, "X");
19          Thread thread2 = new Thread(new Runnable() {
20              public void run() {
21                  try {
22                      for(int i = -1; ; i-=2) {
23                          Thread.sleep(100);
24                          Question12.print(i);
25                      }
26                  } catch (InterruptedException e) {
27                      return;
28                  }
29              }
30          }, "Y");
31          thread1.start();
32          thread2.start();
33          try {
34              Thread.sleep(500);
35          } catch (InterruptedException e) {
36              e.printStackTrace();
37          }
38          thread1.interrupt();
39          thread2.interrupt();
40      }
41  }
```

(a) Which of the following strings are possible outputs from this program?
  (At least one of the strings is a possible output.)

    i.   Y:-1 X:0 X:3 Y:-3 Y:-5 X:6 Y:-7 X:9

    ii. Y:-1 X:0 Y:-3 X:3 X:6 Y:-5 X:9 Y:-7

    iii. X:0 Y:-1 Y:-3 X:3 Y:-5 X:6 Y:-7 X:9

    iv. Y:-1 X:3 X:0 Y:-3 X:6 Y:-5 Y:-7 X:9

(b) What is the purpose of line 34?

(c) Why is line 34 written inside a try–catch loop?

(d) Is Runnable a class or an interface?

(e) What does the "interrupt" method do, which is called in lines 38 and 39?

Question 13

Study the two Java class definitions below and answer the questions that follow.

```java
public class Question13Client {
    public static void main(String[] args) {
        try {
            Socket socket = new Socket("localhost", 50000);
            PrintWriter out = new PrintWriter(socket.getOutputStream(),true);
            BufferedReader in = new BufferedReader(new InputStreamReader(socket.getInputStream()));
            out.println("cotmnraor");
            System.out.println(in.readLine());
            in.close();
            out.close();
            socket.close();
        } catch (UnknownHostException e) {
            e.printStackTrace();
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}

public class Question13Server {
    public static String decode(String s) {
        String r = "";
        int begin = 0;
        for(int i = 0; i < s.length(); i++)
            r = r+ s.substring(begin = (i*7)%s.length(), begin+1);
        return r;
    }
    public static void main(String[] args) {
        try {
            ServerSocket serverSocket = new ServerSocket(50000);
            Socket clientSocket = serverSocket.accept();
            PrintWriter out = new PrintWriter(clientSocket.getOutputStream(), true);
            BufferedReader in = new BufferedReader(new InputStreamReader(clientSocket.getInputStream()));
            String input = "";
            input = in.readLine();
            out.println(decode(input));
            in.close();
            out.close();
            clientSocket.close();
            serverSocket.close();
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

(a) Which of the two programs should be started first?

(b) What is written to the console window by the Question13Server program?

(c) What is written to the console window by the Question13Client program?

(d) What is the effect of the InputStreamReader object instantiated in line 33?

(e) Can the two programs be run on different machines? Explain your answer.

Question 14

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

```
1    public class Question14 extends JFrame implements ActionListener {
2        private static final long serialVersionUID = 1L;
3        private JPanel panel = new JPanel();
4        private JButton button1 = new JButton("B1Unclicked");
5        private JButton button2 = new JButton("B1Clicked");
6
7        public void actionPerformed(ActionEvent e) {
8            JButton source = (JButton)e.getSource();
9            JButton other = button1;
10           if (source.equals(button1))
11               other = button2;
12           if (source.getText().contains("Clicked")) {
13               source.setText(source.getName()+"Unclicked");
14               other.setText(source.getName()+"Clicked");
15           } else {
16               source.setText(source.getName()+"Clicked");
17               other.setText(source.getName()+"Unclicked");
18           }
19       }
20       public Question14() {
21           setTitle("Question14");
22           panel.add(button1); panel.add(button2);
23           getContentPane().add(panel);
24           button1.setName("B1");
25           button2.setName("B2");
26           button1.addActionListener(this);
27           button2.addActionListener(this);
28           pack();
29           setVisible(true);
30       }
31       public static void main(String[] args) {
32           SwingUtilities.invokeLater(new Runnable() {
33               public void run() { new Question14(); }
34           });
35       }
36   }
```

(a) Draw a sketch of the GUI that appears when this program is run.

(b) Which object serves as an ActionListener?

(c) What text is shown on the buttons after button2 is clicked while its text is "B1Clicked"?

(d) What is the purpose of line 28?

(e) On which thread is the GUI run?

Question 15 [10 marks]

An Android app has a **strings.xml** file in its **res/values** folder whose contents is as follows:

```xml
1    <resources>
2        <string name="app_name">2017ReExamQ15</string>
3        <string name="button_text1">Button clicked</string>
4        <string name="textView_text1">Button has been clicked</string>
5        <string name="textView_text2">Button has been clicked again</string>
6    </resources>
```

The following is an excerpt from the app's **activity_main.xml** file which is in its **res/layout** folder:

```xml
9        <TextView
10           android:layout_width="wrap_content"
11           android:layout_height="wrap_content"
12           android:text="Hello World!"
13           app:layout_constraintBottom_toBottomOf="parent"
14           app:layout_constraintLeft_toLeftOf="parent"
15           app:layout_constraintRight_toRightOf="parent"
16           app:layout_constraintTop_toTopOf="parent"
17           android:id="@+id/textView"
18           tools:layout_constraintTop_creator="1"
19           tools:layout_constraintRight_creator="1"
20           tools:layout_constraintBottom_creator="1"
21           tools:layout_constraintLeft_creator="1" />
22
23        <Button
24           android:id="@+id/button"
25           android:layout_width="wrap_content"
26           android:layout_height="wrap_content"
27           android:text="Button"
28           app:layout_constraintLeft_toLeftOf="parent"
29           app:layout_constraintRight_toRightOf="parent"
30           tools:layout_constraintTop_creator="1"
31           tools:layout_constraintRight_creator="1"
32           android:layout_marginTop="44dp"
33           app:layout_constraintTop_toBottomOf="@+id/textView"
34           tools:layout_constraintLeft_creator="1"
35           android:onClick="buttonPressed"
36           tools:ignore="HardcodedText" />
```

The following is an excerpt from the app's manifest file (**AndroidManifest.xml**):

```
 5        <application
 6            android:allowBackup="true"
 7            android:icon="@mipmap/ic_launcher"
 8            android:label="2017ReExamQ15"
 9            android:roundIcon="@mipmap/ic_launcher_round"
10            android:supportsRtl="true"
11            android:theme="@style/AppTheme">
12            <activity android:name=".MainActivity">
13                <intent-filter>
14                    <action android:name="android.intent.action.MAIN" />
15
16                    <category android:name="android.intent.category.LAUNCHER" />
17                </intent-filter>
18            </activity>
19        </application>
```

The following is an excerpt from the app's **MainActivity.java** file:

```
 9    public class MainActivity extends AppCompatActivity {
10
11        public TextView textView;
12        public String text1 = "Button has been clicked";
13
14
15        @Override
16        protected void onCreate(Bundle savedInstanceState) {
17            super.onCreate(savedInstanceState);
18            setContentView(R.layout.activity_main);
19            textView = (TextView)findViewById(R.id.textView);
20        }
21
22        public void buttonPressed(View view) {
23            Button button = (Button)view;
24            button.setText(getString(R.string.button_text1));
25            if (textView.getText().equals(getString(R.string.textView_text1)))
26                textView.setText(getString(R.string.textView_text2));
27            else
28                textView.setText(getString(R.string.textView_text1));
29        }
30    }
```

Answer the following questions relating to the excerpts above.

a) Sketch what the app looks like immediately after it loads, assuming that there are no other components in the GUI than the ones mentioned in the excerpts above.

b) Sketch what the app looks like after the button has been clicked for the first time.

c) Sketch what the app looks like after the button has been clicked for the second time.

d) In which line in which file is the button's event handler function specified?

e) In which line in which file is the TextView's id declared?

f) Where is the TextView's numeric id value defined?

g) In which line(s) in which file is it defined that the MainActivity class should be treated as the main class and loaded when the app is clicked in the launcher?

h) When the button is pressed, what specific object is passed to the buttonPressed method defined in lines 22-29 of MainActivity.java?

i) Describe what is done in line 23 of MainActivity.java and explain why this is necessary.

j) In which line in which file is the layout defined in activity_main.xml declared to be the layout to be used by the app?

END OF EXAMINATION