

Programming for Interaction

Ordinary Examination

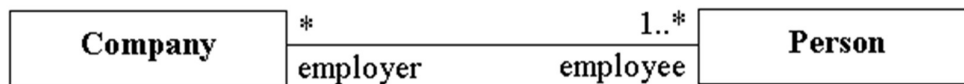
15 June 2018

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 9 questions and there is a total of 100 marks available. 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 1 answer to each question.
- Do not turn over until you are told to do so by an invigilator.

Question 1 [10 marks]

- a) Which one of the following is a thing that has identity, state and behaviour? [2 marks]
- A data field
 - A class
 - A method
 - An object
- b) Which one of the following terms refers to the feature of object-oriented programming that allows you to derive new classes from existing classes? [2 marks]
- Abstraction
 - Inheritance
 - Encapsulation
 - Generalization
- c) Which one of the following is a consequence of polymorphism? [2 marks]
- A variable of class C can refer to an object whose runtime class is a subclass of C.
 - A class can contain another class.
 - Data fields should be declared private.
 - A class can extend another class.
- d) Consider the following diagram and answer the questions that follow it.



- According to this diagram, is it possible for a Company object to have no employees? [2 marks]
- According to this diagram, is it possible for a Person object to not have an employer? [2 marks]

Question 2 [10 marks]

- a) Which of the following statements are true of constructors in Java (at least one is true)? [2 marks]
- Multiple constructors can be defined in a class.
 - Constructors are invoked using the new operator when an object is created.
 - Constructors do not have a return type, not even void.
 - Constructors must have the same name as the class itself.

- b) Analyse the following Java code and state which of the statements that follow it are true (at least one of the statements is true). [2 marks]

```
1 public class Test {
2     public static void main(String[] args) {
3         A a = new A();
4         a.print();
5     }
6 }
7
8 class A {
9     String s;
10
11     A(String s) {
12         this.s = s;
13     }
14
15     void print() {
16         System.out.println(s);
17     }
18 }
```

- i. The program would compile and run if line 3 were changed to `A a = new A("5");`
 - ii. The program compiles and runs as it is and prints out nothing.
 - iii. The program has a compilation error because class A does not have a default constructor.
 - iv. The program has a compilation error because class A is not a public class.
- c) Given the declaration `Circle x = new Circle()`, which of the following statements is most accurate? [2 marks]
- i. x contains a reference to a Circle object.
 - ii. You can assign an int value to x.
 - iii. x contains an int value.
 - iv. x contains an object of type Circle.
- d) Analyse the following code and state which one of the statements that follow it is true. [2 marks]

```
1 public class Test {
2     int x;
3
4     public Test(String t) {
5         System.out.println("Test");
6     }
7
8     public static void main(String[] args) {
9         Test test = null;
10        System.out.println(test.x);
11    }
12 }
```

- i. The program has a compile error because x has not been initialized.
- ii. The program has a runtime `NullPointerException` because test is null while executing `test.x`.
- iii. The program has a compile error because test is not initialized.
- iv. The program has a compile error because Test does not have a default constructor.

- e) Analyse the following code and state which of the statements that follow it are true (at least one of the statements is true). [2 marks]

```
1 class Test {
2     private double i;
3
4     public Test(double i) {
5         this.t();
6         this.i = i;
7     }
8
9     public Test() {
10        System.out.println("Default constructor");
11        this(1);
12    }
13
14    public void t() {
15        System.out.println("Invoking t");
16    }
17 }
```

- i. this.t() may be replaced by t().
- ii. this(1) must be replaced by this(1.0).
- iii. this(1) must be called before System.out.println("Default constructor").
- iv. this.i may be replaced by i.

Question 3 [10 marks]

- a) Analyse the following code and state which of the statements that follow it are true (at least one of the statements is true). [2 marks]

```
1 public class A extends B {
2 }
3
4 class B {
5     public B(String s) {
6     }
7 }
```

- i. The program will compile if the following constructor is added to class A:
A(String s) {super(s);}
 - ii. The program will not compile because A does not have a default constructor.
 - iii. The program will not compile because the default constructor of A invokes the default constructor of B, but B does not have a default constructor.
 - iv. The program will compile if the following constructor is added to class A:
A(String s) {}
- b) Analyse the following code and state which of the statements that follow it are true (at least one of the statements is true). [2 marks]

```
1 public class Test {
2     public static void main(String[] args) {
3         B b = new B();
4         b.m(5);
5         System.out.println("i is " + b.i);
6     }
7 }
8
9 class A {
10    int i;
11
12    public void m(int i) {
13        this.i = i;
14    }
15 }
16
17 class B extends A {
18    public void m(String s) {
19    }
20 }
```

- i. The program will not compile because b.m(5) cannot be invoked since the method m(int) is hidden in B.
 - ii. The program has a runtime error on b.i because i is not accessible from b.
 - iii. The program will not compile, because m is overridden with a different signature in class B.
 - iv. The method m is not overridden in B. B inherits the method m from A and defines an overloaded method m in B.
- c) Write down the line numbers of the lines in the following code that have errors that prevent the code from compiling. [2 marks]

```

1 public class Test {
2     public static void main(String[] args) {
3         m(new GraduateStudent());
4         m(new Student());
5         m(new Person());
6         m(new Object());
7     }
8
9     public static void m(Student x) {
10        System.out.println(x.toString());
11    }
12 }
13
14 class GraduateStudent extends Student {
15 }
16
17 class Student extends Person {
18     public String toString() {
19         return "Student";
20     }
21 }
22
23 class Person extends Object {
24     public String toString() {
25         return "Person";
26     }
27 }

```

- d) In Java, what modifier keyword should you use on a class so that it is visible to other classes within the same package, but not visible to classes outside of its package? [2 marks]
- e) What is the output of the following program? [2 marks]

```

1 public class Test {
2     public static void main(String[] args) {
3         String s1 = new String("Welcome to Java!");
4         String s2 = new String("Welcome to Java!");
5
6         if (s1 == s2)
7             System.out.println("s1 and s2 reference to the same String
8             object");
9         else
10            System.out.println("s1 and s2 reference to different String
11            objects");
12 }

```

Question 4 [10 marks]

- a) What is the output of the following Java program? [2 marks]

```
1 class Test {
2     public static void main(String[] args) {
3         try {
4             System.out.println("Welcome to Java");
5             int i = 0;
6             int y = 2 / i;
7             System.out.println("Welcome to HTML");
8         }
9         finally {
10            System.out.println("The finally clause is executed");
11        }
12    }
13 }
```

- b) In order for an object to function as an Exception in Java, what interface must it implement? [2 marks]
- c) Which of the following statements are true (at least one of the statements is true)? [2 marks]
- A Java class that contains abstract methods must be abstract.
 - A non-abstract class cannot contain any abstract methods.
 - A class can be declared abstract if it does not contain any abstract methods.
 - Abstract classes have constructors.
- d) Which one of the following is syntactically correct in Java? [2 marks]
- interface A { void print(); }
 - interface A { void print() {}; }
 - abstract interface A { print(); }
 - abstract interface A { abstract void print() {}; }
- e) Write down the output of the following Java program. [2 marks]

```
1 interface A {
2 }
3
4 class C {
5 }
6
7 class B extends D implements A {
8 }
9
10 public class Test {
11     public static void main(String[] args) {
12         B b = new B();
13         if (b instanceof A)
14             System.out.println("b is an instance of A");
15         if (b instanceof C)
16             System.out.println("b is an instance of C");
17     }
18 }
19
20 class D extends C {
21 }
```

Question 5 [8 marks]

- What elements are used in use case modelling?
- In use case modelling, explain the concept of generalization?
- In use case modelling, explain the concept of extending?
- In use case modelling, explain the concept of including?

[2 marks for each part]

Question 6 [8 marks]

- a. What elements are used in a sequence diagram?
- b. In a sequence diagram, explain what a lifeline is?
- c. In a sequence diagram horizontal lines between objects are called messages. What does the message call represent?
- d. What type of messages can be passed in a sequence diagram?

[2 marks for each part]

Question 7 [8 marks]

- a. What is GIT and its properties?
- b. What is a repository in GIT?
- c. In version control, what information is related to a revision?
- d. What is the staging area in GIT?

[2 marks for each part]

Question 8 [12 marks]

- a. In software development, what steps are a part of the waterfall model? [2 marks]
- b. In SCRUM, explain the following concepts
 - 1. What is the product backlog? [2 marks]
 - 2. What is a sprint? [2 marks]
 - 3. What is a daily scrum meeting? [2 marks]
- c. What programming paradigms does Java support? [2 marks]
- d. What is event-driven programming? [2 marks]

Question 9 [24 marks]

The following shows the Java source code for the main activity class of an Android app.

```
1 public class MainActivity extends Activity {
2
3     private static final int REQUEST_IMAGE_CAPTURE = 123456;
4
5     @Override
6     protected void onCreate(Bundle savedInstanceState) {
7         super.onCreate(savedInstanceState);
8         setContentView(R.layout.activity_main);
9     }
10
11     public void onPressed(View view) {
12         Intent intent = new Intent(MediaStore.ACTION_IMAGE_CAPTURE);
13         if (intent.resolveActivity(getPackageManager()) != null) {
14             startActivityForResult(intent, REQUEST_IMAGE_CAPTURE);
15         }
16     }
17
18     protected void onActivityResult(int requestCode, int resultCode, Intent data) {
19         if (requestCode == REQUEST_IMAGE_CAPTURE && resultCode == RESULT_OK) {
20             Bundle extras = data.getExtras();
21             Bitmap imageBitmap = (Bitmap)extras.get("data");
22             ImageView imageView = (ImageView)findViewById(R.id.imageView);
23             imageView.setImageBitmap(imageBitmap);
24         }
25     }
26 }
```

The following shows an excerpt from the XML layout definition file for the same activity.

```
1 <TextView
2     android:id="@+id/textView"
3     android:layout_width="wrap_content"
4     android:layout_height="wrap_content"
5     android:text="Hello World!" />
6
7 <Button
8     android:id="@+id/button"
9     android:layout_width="wrap_content"
10    android:layout_height="wrap_content"
11    android:text="Button"
12    android:onClick="onButtonPressed"/>
13
14 <ImageView
15     android:id="@+id/imageView"
16     android:layout_width="wrap_content"
17     android:layout_height="wrap_content" />
```

- Which method runs when the button in the activity is pressed?
- What is the purpose of the REQUEST_IMAGE_CAPTURE field defined in line 3 of the Java code?
- Which of the methods defined in the Java file are life-cycle call-back methods?
- For each of the life-cycle call-back methods implemented in the Java file, describe at which stage of the life-cycle of the activity that call-back is executed.
- Explain the purpose of the resultCode variable and RESULT_OK, as used in line 19 of the Java source code.
- In the XML layout definition file, explain the meaning of the "@+id" prefix of the android:id property as used in lines 2, 8 and 15.
- Explain the effect that "wrap_content" has on the formatting of a GUI element, as used in lines 3, 4, 8, 10, 16 and 17 of the XML layout file.
- Explain the difference between an explicit and an implicit intent.
- In line 12 of the Java file, is the intent explicit or implicit?

- j) What is the purpose of the call to the `resolveActivity` method in line 13 of the Java source code above?
- k) What kind of data structure is the `Bundle` object used in line 20 of the Java file and what purpose does it serve here?
- l) Give an example from the Java file of *type-casting* and explain why type-casting is necessary in the example that you choose.

[2 marks for each part]

END OF EXAMINATION