

# Programming for Interaction

## Ordinary Examination

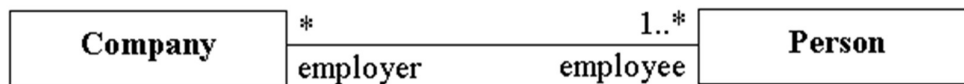
15 June 2018

### 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]
- i. A data field
  - ii. A class
  - iii. A method
  - iv. 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]
- i. Abstraction
  - ii. Inheritance
  - iii. Encapsulation
  - iv. Generalization
- c) Which one of the following is a consequence of polymorphism? [2 marks]
- i. A variable of class C can refer to an object whose runtime class is a subclass of C.
  - ii. A class can contain another class.
  - iii. Data fields should be declared private.
  - iv. A class can extend another class.
- d) Consider the following diagram and answer the questions that follow it.



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

**Solutions:**

- a) iv
- b) ii
- c) i
- d) i. No, the multiplicity on the employee side is 1..\*.
- d) ii. Yes, the multiplicity on the employer side is \* so 0 is a valid value.

## 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 }
```

- The program would compile and run if line 3 were changed to `A a = new A("5");`
  - The program compiles and runs as it is and prints out nothing.
  - The program has a compilation error because class A does not have a default constructor.
  - 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]
- x contains a reference to a Circle object.
  - You can assign an int value to x.
  - x contains an int value.
  - 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 }
```

- The program has a compile error because x has not been initialized.
  - The program has a runtime `NullPointerException` because test is null while executing test.x.
  - The program has a compile error because test is not initialized.
  - 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 }
```

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

## Solution:

a) i, ii, iii, iv

b) i, iii

c) i

d) ii

e) i, iii

**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
            object");
8         else
9             System.out.println("s1 and s2 reference to different String
            objects");
10    }
11 }
```

**Solution:**

a) i, iii

b) iv

c) lines 5 and 6

d) No modifier – the default visibility is package visibility.

e) s1 and s2 reference to different String objects

#### 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 }
```

#### Solution:

a)

```
Welcome to Java
Exception in thread "main" The finally clause is executed
java.lang.ArithmeticException: / by zero
at dk.aau.create.medialogy.pfi.exam2018.Question4a.main(Question4a.java:8)
```

Need to say that "Welcome to Java" is printed out, then an exception is thrown and the String "The finally clause is executed" is printed out. (If they don't mention that an exception is thrown, but do say that the string "Welcome to Java" is printed, followed by the string "The finally clause is executed", then that's OK.)

b) Throwable

c) i, ii, iii, iv

d) i

e)

**b is an instance of A**

**b is an instance of C**

**Question 5 [8 marks]**

- a. What elements are used in use case modelling?

***Actor, use cases, relationships between use cases***

- b. In use case modelling, explain the concept of generalization?

***Definition of more abstract use cases (shared activities)***

- c. In use case modelling, explain the concept of extending?

***Definition of optional use cases (similar)***

- d. In use case modelling, explain the concept of including?

***Definition of complementary use cases (use case would be incomplete without them)***

[2 marks for each part]

**Question 6 [8 marks]**

- a. What elements are used in a sequence diagram?

***Objects, actor, lifeline, messages, option, loop***

- b. In a sequence diagram, explain what a lifeline is?

***It represents time (objects' lifeline)***

- c. In a sequence diagram horizontal lines between objects are called messages. What does the message call represent?

***Messages sent from one object to another***

- d. What type of messages can be passed in a sequence diagram?

***Synchronous/asynchronous, return messages***

[2 marks for each part]

**Question 7 [8 marks]**

- a. What is GIT and its properties?

***It is a distributed version control system. Properties: Speed, Support for non-linear development (branches), Distribution, Handling large projects***

- b. What is a repository in GIT?

***This is considered the "official" copy of the code.***

- c. In version control, what information is related to a revision?

***Revisions are associated with a timestamp and the person who made the change***

- d. What is the staging area in GIT?

***Contains the files that are ready to be committed.***

[2 marks for each part]

**Question 8 [12 marks]**

- a. In software development, what steps are a part of the waterfall model? [2 marks]

***Requirements analysis, design, implementation, testing.***

- b. In SCRUM, explain the following concepts

1. What is the product backlog? [2 marks]

***An ordered list of everything that is known to be needed in the product. It is the single source of requirements for any changes to be made to the product.***

2. What is a sprint? [2 marks]

***A period ranging from 2 weeks (short) to a month (long) that can be considered an iteration. No outside external influence can interfere with the Scrum team during this period***

3. What is a daily scrum meeting? [2 marks]

***Is a short meeting of 15 minutes, held every day***

- ***The Scrum master and team participates***
- ***Every member of the team should answer three questions***
- ***Status: What did you do since the last meeting?***
- ***Issues: What is stopping you from getting on with your work?***
- ***Action: What should you do before the next meeting?***

- c. What programming paradigms does Java support? [2 marks]

***Imperative, OOP, concurrent, (event-driven)***

- d. What is event-driven programming? [2 marks]

***Using events, such as user actions (click, gestures, ...) to control the flow of a program***

- ***The goto paradigm when programming graphical user interfaces or when using Javascript for Web development***
- ***Listening and responding to events by executing callbacks as a response***

## 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" />
```



- a) Which method runs when the button in the activity is pressed?  
**The `onButtonPressed` method defined in lines 11-16 of the Java file.**
- b) What is the purpose of the `REQUEST_IMAGE_CAPTURE` field defined in line 3 of the Java code?  
**It is a unique id that identifies the specific intent sent in line 14 when the button is pressed. It is used by the `onActivityResult` callback to identify which response corresponds to this intent.**
- c) Which of the methods defined in the Java file are life-cycle call-back methods?  
**`onCreate`.**
- d) 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.  
**`onCreate` is called automatically when the `MainActivity` class is instantiated. It is the first lifecycle callback method called in the Activity lifecycle.**
- e) Explain the purpose of the `resultCode` variable and `RESULT_OK`, as used in line 19 of the Java source code.  
**The `resultCode` parameter of the `onActivityResult` method is an integer code identifying whether or not a valid result has been provided for the intent identified by the `requestCode`. `RESULT_OK` is a static final integer variable defined in the Activity class that is used to indicate that a result has been successfully provided for a request.**
- f) 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.  
**The “@id” prefix indicates that the string after the forward slash is an id type constant. The “+” symbol indicates that this is the first time the constant is used and that it should be added to the `R.java` file.**
- g) 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.  
**wrap\_content indicates that the view should be just big enough to hold its content**
- h) Explain the difference between an explicit and an implicit intent.  
**An explicit intent requests a service from an object of a specific class; an implicit intent only specifies the nature of the action that the requesting activity wants to have carried out.**
- i) In line 12 of the Java file, is the intent explicit or implicit?  
**Implicit intent.**
- j) What is the purpose of the call to the `resolveActivity` method in line 13 of the Java source code above?  
**It uses the package manager to check to see if there is an activity installed on the system that can fulfill the intent. If there is, then the if clause is executed.**
- 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?  
**A Bundle is an associative array or map containing key-value pairs. In this case, the Bundle contains a key-value pair whose key is “data” and whose value is a byte array that is used to store a small image in the intent sent back to `onActivityResult` from the Camera app.**
- l) Give an example from the Java file of *type-casting* and explain why type-casting is necessary in the example that you choose.  
**There are two examples of type-casting in the code. In line 21 of the Java file, the byte array stored in the data field the “extras” Bundle in the result Intent has to be typecast to a Bitmap so that it can be displayed in the ImageView object. In line 22, the View object returned by `findViewById` has to be type-cast to an ImageView object so that it can be used to display a bitmap.**

[2 marks for each part]

END OF EXAMINATION