

Written Exam

Programming Mobile Applications

Medialogy, 2nd semester

Thursday, 11 June 2026

Navn: _____

Studienr: _____

Programming Mobile Applications

Examination

11 June 2026

Instructions

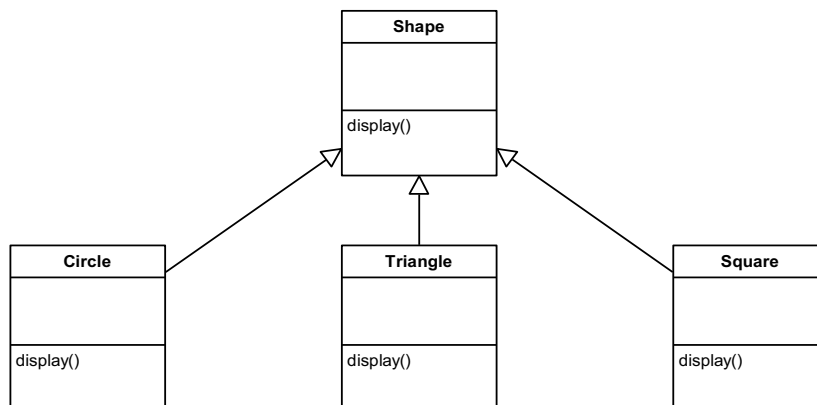
- Neither electronic devices nor written material are allowed in the examination room.
- This examination consists of 10 questions. Each question is worth 10 marks. You must obtain at least 50 marks to pass.
- Do not write any answers on this question paper—answers written on the question paper will 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

- a) Why did Dijkstra consider “goto” statements to be harmful? [2 marks]
- b) In the context of software engineering, what does it mean to say that a software system is “flexible”? [2 marks]
- c) Why is it considered good practice to minimize coupling between modules in a software system? [2 marks]
- d) Suppose we have two modules, A and B, and A depends on B. Which of the two modules is the client module in this relationship? [1 mark]
- e) Give two examples of the benefits of encapsulation and modularity? [2 marks]
- f) In Java, how many different interfaces can a class implement? [1 mark]

Question 2

Suppose that the classes Shape, Circle, Triangle and Square are related to each other according to the following inheritance hierarchy:



Now study the following code and answer the questions that follow it.

```
1 package dk.aau.imi.med4.ooadp2009.substitutability;
2
3 import java.util.ArrayList;
4
5 public class Substitutability {
6     public static void main(String[] args) {
7         //Create an ArrayList to hold Shape objects
8         ArrayList<Shape> shapeList =
9             new ArrayList<Shape>();
10        //Create a Shape object
11        Shape shape = new Shape();
12        //Create a Triangle object
13        Triangle triangle = new Triangle();
14        //Create a Circle object
15        Circle circle = new Circle();
16        //Create a Square object
17        Square square = new Square();
18        //Add all the Shape objects to shapeList
19        shapeList.add(shape);
20        shapeList.add(triangle);
21        shapeList.add(circle);
22        shapeList.add(square);
23        //Print out the objects in shapeList
24        for (Shape s : shapeList) {
25            s.display();
26        }
27    }
28 }
```

- a) In which line is there a call to a method that is dynamically bound? [2 mark]
- b) Give an example from the code of a polymorphic variable. [2 mark]
- c) Write down the Liskov substitution principle. [3 marks]
- d) Can the variable called triangle, defined in line 13 of the code above, be used to refer to an object of type Shape? [1 mark]
- e) Does the display() method defined in the Square class override the display() method defined in the Shape class? [1 mark]
- f) Is Shape a subclass of Circle? [1 mark]

Question 3

Suppose that the following class is compiled and exported to a runnable jar file called JavaIntroQuestion.jar:

```

1 package dk.aau.create.pma2026;
2
3 import java.util.TreeSet;
4
5 public class JavaIntroQuestion {
6     public static void main(String[] args) {
7         TreeSet<String> l = new TreeSet<String>();
8         for(String s : args) l.add(s);
9         for (String s : l) System.out.println(s);
10    }
11 }

```

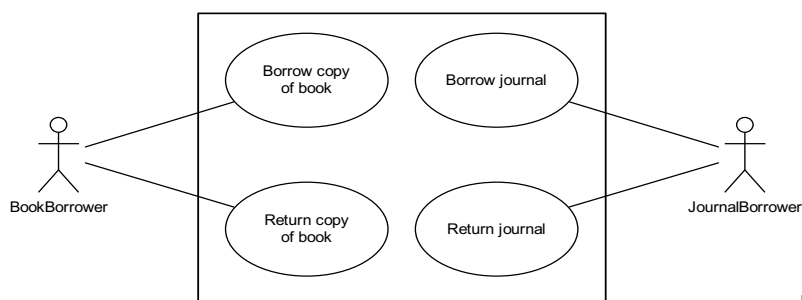
Now suppose we open a command line console, change directory to the directory that contains this jar file and type the following command at the command prompt:

```
java -jar JavaIntroQuestion.jar cat bat tab lap rap
```

What does this cause to be printed to the console window? [10 marks]

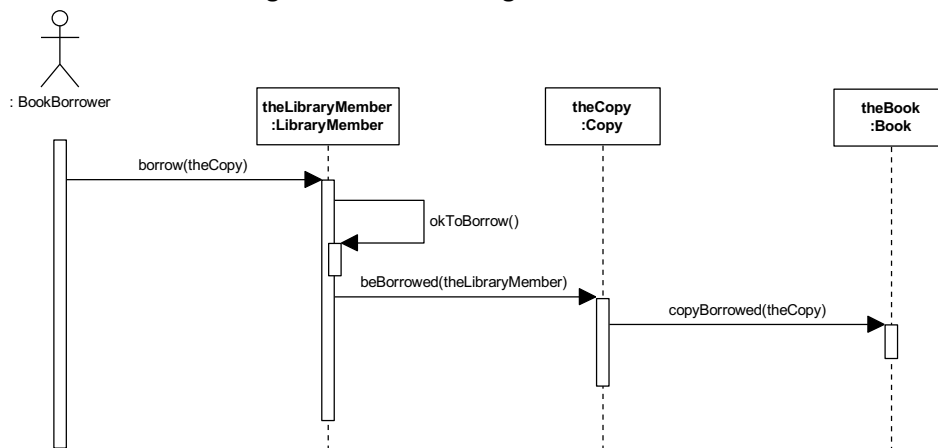
Question 4

- Explain the difference between using UML in sketch mode and using UML in blueprint mode. [2 marks]
- Give an example of a type of UML diagram that is a Structure diagram. [1 mark]
- Give an example of a type of UML diagram that is a Behaviour diagram. [1 mark]
- In a UML use case diagram, what is an *actor*? [2 marks]
- In the following diagram, what does the rectangular box represent? [2 marks]



[2 marks]

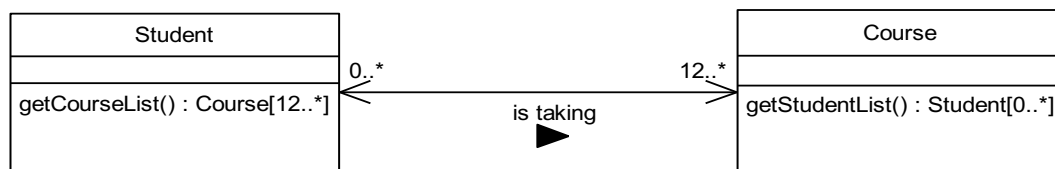
- What kind of UML diagram is the following? [2 marks]



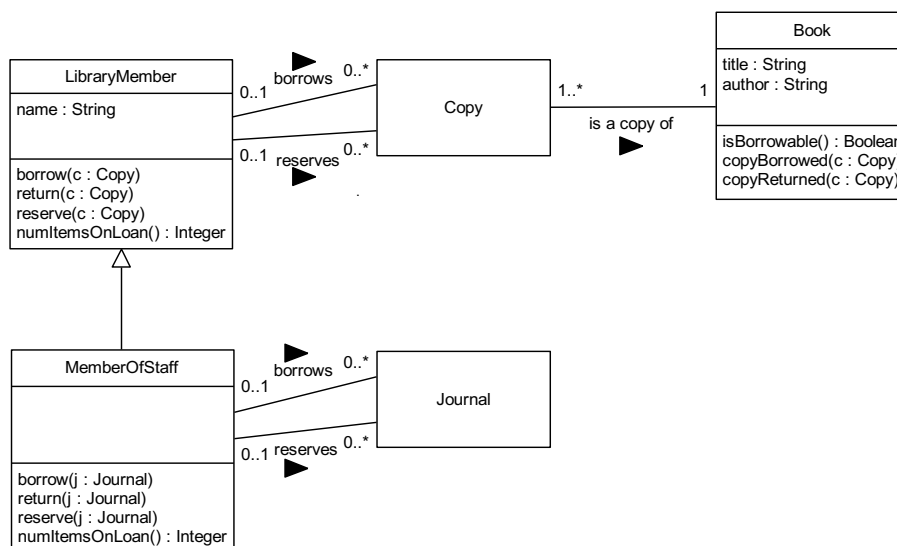
[2 marks]

Question 5

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



- What type of object is returned by the `getCourseList()` method? [2 marks]
 - How many `Course` objects can be associated with each `Student` object? [1 mark]
 - Is it possible for a `Course` not to have any students? [1 mark]
 - How do we know that `Courses` do not take `Students`? [1 mark]
- b) Study the following diagram and answer the questions that follow it.



- What is the maximum number of `LibraryMember` objects that can be associated with a single `Copy` object? [1 mark]
- Give an example from the diagram of *method overloading*. [1 mark]
- Give an example from the diagram of *method overriding*. [1 mark]
- How many `Copy` objects can be associated with each `Book` object? [1 mark]
- Can `MemberOfStaff` objects be associated with `Copy` objects? [1 mark]

Question 6

What does the following Java program print to the console window when it is run?

```
1 package dk.aau.create.pma2026;
2
3 class A {
4     int x, y;
5
6     public A(int x, int y) {
7         this.x = x;
8         this.y = y;
9     }
10
11     public String toString() {
12         return x + " " + y;
13     }
14 }
15
16 class B extends A {
17     int z;
18
19     public B(int x, int y, int z) {
20         super(x, y);
21         this.z = z;
22     }
23
24     public String toString() {
25         return super.toString() + " " + z;
26     }
27 }
28
29 public class Q6 {
30     public static void main(String[] args) {
31         A a = new A(1,2);
32         B b = new B(3,4,5);
33         System.out.println(a.toString() + b.toString());
34     }
35 }
```

[10 marks]

Question 7

What does the following Java program print to the console window when it is run?

```
1 package dk.aau.create.pma2026;
2
3 class HighDigitsException extends Exception {
4
5     private static final long serialVersionUID = 2798380313364582392L;
6
7     public HighDigitsException() {
8         super();
9     }
10
11     public HighDigitsException(String msg) {
12         super(msg);
13     }
14 }
15
16 class LowDigitsException extends Exception {
17
18     private static final long serialVersionUID = -2119586743596369004L;
19
20     public LowDigitsException() {
21         super();
22     }
23
24     public LowDigitsException(String msg) {
25         super(msg);
26     }
27 }
28
29 public class Q7 {
30
31     public static void lowDigits(String s) throws HighDigitsException {
32         for (int i = 0; i < s.length(); i++) {
33             int j = Integer.parseInt(s.substring(i,i+1));
34             if (j > 5)
35                 throw new HighDigitsException(j + " is greater than 5");
36         }
37     }
38
39     public static void highDigits(String s) throws LowDigitsException {
40         for (int i = 0; i < s.length(); i++) {
41             int j = Integer.parseInt(s.substring(i,i+1));
42             if (j < 6)
43                 throw new LowDigitsException (j + " is less than 6");
44         }
45     }
46
47     public static void main(String[] args) {
48         String s = "341623";
49         try {
50             lowDigits(s);
51         } catch (HighDigitsException e) {
52             System.out.println(e.getMessage());
53             try {
54                 highDigits(s);
55             } catch (LowDigitsException f) {
56                 System.out.println(f.getMessage());
57             }
58         }
59     }
60 }
```

[10 marks]

Question 8

The following program does not necessarily output the same thing every time it is run. Write down two possible outputs from the program.

```
1 package dk.aau.create.pma2026;
2
3 public class Q8 {
4
5     public static void main(String[] args) {
6         Thread t1 = new Thread(new Runnable() {
7             public void run() {
8                 try {
9                     for (int i = 0; i < 5; i++) {
10                        System.out.print(i + " ");
11                        Thread.sleep((long)Math.random()*1000);
12                    }
13                } catch (InterruptedException e) {
14                    return;
15                }
16            }
17        });
18        Thread t2 = new Thread(new Runnable() {
19            public void run() {
20                try {
21                    for (int i = 5; i > 0; i--) {
22                        System.out.print(i + " ");
23                        Thread.sleep((long)Math.random()*1000);
24                    }
25                } catch (InterruptedException e) {
26                    return;
27                }
28            }
29        });
30        t1.start();
31        t2.start();
32    }
33 }
```

[10 marks]

Question 9

For each of the following statements, write down whether it is true or false.

- a) An Android app runs in its own process, which runs in its own virtual machine.
- b) The process for an Android app starts when a component of that app is first executed.
- c) Each process has its own virtual machine.
- d) There are four types of component in an Android app: activities, services, content providers and broadcast receivers.
- e) Services run in the foreground and typically perform long-running operations.
- f) An Android app has a single point of entry which is its `main()` method.
- g) An implicit intent requests a component of a specified class.
- h) The `startActivity(Intent)` method launches an Activity without receiving any information back when the Activity exits.
- i) Among other things, the Android manifest file is used to give the user permissions that the application requires and specify the minimum API level required by the application.
- j) An Activity represents a single screen layout in an App.

[1 mark for each part]

Question 10

- a) What type (or types) of sensor would you use in order to allow a game to be controlled by the user tilting a device or changing its orientation? [2 marks]
- b) Give two examples of environmental sensors that an Android app might use. [2 marks]
- c) Write down one line of code that would get a List of all the sensors available on an Android device. [2 marks]
- d) To monitor a Sensor's readings, one needs to implement a `SensorEventListener`. What are the two callback methods that need to be implemented in a `SensorEventListener`? [2 marks]
- e) In which Activity lifecycle callback should you unregister all active `SensorEventListener`s and why? [2 marks]

END OF EXAMINATION