Object-oriented software engineering
Examination

Object-oriented analysis, design and programming
Re-examination

Medialogy 4th Semester, Aalborg

14 June 2013, 9.00 - 12.00

Instructions

READ THE FOLLOWING INSTRUCTIONS CAREFULLY!

You have 3 hours to complete the examination.

Neither written material nor electronic equipment may be brought into the examination room.

There are 12 questions and the maximum number of marks for each question is 10.

If you are taking the examination as an ordinary examination or re-examination for the "Object-oriented software engineering" course, you must get at least **60** marks in order to pass (i.e., 50% of the maximum possible number of marks).

Write your answers in blue or black ink. Answers written in pencil or any other colour of ink will be ignored by the examiner.

Submit no more than one answer to each question. If multiple answers are submitted for a single question, only one of your answers to the question will be marked.

Write your answers on the writing paper provided. Do not write your answers on the question paper. Anything written on the question paper will not be marked.

The following applies only to those students sitting this exam as a re-exam for the discontinued course,"Object-oriented analysis, design and programming"

If you are taking the examination as a re-examination for the discontinued "Object-oriented analysis, design and programming" (OOADP) course, then you must get at least **45** marks in order to pass. Questions 1-9 test knowledge of material that was presented in the OOADP course. If you are sitting a re-exam for OOADP, you are therefore not expected to be able to answer questions 10-12. However, any marks you gain on questions 10-12 will be counted towards your total mark.
DO NOT TURN OVER UNTIL TOLD TO DO SO!

Question 1

a. In software engineering, it is generally accepted that a good software system should be *useful*, *usable*, *reliable*, *flexible*, *affordable* and *available*. Briefly explain the meaning of each of these italicised terms. [5 marks]

b. Explain what is meant by the terms *spaghetti code*, *modularity* and *encapsulation*. What is the main problem caused by spaghetti code and how can modularity and encapsulation help to prevent it? [5 marks]

Question 2

a. Write down the output of the following Java program.

```
1 package dk.aau.medialogy.semester4.oose.exam2013;
2
3 public class Question2 {
4
5     public static void main(String[] args) {
6         for (int i = -4; i < 4; i++)
7             System.out.println(i % 3);
8     }
9 }
```

[5 marks]

b. Write down the output of the following Java program.

```
1 package dk.aau.medialogy.semester4.oose.exam2013;
2
3 public class Question2b {
4     public static void main(String[] args) {
5         char[] a = {'t','s','h','t','i','h',' ','t','\'','g','a','r'};
6         for(int i = 0; i < 12; i++)
7             System.out.print(a[5*i % 12]);
8     }
9 }
```

[5 marks]

TURN OVER

Question 3

Define each of the following terms as used in the context of object-oriented software engineering and give an example of each.

i. method selector

ii. method signature

iii. member visibility

iv. public interface

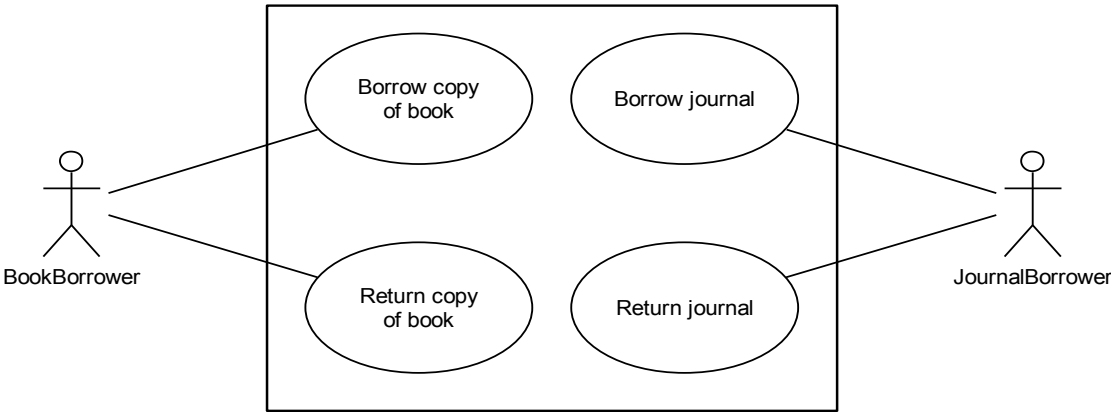
v. inheritance

[2 marks each]

Question 4

a. In UML, explain the difference between a *static structural model* and a *dynamic behavioural model*. Give examples of each type of model. [4 marks]

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



i. What kind of diagram is this?

ii. What kind of thing is represented by the stick-man labelled "BookBorrower"?

iii. What does the square box containing the 4 ellipses represent?

iv. What kind of thing does each of the four ellipses represent?

v. Is it possible for the same physical person to be both a BookBorrower and a JournalBorrower?

vi. At what stage in the development process are you most likely to use this kind of model?

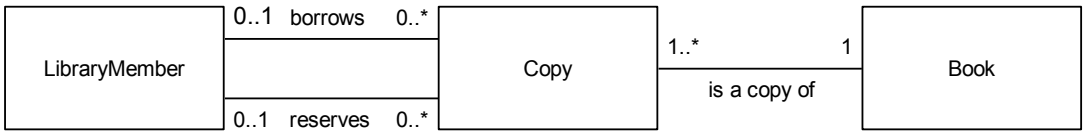
[1 mark each]

TURN OVER

Question 5

a. Describe four types of way in which two classes can be associated. [4 marks]

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



i. What kind of UML diagram is this?

ii. How many Copy objects are associated with each LibraryMember object?

iii. How many Book objects are associated with each Copy object?

iv. From the diagram, it is possible that each Book object is a copy of a Copy object. How could you indicate that this is not the case and that, in fact, each Copy object is a copy of a Book object?

v. How many LibraryMember objects are associated with each Copy object?

vi. When might you use such a diagram in the process of developing software?

[1 mark each]

TURN OVER

Question 6

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

```
1  package dk.aau.medialogy.semester4.oose.exam2013;
2
3  public class Question6 {
4
5      static class Point {
6          int x,y;
7
8          public String toString() {
9              return "("+x+","+y+")";
10         }
11     }
12
13     public static void main(String[] args) {
14         Point p = null;
15         Point q = new Point();
16         q.x = 5; q.y = 10;
17         p = q;
18         q.y = 12;
19         System.out.println(p);
20     }
21 }
```

i. What is the output of this program?

ii. Why is Point class marked as “static”?

iii. Why does the toString() method have to be marked “public”?

iv. Where is the no-args constructor for the Point class defined?

v. What is the type of System.out?

[2 marks each]

TURN OVER

Question 7

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

```
1  package dk.aau.medialogy.semester4.oose.exam2013;
2
3  public class Question7 {
4
5      final int d = 2;
6
7      interface A {
8          int c(int d);
9      }
10
11     class B implements A {
12         int c(int k) {
13             return 2*k;
14         }
15     }
16
17     public static void main(String[] args) {
18         A b = new B();
19         d = 3;
20         System.out.println(b.c(d));
21     }
22 }
23
```

a. What is the error in line 12?

b. What is the error in line 19?

c. What is the error in line 20?

d. There is an error in line 18. What would you need to do to correct this?

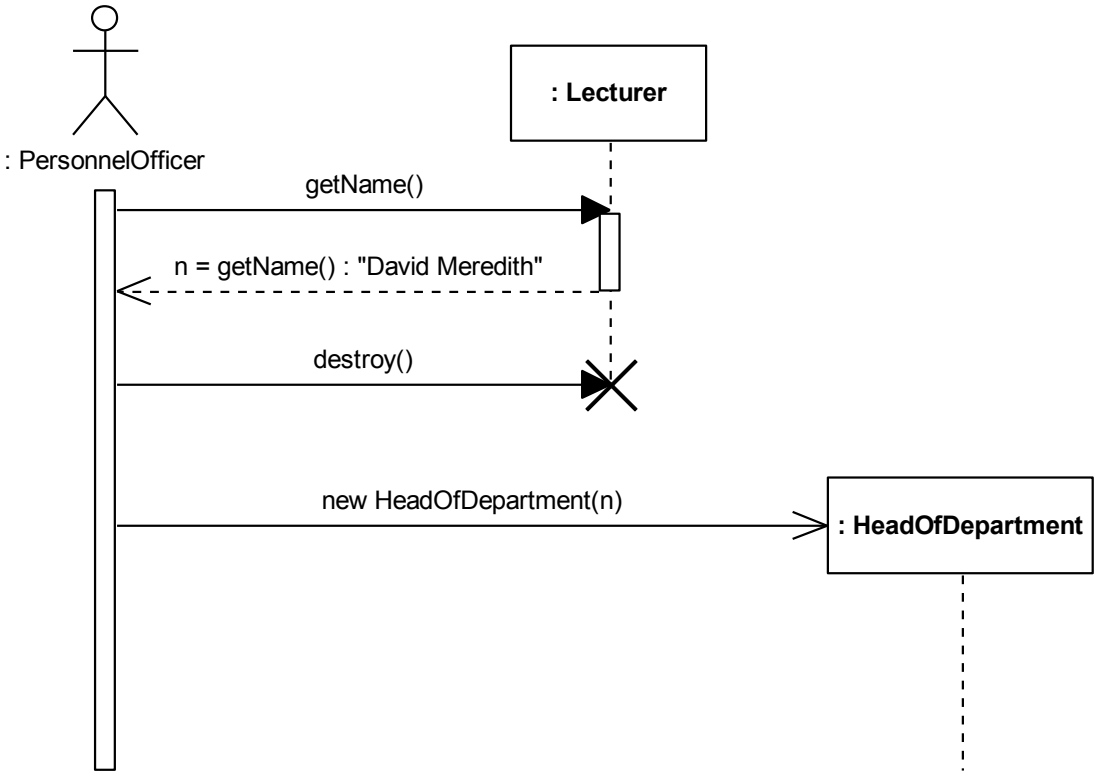
e. Write down the corrected versions of the lines that you need to change to make the program run and then write down the output of this corrected program. You should change the program as little as possible from that given.

[2 marks each]

TURN OVER

Question 8

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



a. Why is there a colon written at the beginning of the label ": PersonnelOfficer"?

b. What does the colon in the label of the return arrow signify?

c. What does the "X" at the end of the message labelled "destroy()" signify?

d. Which message or messages in the diagram is (or are) asynchronous?

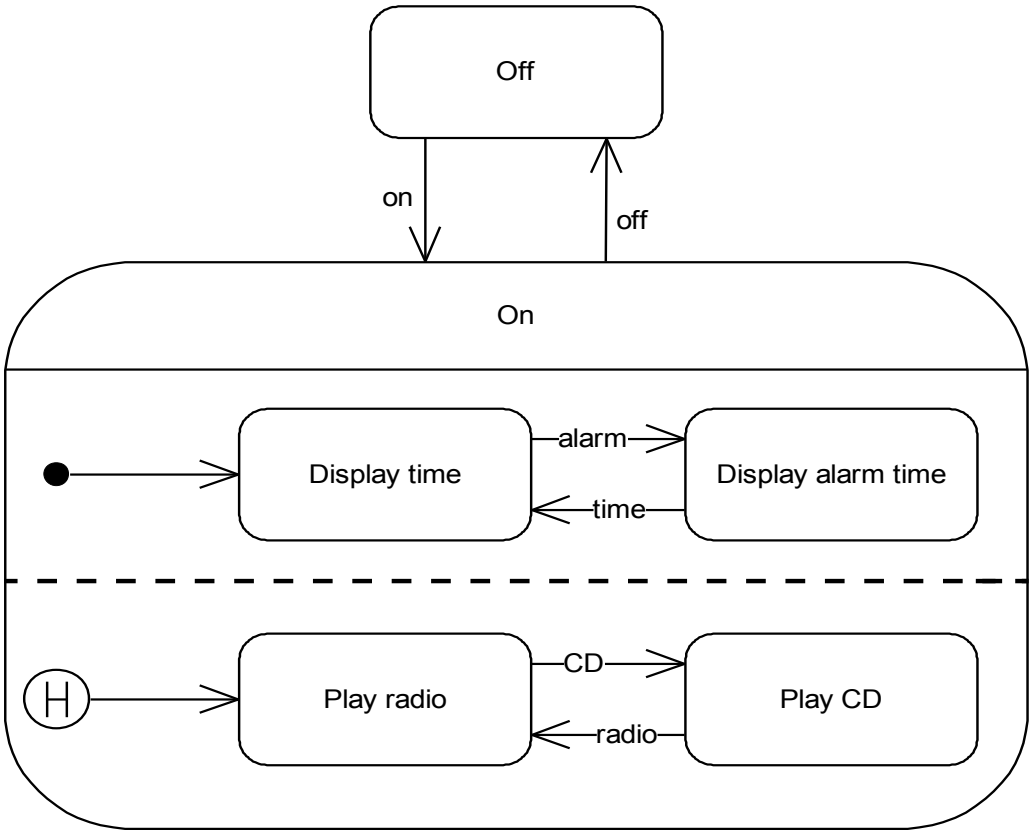
e. In which participant is the "getName()" method defined?

[2 marks each]

TURN OVER

Question 9

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



a. What kind of diagram is this?

b. If the device was playing a CD when it was last switched off, will it play the radio or the CD when it is switched back on again?

c. The first time the device is switched on, will it be playing the radio or the CD?

d. When you switch the device on, does it display the time or the alarm time?

e. What are such diagrams typically used for in the software development process?

[2 marks each]

TURN OVER

Question 10

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

```
1  package dk.aau.create.med8.mp;
2
3  public class Threads {
4
5      public static void main(String[] args) {
6          Thread thread1 = new Thread(new Runnable() {
7              public void run() {
8                  for(int i = 0; i < 5; i++) {
9                      System.out.println(i);
10                     try {
11                         Thread.sleep(100);
12                     } catch (InterruptedException e) {
13                         e.printStackTrace();
14                     }
15                 }
16             }
17         });
18         Thread thread2 = new Thread(new Runnable() {
19             public void run() {
20                 for(int i = 100; i > 95; i--) {
21                     System.out.println(i);
22                     try {
23                         Thread.sleep(10);
24                     } catch (InterruptedException e) {
25                         e.printStackTrace();
26                     }
27                 }
28             }
29         });
30
31         thread1.setName("Thread1");
32         thread2.setName("Thread2");
33         thread1.start();
34         thread2.start();
35     }
36 }
```

a. Give three possible outputs for this program. [3 marks]

b. How would you *minimally* change the program so that it always produces one of the outputs that you gave in part a? [4 marks]

c. If you make the change that you suggest in part b, would the program still be multithreaded? Explain your answer. [3 marks]

TURN OVER

Question 11

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

```
 6 public class MulticastClient {
 7     public static void main(String[] args) throws IOException {
 8         MulticastSocket socket = new MulticastSocket(4446);
 9         InetAddress address = InetAddress.getByName("230.0.0.1");
10         socket.joinGroup(address);
11         DatagramPacket packet;
12         for (int i = 0; i < 5; i++) {
13             byte[] buf = new byte[256];
14             packet = new DatagramPacket(buf, buf.length);
15             socket.receive(packet);
16             String received = new String(packet.getData(), 0, packet.getLength());
17             System.out.println(received);
18         }
19         socket.leaveGroup(address);
20         socket.close();
21     }
22 }
```

```
 3 public class MulticastServer {
 4     public static void main(String[] args) throws java.io.IOException {
 5         MulticastServerThread t = new MulticastServerThread();
 6         t.start();
 7     }
 8 }
```

```
 7 public class MulticastServerThread extends Thread {
 8
 9     private DatagramSocket socket = new DatagramSocket(4445);
10
11     public MulticastServerThread() throws IOException {
12         super("MulticastServerThread");
13     }
14
15     public void run() {
16         try {
17             while (true) {
18                 byte[] buf = new Date().toString().getBytes();
19                 InetAddress group = InetAddress.getByName("230.0.0.1");
20                 DatagramPacket packet = new DatagramPacket(buf, buf.length, group, 4446);
21                 socket.send(packet);
22                 sleep(5000l);
23             }
24         } catch(Exception e) {
25             socket.close();
26             return;
27         }
28     }
29 }
```

a. What is the port number of the client socket?

b. What is the difference between a MulticastSocket and a Socket?

c. Which program should be started first, MulticastServer or MulticastClient?

d. How many copies of MulticastClient can be run simultaneously?

e. What is the purpose of line 16 in MulticastClient?

[2 marks each] TURN OVER

Question 12

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

```
1  package dk.aau.medialogy.semester4.oose.exam2013;
2
3  import javax.swing.*;
6
7  public class BorderLayoutDemo {
8
9
10     public static void main(String[] args) {
11         javax.swing.SwingUtilities.invokeLater(new Runnable() {
12             public void run() {
13                 JFrame frame = new JFrame("BorderLayoutDemo");
14                 frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
15                 Container pane = frame.getContentPane();
16                 pane.add(new JButton("PAGE_START"), BorderLayout.PAGE_START);
17                 pane.add(new JButton("CENTER"), BorderLayout.CENTER);
18                 pane.add(new JButton("ANOTHER_CENTER"));
19                 pane.add(new JButton("LINE_START"), BorderLayout.LINE_START);
20                 JTextField textField = new JTextField("Hello");
21                 pane.add(textField, BorderLayout.LINE_START);
22                 pane.remove(textField);
23                 pane.add(new JButton("LINE_END"), BorderLayout.LINE_END);
24                 pane.add(new JButton("PAGE_END"), BorderLayout.PAGE_END);
25                 BorderLayout layout = (BorderLayout)(pane.getLayout());
26                 frame.pack();
27                 frame.setVisible(true);
28             }
29         });
30     }
31 }
32
```

a. Sketch the output of this program. [5 marks]

b. What is the effect of line 14? [1 mark]

c. What is the purpose of line 26? [2 marks]

d. In a Swing JFrame, which GUI components are *not* contained within the JFrame's content pane? [2 marks]

END OF EXAMINATION