



Magdeburg, den 13.09.2024

Exam

Introduction to Software Engineering for Engineers (Summer 2024)

Nachname: _____

Vorname: _____

Matrikelnummer: _____

Please note the following information:

- The duration of the exam is **120 minutes**. One point corresponds to approximately 90 seconds of the exam time.
- Please place your student ID card or your identity card visibly in front of your seat. The invigilators will check these during the examination.
- The exam consists of 15 pages. Check that all sheets are present before starting.
- Label **each** of the submitted sheets with your name and matriculation number.
- Read the task carefully before starting. Write your solution under the task in the box provided. If there is not enough space, use the reverse side or ask the supervisors for additional sheets. Solutions on sheets other than those provided by the supervisors will **not be counted**. Use a separate sheet for each task (not subtasks) and clearly indicate the assignment to a task.
- Cross out incorrect solutions **clearly**.
- Do not use pencils or pens with a red or green colour!
- Only pens and a ruler are permitted as tools. **No calculators are allowed!**
- If several solutions are given for a task, or if the solution is not clear, or if the required justification for a solution is not given, the task is deemed not to have been solved.
- If you have any questions, give a visible hand signal. A supervisor will then approach you.
- Leaving the room before the end of the examination period is only permitted by prior agreement and only individually.

Good luck!

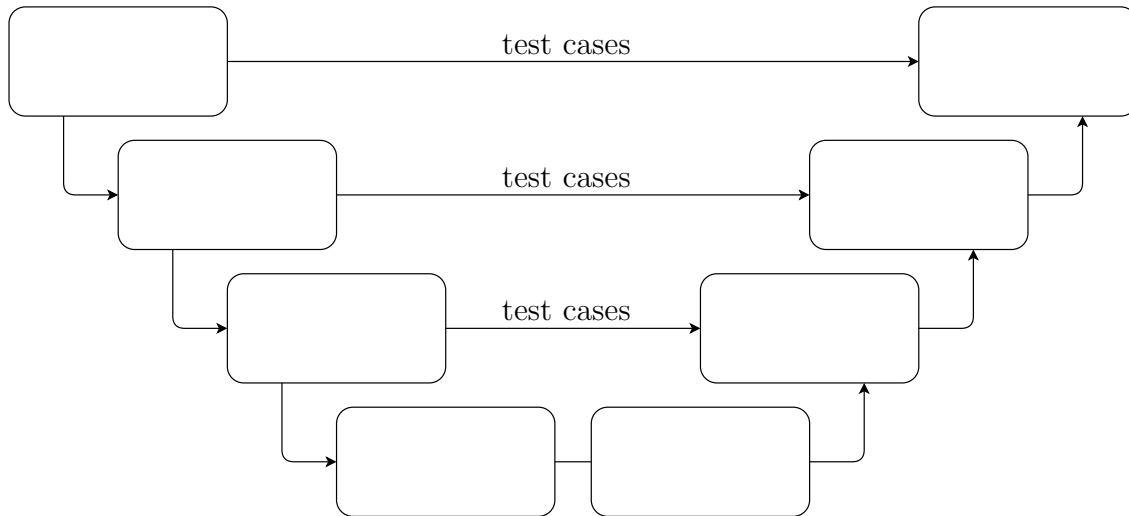
Aufgabe	1	2	3	4	5	6	Σ
maximale Punkte	10	10	10	10	10	10	60
erreichte Punkte							



Magdeburg, den 13.09.2024

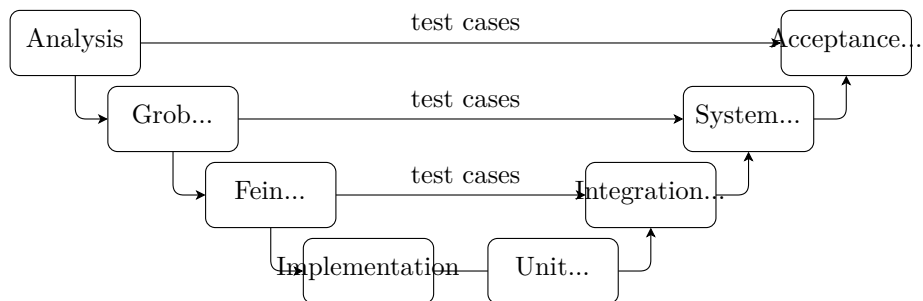
Aufgabe 1 : Process Models

- a) Complete all stages of the V-model according to Boehm! Use the terms from the lecture.
[4 points]



Musterlösung:

$\frac{1}{2}$ Punkte Abzug für jede falsche/fehlende Angabe





Magdeburg, den 13.09.2024

b) *Name three process models (other than the V-model from the previous task). Briefly (!) describe how they work, and state at least one advantage and disadvantage for each.*

Hint: *Make sure, that your advantages/disadvantages are actually concrete. Statements such as Helps to streamline software development will not give any points.*

[6 points]

Musterlösung:



Magdeburg, den 13.09.2024

Aufgabe 2 : Requirements Engineering

a) Scenario: Wildlife camera

Your software engineering teacher has won a lot of money and stops work. He has discovered his passion for wildlife documentaries and yoga. He wants you to develop a wildlife camera for him. He is a talented craftsman himself - he has already assembled the camera once. So all the hardware is available. There is a camera, a lens with a variable focal length, rechargeable batteries with a large capacity, a robust housing, a normal built-in smartphone, a CCD image sensor for normal images and one for night shots, a microcontroller to control the whole thing and everything else a camera needs. The system is to be set up in a protected nature conservation area – where you can only enter with permission. It is designed to be inconspicuous so that it will not be discovered by hikers or animals. For this purpose, it is covered in camouflage paint – a camouflage net has been omitted, as animals could get caught in it. An internet connection via mobile phone is available – however, only GPRS is supported in rural areas. The camera is designed to take pictures automatically when movement is detected in the picture. If the memory is 90% full or the battery power only lasts for 4 weeks a message is to be sent to the user by e-mail every 2 days. Otherwise, the camera only sends a status message once a week. As your teacher is travelling to India on a yoga trip, he will not be available for the next 6 months. When he returns, the system should be up and running.

1. Think about which functional and non-functional requirements were important at the start of the project. Name 3 of each!
2. Which process model presented in the lecture would you use for this scenario? Justify your decision and discuss why the other models mentioned are rather unsuitable.

[5 points]

Functional requirements

1. _____
2. _____
3. _____

Non-functional Requirements

1. _____
2. _____
3. _____

Musterlösung:

- 3P auf die Anforderungen, 1P pro 2 Anforderungen
- 1P auf das Modell
- 1P auf die Begründung
- ein sequentielles Modell
- am ehesten Wasserfall, da ja eigentlich schon alles gebaut ist
- V-Modell geht auch, das kann gut mit Tests begründet werden
- Kanban würde auch gehen
-
- NICHT Spiral oder SCRUM



Magdeburg, den 13.09.2024

b) Your mate Robin the Cool has a chameleon Mad Eye Moody. Moody eats insects but also loves mango. Robin approaches you and asks you to build a machine. It should process the mango and feed it to Moody. He gives you the following explanation:

“So, Moody loves eating mango. The pieces should be at most half the size, no, better yet, three-quarters the size of Moody’s mouth. And they need to be at least as big as his claws so he can grab them. I always give him different pieces. But what’s important for the cutting machine is that it shouldn’t be too loud. It would annoy me at work if there’s always something chopping mangoes in the next room. I’ve got two scalpel knives, they’re enough for cutting, no need for anything new. It would be best if the machine is green, so it blends in with the plants. Oh, and it shouldn’t run at night because it needs a timer. Moody sleeps at night and gets grumpy if he sees dried-out mango that’s been sitting around forever. Ideally, I should be able to turn the machine on and off with a switch—I don’t want to have to unplug it every time I clean Moody. The thing also needs to be easy to clean—mango juice is way too sticky to wipe off all the time. And woe unto you if Moody even has the slightest chance of cutting himself on the blades, they should be covered so he can’t even see them—got it? And don’t make it too complicated to use, I’m no computer geek.”

What functional and non-functional requirements does Robin have for the mango cutting machine? (Keywords are sufficient) [5 points]

Musterlösung:

- $\frac{1}{2}$ Punkt pro Anforderung

Funktional:

- Größe der Stückchen: $sizeof(Kralle) \leq Mango \leq \frac{1}{2} \times sizeof(Maul)$
- Schalter: zum An- und Ausmachen
- Timer: Maschine arbeitet nachts nicht
- Skalpelle zum Schneiden
- Abdeckung für die Skalpelle

Nicht-Funktional:

- leise
- sicher
- einfach zu bedienen
- leicht zu reinigen
- Farbe ist grün



Magdeburg, den 13.09.2024

Aufgabe 3 : Design

a) Fill in the blanks! **For each blank just write the number of the matching term.** Some terms might be used more than once.

1. DERIVED,

4. BASE CLASS(ES),

7. REGULAR,

2. ABSTRACT,

5. CLASS(ES),

8. SUBCLASS(ES),

3. ATTRIBUTE(S),

6. METHOD(S),

9. ACCESS MODIFIER(S).

The concepts of and interfaces play a central role in object-oriented analysis. A represents a group of objects that share common and . An interface defines a collection of that can be implemented by .

Inheritance is another important concept with which common and can be placed in a . The inherit these properties and can extend or customise them.

In addition to classes, there are classes, which are special types and can contain methods. classes may not be instantiated directly, but serve as the basic framework for classes.

play a decisive role, as they determine which classes and objects may see which and .

[6 points]

Musterlösung:



Magdeburg, den 13.09.2024

b) Scenario: Feed the Cat!

Dramatis personae:

- Christian, standing next to the patio door
- Toni, a cat, waiting outside the patio door
- Linus, in his room, the door is open
- Abraham, in his room, the door is closed
- Linus and Abraham are playing BrawlStars, they are using some form of voice chat

Toni: "Meow!"

Christian (towards Toni): "Well, has anyone fed you today?"

Christian (shouting): "LIHINUS!!!"

Linus (shouting): "Yes, what is it?"

Christian (shouting): "Have you fed the cat today?"

Linus (shouting): "No, I didn't."

Christian (shouting): "And Abraham, did he feed the cat?"

Linus (using his microphone): "Abrahams, did you feed the cat?"

Benni (using his microphone): "No, I didn't."

Linus (shouting): "No, Abraham did not feed the car."

Christian (shouting): "Ok, thanks!"

Christian opens the patio door and waits until **Toni** is in the kitchen. He then proceeds to feed the cat. After the cat has left, Christian closes to patio door.

-
- *Model this scenario as a sequence diagram!*
 - *Pay attention to the distinction between synchronous and asynchronous messages and replies.*

[4 points]

Musterlösung:

- 4 Akteure (Katze, Christian, Linus, Abraham)
- 4 Aktivitätsbalken
- 4 asynchrone Nachrichten
- 5 synchrone Nachrichten

- 0.5P für die Akteure
- 0.5P für die Aktivitätsbalken
- 3P für die Nachrichten (jeweils Abzug 0.5 falls eine Nachricht fehlt)
- auf unterschiedliche Pfeilarten achten



Magdeburg, den 13.09.2024

Aufgabe 4 : Implementation

a) Given the following Java source code, identify at least three things that can be done to improve the code's readability and maintainability. What and how would you change these?

```
1 public class A{  
2 public static boolean parity(String[] b){  
3 boolean y = false;  
4 int x= 0 ; if(x% 2== 0) { y = true;}  
5 else { return true;}  
6 return true;  
7 }}
```

[6 points]

Musterlösung:

1P je Anmerkung, maximal 6P

1. Klassenname
2. Variablenname
3. Code ist nicht kommentiert
4. Leerzeichen um Operatoren einheitlich
5. Nur eine Anweisung pro Zeile
6. falsche Parameter, bzw. Parameter ungenutzt
7. if mit setzen von booleans statt direktem return
8. Funktion gibt immer true zurück



Magdeburg, den 13.09.2024

b) You are currently developing a small game. A centrepiece of the game is the *PlayerManager*. This takes care of the centralised creation and administration of the individual *Player*. Of the *PlayerManager* there is exactly one instance at programme runtime.

1. Which design pattern is this?
2. Implement the pattern by adding to the following Java source code!

Hints:

- Your code will be inserted at the marked line,
- The rest of the code is ok and must remain functional,
- Attributes and methods are missing,
- You can use pseudo code.

```
1  import java.util.List;
2  import java.util.ArrayList;
3
4  class Player { public void update() { /* important stuff */ } }
5
6  public class PlayerManager {
7      // class attributes
8      static List<Player> players = new ArrayList<>();
9
10     /* TODO: add missing code */
11
12     // create a new Player and add it to the list
13     public static Player createPlayer() {
14         Player new_player = new Player();
15         players.add(new_player);
16         return new_player;
17     }
18     // update Players in each turn
19     public static void update() {
20         for (Player player : players)
21             player.update();
22     }
23     // main creates 2 Players and updates them
24     public static void main(String[] argc) {
25         PlayerManager mgr = PlayerManager.getInstance();
26         mgr.createPlayer();
27         mgr.createPlayer();
28         mgr.update();
29     }
30 }
```

[4 points]



Magdeburg, den 13.09.2024

Musterlösung:

- 1P auf Attribut wichtig ist, dass es irgendwo null gesetzt wird
- 1P auf Konstruktor
- 1P auf getInstance()
- 1P auf die korrekte Verwendung von static und private

```
1 import java.util.List;
2 import java.util.ArrayList;
3
4 class Player {
5     public void update() {
6         /* important stuff */
7     }
8
9     public class PlayerManager {
10        // class attributes
11        static List<Player> players = new ArrayList<>();
12        private static PlayerManager instance = null;
13
14        // constructor
15        private PlayerManager() {
16        }
17
18        // access PlayerManager
19        public static PlayerManager getInstance() {
20            if (instance == null)
21                instance = new PlayerManager();
22            return instance;
23        }
24
25        // create a new Player and add it to the list
26        public static Player createPlayer() {
27            Player new_player = new Player();
28            players.add(new_player);
29            return new_player;
30        }
31
32        // update Players in each turn
33        public static void update() {
34            for (Player player : players)
35                player.update();
36        }
37
38        // main creates 2 Players and updates them
39        public static void main(String[] args) {
40            PlayerManager mgr = PlayerManager.getInstance();
41            mgr.createPlayer();
42            mgr.createPlayer();
43            mgr.update();
44        }
45    }
```



OTTO VON GUERICKE
UNIVERSITÄT
MAGDEBURG

INF

FAKULTÄT FÜR
INFORMATIK

Magdeburg, den 13.09.2024

/ 10



Magdeburg, den 13.09.2024

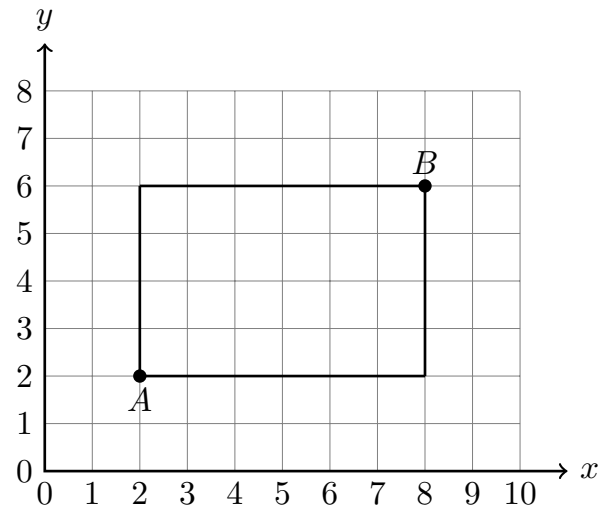
Aufgabe 5 : Testing

We describe a point in 2D using the coordinate pair (x, y) . An axis-parallel rectangle is described in 2D by the lower left point and the upper right point. Given is an implementation of this with the following two classes *Point* and *Box*. The function *countHits* is also given. This is called with a *Box* and a list of *Points*. The function tests how many points are inside the box and returns this number. The sketch at the bottom right shows an explicit example with a *Box* defined by the points *A* and *B*.

```
1 class Point {
2 public Point(int vx, int vy) {
3     x = vx;
4     y = vy;
5 }
6 public int x = 0;
7 public int y = 0;
8 }
```

```
1 class Box {
2 public Box(Point vp0, Point vp1) {
3     p0 = vp0;
4     p1 = vp1;
5 }
6 Point p0 = null; // lower left
7 Point p1 = null; // upper right
8 }
```

```
1 public static int
2 countHits(Box box, List<Point> points) {
3     int hits = 0;
4     if (points.size() > 0) {
5         for (Point pnt : points) {
6             if (pnt.x < box.p0.x) { continue; }
7             if (pnt.x > box.p1.x) { continue; }
8             if (pnt.y < box.p0.y) { continue; }
9             if (pnt.y > box.p1.y) { continue; }
10            hits++;
11        }
12    }
13    return hits;
14 }
```





Magdeburg, den 13.09.2024

a) Zeichne den Kontrollflussgraphen für die Funktion `int countHits(Box box , List <Point > points)!`
[4 points]

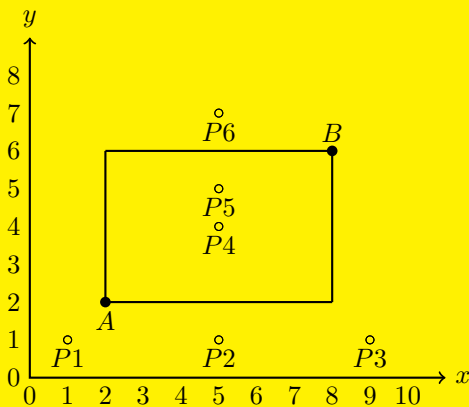
b) For the function `int countHits (Box box , List <Point > points)` create a C_{2c} boundary-interior White-Box test. To do this, mark points $P_1 \dots P_n$ in the sketch. Give a list of the points you have selected for each of the following test cases:

1. The loop is run through 0 times
2. The loop is executed 5 times, whereby each control path within the loop is covered exactly once.
3. The loop is run through completely with exactly 2 different points.

[6 points]

Musterlösung:

- 2P für die leere List - 0-mal durchlaufen
- 2P für 5 fachen Durchlauf P_1, P_2, P_3, P_4, P_6
- 2P für 2 fachen Durchlauf P_4, P_5
- Punkte müssen nicht genau auf diesen Positionen liegen; relative Lage Punkt $\langle \rangle$ Box ist wichtig
- 0.5P Abzug, wenn die Punkte nicht auf den Integer Koordinaten liegen





Magdeburg, den 13.09.2024

Aufgabe 6 : Management

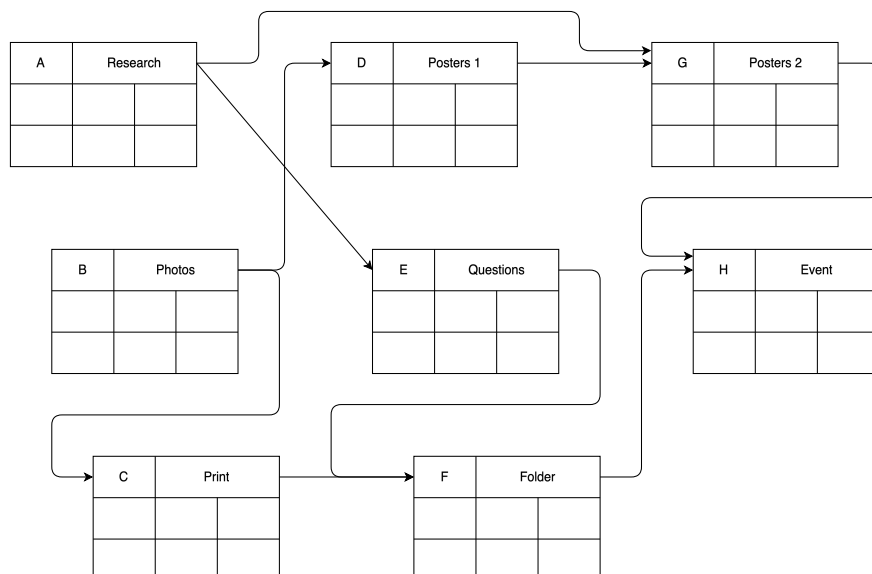
Kevin is working on an event with the topic: "Cheese in Christian-ity". He has already written a list of processes that he wants to edit for his project. Kevin has a few friends who are helping him with the editing. He asks you to create a network diagram. The following activities are on Kevin's list:

- (A) Research: The first thing Kevin wants to do within a day is to get an overview of the advertising opportunities.
- (B) Photos: Thomas is to take photos of the different types of cheese, As Thomas is a sought-after photographer, this will take three days.
- (C) Print: After Thomas has taken the photos, Arun will print them within 24 hours.
- (D) Posters 1: Nicholas is given one week to create posters with the digital version of the pictures.
- (E) Questions: After the research, Kevin wants to conduct interviews with cheese experts for his project. To do this, he has to finalise a list of questions before he can conduct the interviews. He expects it to take him one day.
- (F) Folder: Once the photos have been printed, they are placed along with the finished questions into the interview folder. While Kevin goes through his questions in his mind, a day will pass.
- (G) Posters 2: When Nicholas has finished the posters, Arun will post them within 3 days on the advertising options chosen by Kevin.
- (H) Event: Only when everything is ready can the event take place and Kevin will interview Christian, Christian and of course Christian The interview will take place in just one day.

The project ends with the event and the interviews.

Tasks:

1. Complete the network diagram using the metra-potential method! (Use full days for time specifications.)
2. Mark the critical path!





Magdeburg, den 13.09.2024

[10 points]

Musterlösung:

- $\frac{8}{2}$ Punkte für die Vorwärtsrichtung (obere Zeile)
- $\frac{8}{2}$ Punkte für die Rückwärtsrichtung (untere Zeile)
- $\frac{4}{2}$ Punkte für die Pfeile
- -1 Punkte falls der kritische Pfad falsch angegeben wurde
- Folgefehler bei falscher Berechnung oder falschen Pfeilen