



First name:	Last Name:	Matriculation number:

Software Engineering

Fall Semester 2014

Unofficial English Translation

13. January 2015

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- This is an **unofficial English translation**. For correction, the wording in the official German version is considered the reference.
 - The exam lasts for 90 minutes.
 - Use only the provided sheets – you can ask for additional sheets, if needed.
 - Write your name and matriculation number on the title sheet, and on each sheet that is not stapled to the title sheet.
 - Solve all tasks on your own.
 - Only the following help tools are allowed: – 1 A4 sheet with handwritten notes, written by you. – For students who are not native German speakers: A dictionary.
 - Cheating results in failing the exam.
 - Put your university ID card („Legi“) on your desk.
 - If you have questions, raise your hand.
 - During the last 15 minutes of the exam, you can no longer hand it in early.. If you are finished, remain seated at your place and wait until the exam is officially over.
 - After the 90 minutes are over, remain seated at your place and wait until the supervisors have collected all the exams. Don't talk to the other students during this time.
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Good Luck!

Please leave empty!

Teil 1	Teil 2	Teil 3	Total
/33	/47	/40	/120

Part 1 – Multiple Choice Questions (33 points, approx. 25 minutes working time)

Tip:

We use three types of multiple choice questions:

Type 1 For any given question of this type, exactly one answer has to be marked.

Type N For any given question of this type, exactly n answers have to be marked. The number of correct answers (n) is given in every such Type N question.

Type ALL For any given question of this type, all statements have to be appropriately answered.

Please note that for each wrong answer, we will subtract the same amount of points that we would give for a correct answer. Negative points yield zero points for the whole question.

Question 1.01 [Type 1]: Software Engineering (1 point)

Which element from the following list is a goal of Software Engineering?

- Diversification of the productivity
- Communication of the quality
- Application of new research achievements
- Facilitation of the management of projects
- Adherence to the contract conditions between the client and the developers

Question 1.02 [Type 1]: Requirements Engineering (1 point)

Which of the following elements is *not* part of Requirements Engineering?

- Elicitation of requirements
- Identification of conflicts and inconsistencies
- Validation of requirements
- Finding a consensus
- Implementation of requirements

Question 1.03 [Type N]: Stakeholders (1.5 points)

Which three of the following statements are correct with regard to stakeholders?

- Stakeholders can be separated into the categories critical, important and unimportant.
- Stakeholders are always able to express their needs regarding the system to be built.
- Stakeholders are persons or organizations that directly or indirectly influence the requirements regarding a particular system.
- Stakeholders can have needs that conflict with the needs of other stakeholders.
- All needs of the stakeholders regarding a system should be fulfilled.
- Stakeholders are not involved in prioritizing requirements.

Question 1.04 [Type 1]: Requirements Classification (1.5 points)

When classifying requirements, we distinguish between four categories of requirements:

- (A) Functional requirements
- (B) Performance requirements
- (C) Quality requirements
- (D) Constraints

Into which of these four categories belong...

1. ... restrictions regarding response times or throughput?
 (A) (B) (C) (D)
2. ... requirements regarding system behavior or data?
 (A) (B) (C) (D)
3. ... restrictions regarding regulatory requirements?
 (A) (B) (C) (D)

Question 1.05 [Type ALL]: Requirements Specification (2 points)

Which of the following are characteristics of a good requirements specification (Yes) and which one are not (No)?

	Yes	No
Risk adequacy	<input type="checkbox"/>	<input type="checkbox"/>
Risk-minimization	<input type="checkbox"/>	<input type="checkbox"/>
Indication of contradictions	<input type="checkbox"/>	<input type="checkbox"/>
Free of contradictions	<input type="checkbox"/>	<input type="checkbox"/>

Question 1.06 [Type N]: Models (1 point)

Which two of the following statements are true for models in Software Engineering?

- Models provide domain-specific knowledge to the developers.
- Models depict reality exactly.
- Models are free of judgment.
- Models require a validation.
- Models do not provide process knowledge.

Questions 1.07 [Type 1]: Class Models (1 point)

For what actions are class models used?

- To model different objects of the same class.
- To describe functions transforming the data flow.
- To model the interactions between the system and its environment.
- To model parts of the reality.
- To model interactions between system components.

Question 1.08 [Type 1]: Classes (1 point)

Which of the following statements about well-structured classes is *not* true?

- A well-structured class hides the largest part of its complexity (information hiding).
- A well-structured class has only one specific context (no schizophrenic classes).
- A well-structured class cannot be modeled due to the information hiding.
- A well-structured class is open if extensions shall be allowed
- A well-structured class is closed if changes shall be avoided.

Question 1.09 [Type 1]: Design Patterns (1.5 points)

You decided to use the following design patterns:

- (A) Composite
- (B) Mediator
- (C) Façade
- (D) Observer

Which pattern is best suited for...

- a. ... ensuring that upon a status change, all interested objects are notified automatically in order to update themselves?
 (A) (B) (C) (D)
- b. ... steering the interactions within a group of objects?
 (A) (B) (C) (D)
- c. ... conveniently using the interfaces of a subsystem that consists of multiple classes?
 (A) (B) (C) (D)

Question 1.10 [Type 1]: Naming (1 point)

You are writing a program code for a game in which an avatar need to pass as many obstacles as possible. The game consists of several levels. Which of the following names is the best-suited for the variable that counts the total amount of passed obstacles so far, according to the rules of choosing variable names?

- totalObstacleSuccessesSoFarInCurrentGame
- countObstacles
- i
- obstacleCounter
- obstaclesOvercomePerLevel

Question 1.11 [Type ALL]: Testing (3 points)

You want to test the application your team has developed. Indicate for each of the following activities, if it belongs to the systematic test process (Yes) or if it does not belong to it (No).

Yes **No**

- | | | |
|---|--------------------------|--------------------------|
| Establishing a test vision according to the general test strategy. | <input type="checkbox"/> | <input type="checkbox"/> |
| Planning the test. | <input type="checkbox"/> | <input type="checkbox"/> |
| Requesting the test procedure from the client. | <input type="checkbox"/> | <input type="checkbox"/> |
| Conducting the test according to the test procedure. | <input type="checkbox"/> | <input type="checkbox"/> |
| Identifying the defects that have caused the errors found during the testing. | <input type="checkbox"/> | <input type="checkbox"/> |
| Documenting the test results. | <input type="checkbox"/> | <input type="checkbox"/> |

Question 1.12 [Type N]: Error Terminology (1 point)

Which two of the following statements are correct?

- A defect does not always lead to an error.
- A defect can always be explained by a failure
- Every error is caused by a defect.
- A defect can have multiple errors as a consequence.

Question 1.13 [Type ALL]: Test Processes (2 points)

Test processes are divided into static and dynamic ones. Classify the following processes accordingly.

	Static	Dynamic
Testing	<input type="checkbox"/>	<input type="checkbox"/>
Measuring	<input type="checkbox"/>	<input type="checkbox"/>
Model Checking	<input type="checkbox"/>	<input type="checkbox"/>
Simulating	<input type="checkbox"/>	<input type="checkbox"/>

Question 1.14 [Type 1]: Review (1 point)

Which two of the following statements are *not* goals of a review?

- Determine shortcomings of the unit under test
- Determine shortcomings within the development process
- Determine the weak points of the unit under test
- Evaluating the quality of the unit under test
- Evaluating the quality of the developer

Question 1.15 [Type N]: Software Analysis (1 point)

The following pseudo code is given:

```
z:=3
While a loop
    If b then
        c:=d
    End if;
    d:= z+1
End loop
```

Which two of the following statements apply to this pseudo code?

- $c:=d$ is control dependent (*kontrollabhängig*) from z
- $d:=z+1$ is control dependent (*kontrollabhängig*) from a
- d is data dependent (*datenabhängig*) from z
- d is data dependent (*datenabhängig*) from c

Question 1.16 [Type ALL]: Software Types According to Lehman (2 points)

According to Lehman, software can be classified into three types. Mark the correct type for each of the following cases.

	S-Typ	P-Typ	E-Typ
The software can completely be described by a formal specification.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The software realizes an application that is embedded in the real world context.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The software is not subject to any evolution.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Users' satisfaction is the success criterion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question 1.17 [Type 1]: Process Models (1 point)

You are well familiar with the following process models:

- (A) Spiral model *Spiralmodell*
- (B) Goal-oriented phase model (*Ergebnisorientiertes Phasenmodell*)
- (C) Agile software development
- (D) Evolutionary model (*Wachstumsmodell*)

Which process model do you chose for....

- a. ... a semi-large project, in which the requirements are precisely defined, and the development shall follow the natural life of software?
 (A) (B) (C) (D)
- b. ... a large, risky project, which shall be conducted in a quadrinomial cycles of planning, goal correction, risk examination, and development and checking?
 (A) (B) (C) (D)

Question 1.18 [Type N]: Milestones 1 (1 point)

Which two of the following intermediate results are suitable for milesontes?

- The major part of the stakeholders has been questioned.
- All system tests have been successfully conducted.
- The coding part will be finished this autumn.
- 80% of all requirements have been implemented.

Question 1.19 [Type 1]: Milestones 2 (1 point)

What do you do at first, if you have *not* reached a milestone at the planned deadline?

- Request more personnel resources.
- Split the missed milestone into smaller sub-goals.
- Nothing. Only when the milestone is actually reached further actions will be required.
- Estimate the schedule by estimating the remaining effort.
- Intensificate the progress monitoring.

Question 1.20 [Type 1]: Effort Estimation (1.5 points)

You have to calculate the estimated effort for a new software project. In you education you got to know following methods:

- (A) Function Point
- (B) Parkinson's law
- (C) Delphi-Method
- (D) COCOMO

Which of the methods do you chose if you want to...

- c. ... integrate the estimations of different experts?
 (A) (B) (C) (D)
- d. ... adjust the effort to the available capacity?
 (A) (B) (C) (D)
- e. ... determine the functionality of the planned system in order to calculate the expected effort?
 (A) (B) (C) (D)

Question 1.21 [Type ALL]: Quality management (2 points)

Which of the following statements describe principles of a modern quality management (True) and which not (False)?

True **False**

Quality management must have a report path that is dependent on the chain of command, in order to make sure that all relevant facts can be communicated to the management.

Quality management provides services in the scope of identifying quality. It is not responsible for the product quality.

Employees must be informed about their co-workers' quality of work in order for them to improve themselves resp. support others to increase their quality.

Quality can not be reached by checking, but must be generated.

Question 1.22 [Type 1]: Quality Testing (1 point)

Which of the following tasks is *not* used to evaluate products?

Formal code verification

Review

Audit

Prototypes

Simulation

Question 1.23 [Type ALL]: QM-Plan (3 points)

Which of the following elements belong to the typical content of a QM-plan as it is used in software projects (Yes), and which do not belong in such a QM-plan (No)?

Yes

No

Emergency plan

Measurement plan

Lecture plan

Training course

Problem registration

Context diagram

Part 2 – Applied Tasks – Mobile Payment System (47 points, approx. 35 minutes working time)

The possibility of mobile payments is considered one of the great innovations of the 21st century by leading technology companies. The GoPay Corporation is trying to establish itself in this relatively small but promising market. In order to distinguish itself from the big players in this segment, the GoPay Corporation relies on a watch-based payment system. While the core competence of the GoPay Corporation is on the technical realization of the mobile payment solution, for the development of visually and functionally optimal watch designs, it works closely together with the renowned watch manufacturer Slook. This way, the GoPay Corporation hopes to also attract customers who are more attired in the appearance of an elegant or sporty watch rather than in the technology itself. The global bank TAR does not want to miss the trend towards mobile payment solutions. Due to the innovative approach and good references of the GoPay Corporation, the TAR bank took over 62.5% of equity of the GoPay Corporation last year. In order for both companies to focus on their core businesses, the technological know-how shall remain with the GoPay Corporation. The management of the TAR bank has therefore only given the following cornerstones.

The payment solution should replace or supplement the traditional credit and debit cards. The watch will be equipped with an RFID chip, which ensures the radio communication to the pay station at the counter of the shop. The RFID chip stores personal information and the daily limits. For each credit-based transaction, these data are transmitted together with the location information of the shop, the amount paid and the unique shop ID to the bank. In order to ensure the maximum safety standard, the information communicated is encrypted by the AES standard with a 128-bit encryption. Initially, a pilot is planned for a few participating merchants. Later, the solution will be deployed as widely as possible. The GoPay Corporation invited representatives of the relevant stakeholder groups for a workshop in order to get an idea of the most present needs and requirements for such a system. The following given statements have been recorded:

Franz U., CEO of the retail chain EDEL&GUT (PRECIOUS & GOOD): *"With this solution we want to address a young and mobile customer segment. However, the cost per transaction shall not be higher than paying by card, otherwise the whole thing is not economical for us. "*

Olena B., project manager of FIVE Payments: *"As manager of the financial market infrastructure we certainly prefer a system that can be used across platforms and uses the existing interfaces."*

Ludwig A., computer science student, University of Zurich: *"I would immediately use such a solution if it supports payments of small amounts. With my low income, it is difficult to get a credit card but it also completely impractical to always carry around these coins. "*

Peter T. watch dealer: *"Our clientele is very demanding. Merging Swiss precision with the independence of being able to pay at any moment of time is the perfection of Swissness. The watch should be elegant and simple. The data storage and transfer must be encrypted, and the information on the chip must be deletable by code at any time. "*

Yolanda D., computer scientist and jogger: *"Debit cards and cash can not be transported easily in sweatpants. I have therefore been wondering, therefore, for a long time why there is no payment system available that is compatible with my heart rate monitor watch! On my jogging route I pass every day by a farm where you can buy apples with debit cards contactlessly. If such a contactless payment solution embedded in my heart rate monitor watch existed, using the same interface, it would finally be possible for me to buy an apple during my jogging routine. Further, I would like to manage my purchases in an app through which I can see my purchases and filter them by various criteria. In the same app I would also like to be able to charge a desired amount with a few clicks to my heart rate monitor watch. The app should run on both my mobile phone and my laptop. "*

Question 2.1: Goals (9 points, approx. 7 minutes working time)

a. The GoPay Corporation as well as the interviewed stakeholders have a number of goals related to the planned mobile payment system. Identify six of these goals. (7.5 points)

b. Indicate for each of the identified goals one stakeholder who pursues this goal. (1.5 points)

Question 2.3: Analysis of the Project Risks (11 points, approx. 8 minutes working time)

In this task, you analyze potential risks of the project "Development of a clock based mobile payment system" for the following four parties:

- The GoPay Corporation
- The Bank TAR
- The retail chain EDEL&GUT (PRECIOUS&GOOD)
- The watch dealer Peter T.

a. Identify one potential risk for each of these parties. (4 points)

b. For each of the risks specified for point a., calculate the risk factor by estimating the corresponding probability of occurrence and the extent of the damage on a scale (1 = low, 2 = medium, 3 = high). Explain your assessment shortly in at most five sentences each. (6 points)

- c. When calculating the risk factor in part b. a risk factor of 3 can mean both "high damage with low probability of occurrence" and "minor damage with high probability of occurrence". Explain briefly in at most five sentences why this can be a problem. (1 point)

Question 2.4: User Stories (6 points, approx. 5 minutes working time)

The project manager of the GoPay Corporation opts for an agile process model.

Create three user stories for the stakeholder Yolanda D. (see page. 11). Formulate the user stories according to the template *As <role> I want <my requirement> so that <use for>*. Provide two acceptance criteria for each user story. (6 points)

Part 3 – Applied Task – Implementation (40 points, approx. 30 minutes working time)

Think of different items, each with a different value (profit) and a different weight (weight), and a backpack with limited load capacity. The following algorithm selects the items to be included into the backpack so that together they provide the greatest possible value that can be carried within the backpack. The problem described is known as Knapsack Problem and belongs to the group of optimization problems.

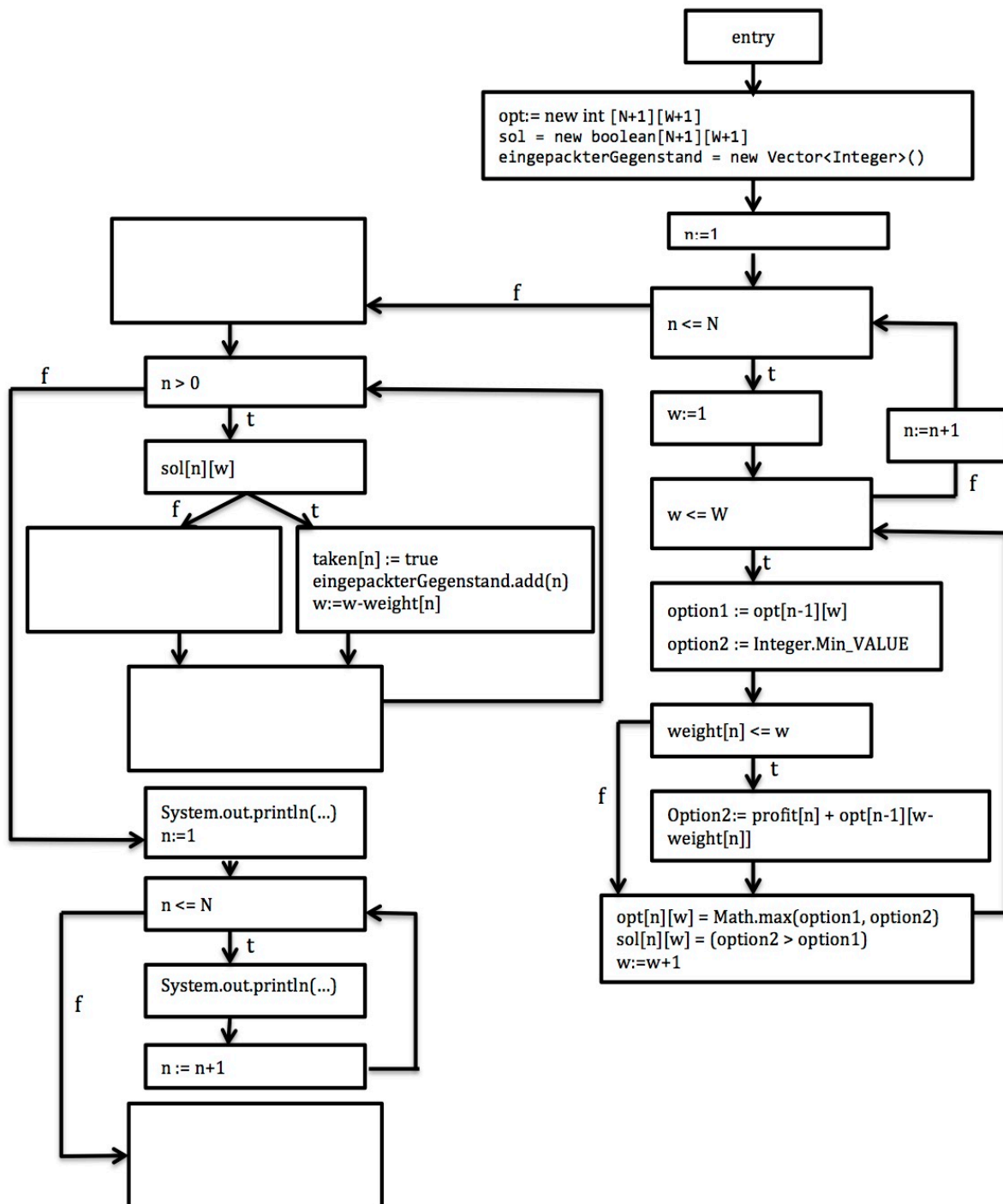
```
0: import java.util.Vector;
1: public class knapsackli {
2: //Changed 2015-01-07 by AM (original Version by KLG on 4.12.14)
3: public Vector<Integer> compute(int N, int W, int[] profit, int[] weight ) {
4
5:     int[][] opt = new int[N+1][W+1];
6:     boolean[][] sol = new boolean[N+1][W+1];
7:     Vector<Integer> eingepackterGegenstand = new Vector<Integer>();
8:     // Pers.Note: Klaus hat angerufen -> Mo bei ihm melden
9:     for (int n = 1; n <= N; n++) {
10:         for (int w = 1; w <= W; w++) {
11:             // don't take item n
12:             int option1 = opt[n-1][w];
13:             // take item n
14:             int option2 = Integer.MIN_VALUE;
15:             if (weight[n] <= w) option2 = profit[n] + opt[n-1][w-weight[n]];
16:             // select better of two options
17:             opt[n][w] = Math.max(option1, option2); sol[n][w] = (option2 > option1);
18:         }
19:     }
20:     // determine which items to take
21:     boolean[] take = new boolean[N+1];
22:     // Loop down until n becomes negative
23:     for (int n = N, w = W; n > 0; n--) {
24:         if (sol[n][w]) { take[n] = true; eingepackterGegenstand.add( n );
25:             w = w - weight[n]; }
26:         else { take[n] = false; }
27:     }
28:
29:     // print results
30:     System.out.println("item" + "\t" + "profit" + "\t" + "weight" + "\t" + "take");
31:     for (int n = 1; n <= N; n++) {
32:         System.out.println(n + "\t" + profit[n] + "\t" + weight[n] + "\t" + take[n]);
33:     }
34:
35:     return eingepackterGegenstand;}}
```


Question 3.3: Control Flow (5 points, approx. 4 minutes working time)

Below is an intra-procedural flow graph of the program code listed above.

- Specify the number of the first line and the number of the last line of code that are described by the intra-procedural flow graph? (1 point)

- Fill the four empty boxes with the correct content. (4 points)



Question 3.4: Testing (14 points, approx. 11 minutes working time)

The startup founded by you works on a collaborative brain-training app in the form of a game. The project team currently develops a level of the game, in which a player can type a linguistically correct German string (a word, a group of words or a sentence) into the app and send it to an opponent player. The opponent gets the term written backwards and has to recognize it as fast as possible. Your project team has written the following class, in which the method `reverseString(String str)` takes a string and returns it in reverse order in the following form (without the quotes “”): “Start:Reversetext:End”

```
import java.util.Scanner;

public class StringReversal {

    public String reverseString(String str){
        if(str.length() <= 1){
            return "D";
        }
        return str.charAt(str.length()-1) + reverseString(str.substring(0,str.length()-1));
    }

    public static void main(String a[]){
        StringReversal srr = new StringReversal();
        Scanner scan = new Scanner(System.in);
        String reverse = scan.nextLine();
        System.out.println("Start:"+ srr.reverseString(reverse) +":End");
    }
}
```

Your task is to test the method.

- a. Define two equivalence classes and specify a test case for each equivalence class. Choose the equivalence classes such that any conceivable input string belongs to one of the two classes. (4 points)

b. Specify two test cases, such that each one of them tests a boundary value for this method. (4 points)

c. Test the method, as a dry run, with the test cases you defined, and document your findings. (6 points)