Prof. Dr. A. Podelski,
Dr. B. Westphal

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Softwaretechnik/Software Engineering

`http://swt.informatik.uni-freiburg.de/teaching/SS2017/swtvl`

Exercise Sheet 3

Early submission: Thursday, 2016-06-08, 12:00 Regular submission: Monday, 2017-06-12, 14:00

Exercise 1 – Requirements Elicitation (5 Points + 5 Bonus)

At the *Softwarepraktikum*, one requirement from the customer is the following:

> "Das Spiel muss mindestens 5 verschiedene *statistics* sammeln und anzeigen."
>
> "The game must collect and display at least 5 different statistics."

In this exercise, you are asked to clarify and specify that requirement as precise as possible, i.e. to assume the role of an analyst or requirements engineer:

(i) State what terms or conditions need to be clarified. For all terms and conditions needing clarification, name at least two different, plausible interpretations that you can apply to the requirement to highlight its ambiguity. (2)

Hint: If you consider the requirement to be already clear, give a specification and ask your tutor by mail to give you another possible interpretation.

(ii) Clarify which of your interpretations is correct and give a **specification** for our requirement. Use any means available to make it as precise as possible (e.g., a term glossary, formalization, a list of positive and negative examples, etc.). In order to obtain sufficient information to clarify the requirement, you will have to ask the customer any questions you consider necessary. (3)

Note: For the course of this exercise, your software engineering (!) tutor will play the role of the customer's representative for all requirements issues.

Document which questions you would ask the customer in order to disambiguate the interpretations you found in (i). For each question, explain what information you expect to receive, or which interpretation you are trying to refute or confirm.

Ask the questions to the customer by mail (your software engineering tutor's mail can be found in the description of your ILIAS exercises group) and document the answers received. If you are not satisfied with the answer[1]*, reformulate your question and ask again to elicit the exact conditions. Please be aware that answering questions may take some time. Expect a worst-case response time of three working days.*

Once again (to avoid any confusion): This task is made up in the sense that your software engineering tutor *plays* the role of the customer. The software engineering tutor's answers are authoritative for this exercise (but not necessarily for your *Softwarepraktikum*). Answers from anybody else, including your *Softwarepraktikum* tutor, do not count for this exercise (but may be relevant for your *Softwarepraktikum*). The point of this "play" is that the answers are not made up, but from *real Softwarepraktikum*-Game customers: if necessary, your software engineering tutor will clarify with the "big bosses" of *Softwarepraktikum*.

[1] Do not expect the customer to give *perfect*, *exhaustive* answers on the first mail. Customers may not get your point, may be busy with other things and answer briefly, may consider their brief answer to be perfect, may ask back, etc. Do not give up easily! Here, it's *your* job to clarify the requirements, not the customer's. You may ask as many questions as you need for this task.

Originality Challenge* **(5 Bonus)**

Provide a third different plausible interpretation of the *Softwarepraktikum* requirement given above. Plausibility here means that it is worth the customer's time needed to consider it and decide whether this interpretation is an acceptable realisation of the requirement or not. Plausibility is at the discretion of your tutor, and you may ask your tutor. (For example, "we consider 'statistics' to denote flowers and for us, 'display' means putting collected flowers into a vase and placing the vase on a window sill" is very creative and original, but not a plausible interpretation in the context of the *Softwarepraktikum*). Make sure to clearly mark which interpretation you would like to propose for the originality challenge.

> *** Originality Challenge** (refined explanation): For this type of exercise, the points attained depend on how original the answer you provide is. Every different answer is given the total number of points (5 in this case). These points will be divided among the teams (in your tutorial group) that provide the same answer (deciding the "is the same as"-relation is at your tutor's discretion). Concretely, the number of points you will obtain for a certain answer is $\lceil p/n \rceil$, where p is the number of points for the originality challenge exercise and n is the number of teams in your tutorial group that provided the same answer.

Exercise 2 – Analysis of Decision Tables (5 Points)

Consider the decision tables shown in Figure 1.

DT: 1	**R1**	**R2**	**R3**
C1	$\times$	$-$	$*$
C2	$-$	$*$	$\times$
C3	$*$	$-$	$*$
A1	$\times$	$-$	$-$
A2	$-$	$\times$	$-$
$\neg[\neg C1 \land \neg C2]$			

(a) Decision Table 1

DT: 2	**R1**	**R2**	**R3**	**R4**
C1	$*$	$*$	$-$	$\times$
C2	$\times$	$-$	$-$	$-$
C3	$*$	$\times$	$-$	$-$
A1	$\times$	$-$	$-$	$\times$
A2	$\times$	$-$	$\times$	$-$

(b) Decision Table 2

DT: 3	**R1**	**R2**	**R3**
C1	$\times$	$-$	$*$
C2	$\times$	$*$	$\times$
C3	$*$	$*$	$*$
A1	$\times$	$-$	$-$
A2	$-$	$-$	$\times$
$\neg[C1 \land C2]$			

Conflicting actions: A1 $\lightning$ A2

(c) Decision Table 3

Figure 1: Decision Tables for Exercise 1

(i) Are decision tables 1 and 2 **complete**? Is table 1 *without the conflict axiom* complete? Justify your answer: If they are complete, show why; if they are not, give examples of missing rules. (2)

(ii) Are decision tables 1 and 2 **deterministic**? Justify your answer: If they are deterministic, show why; if they are not, state which rules are non-deterministic. (1)

(iii) Are there any **useless rules** in tables 2 and 3? If not, show why. If there are, state which rules are useless. (1)

(iv) Is table 3 **consistent** with respect to conflicting actions? If it is, show why. If not, give at least one example of a valuation that causes conflicting actions to be executed. (1)

Hint: One possible method for showing properties of a decision table is by creating a truth table *with all possible combinations of conditions and determining which rules and actions are applied to each. Another possible method is deriving the formulas represented by the table and using the rules of propositional logic to show their validity, satisfiability, etc.*

Exercise 3 – Creation of Decision Tables (5 Points + 5 Bonus)

In this exercise, you are required to formalize the requirements for a software to calculate the shipping costs of an online store.
The following is a transcription of the interview with the customer:

- For small packages, the shipping costs depend on the weight of the items in the shopping cart, there is a fixed price for the first 2kg and a variable fee for each additional kg.
- If the shipping address is in the same city as the online shop, a charge on delivery (COD) shipping option should be offered, for a fixed price of 10 €.
- For shipping to metropolitan areas, the first 2kg cost 3 € and 1 € for each additional kg of effective weight.
- Intermediate cities and rural regions have different shipping prices: For intermediate cities 5 € and 1.50 € and for rural regions 10 € and 2.50 € respectively.
- There is a table that uniquely indicates the type of destination for each supported delivery address. You can assume that all addresses and their categories are known.
- Since packages also occupy space, we take the maximum between the package weight and the *volumetric weight*. We call this *effective weight*. All shipping costs calculations use the effective weight as input.
- The volumetric weight is calculated as $length * width * height/factor$ where the measurements are specified in centimeters.
- The factor depends on the shipping method employed, we can use the small package shipping method, which is cheaper, for packages up to 5kg effective weight. Otherwise, we use the parcel shipping method for packages of 5kg and more. The factor for small packages is $f_1 = 2500$ and for parcels $f_2 = 5000$. For example, a package of size $10 \times 5 \times 20$ has a volumetric weight of $v_s = 10 * 5 * 20/2500 = 0.4$kg for small packages or $v_p = 10 * 5 * 20/5000 = 0.2$kg for parcel shipping.
- The parcel shipping costs for the first kilogram and additional kilograms are given on the following table:

Type	**First kg.**	**Additional kg.**
Metropolitan	1.00	0.75
Intermediate	2.25	1.25
Rural	5.00	2.75

- There is a special offer: For rural areas, small but heavy packages (volumetric weight less than 5kg but more than 5kg actual weight) pay the price of intermediate cities.
- Here are a few examples:
  - Shipping a box with size $12cm \times 5cm \times 30cm$ and 3kg actual weight to Berlin (a metropolitan area, also the city where our shop is located) costs 4€. Additionally, we offer the COD option.
  - Shipping a pillow to Offenburg (an intermediate city) with size $40cm \times 80cm \times 25cm$ and weight 1.5kg costs 21€. Because the volumetric weight $v_s = 40 * 80 * 25/2500 = 32$ is over 5kgs, we have to use the parcel shipping option. So we use the volumetric weight for parcels $v_p = 40 * 80 * 25/5000 = 16$ to calculate the price according to the table.

Considering those informal requirements: Specify all the requirements above as a decision table.

(i) Assume that you are given the size and the actual weight of a package to be shipped. Also assume that you know the shipping address and thus also know whether it is a metropolitan, intermediate or rural address. Create a **decision table** to choose which price calculation to use, and whether the COD shipping option should be displayed.

For example, a package with effective weight of 10kg shipped to a metropolitan address would use the formula $price = 1 + 0.75(w - 1) = 1 + 0.75(10 - 1)$.

Create **conditions** and **actions** as necessary and make appropriate use of environment assumptions and conflict axioms. Specify the **rules** necessary to decide which price calculation to apply.

Assume you will apply the collecting semantics to interpret the table. (4)

(ii) According to your decision table, and assuming that the online store is in Berlin (a metropolitan area):

- What is the price of shipping a box of printed exercise sheets to Niederaichbach (a rural area) of size $29.7cm \times 21cm \times 20cm$ and a weight of 6.25kg? (1)

(iii) Show that your decision table is consistent. Actually, what we want to check is whether the requirements from the text are consistent. Are they? (5 Bonus)

Exercise 4 – Use Cases (5 Points)

Consider the ATM example from the lecture. One feature typically offered by ATMs is the possibility of checking account balances.

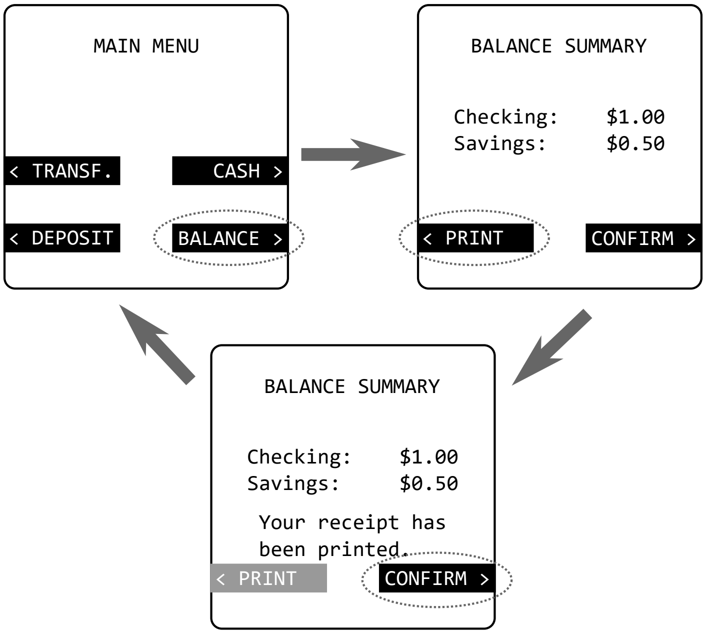

Figure 2: ATM screen example for the “Check Balances” use case.

When the user selects the “Balance” option from the main menu, the ATM should consult the bank and display a summary of the most recently available account balances (see Figure 2). By selecting the “Confirm” option, the user can return to the main menu at any time. Additionally, the user has the option to print a receipt showing the balances displayed on the screen. The user is allowed to print only one receipt. Once selected, the bank is notified by the ATM for statistical purposes and the “Print” option should be disabled (so that a receipt can be printed only once).

Note that the ATM also has a physical “Cancel” button, that may be pressed at any time to cancel any running transaction and return the card.

(i) Construct the “Check Balances” **use case**, specify all fields following the format from the lecture. The normal case is the one in which the user checks his account balances on the screen and confirms right after. Assume for the description of the use case that the user never presses the physical “Cancel” button. Also include the following alternatives:

- The connection to the bank is interrupted when checking balances. An error message should be displayed.
- The user selects the “Print” option and the ATM prints a receipt.
- For all other alternatives that you consider necessary, please use your experience on using ATMs. Please mark clearly which alternatives are based on your experience.

(4)

(ii) Draw the corresponding **use case diagram**. Describe the procedure by which you produced the use case diagram from your use case. What information is included in the diagram(s)? What information from the use case is not? (1)