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Softwaretechnik/Software Engineering

http://swt.informatik.uni-freiburg.de/teaching/SS2021/swtvl

Exercise Sheet 3

Early submission: Monday, 2021-06-07, 13:00 Regular submission: Tuesday, 2021-06-08, 13:00

Exercise 1 – Requirements Elicitation (7/20 Points + 5 Bonus)

Recall the video game from Exercise Sheet 2. One of the requirements read:

> The game must have either 2D or 3D graphics (no ASCII).
> ("Das Spiel muss entweder 2D oder 3D Grafik (kein ASCII) haben.")

(i) Clarify the meaning of the terms that the requirement directly depends on as intended by the customer.[1] Present the results in form of a dictionary.

For at least 3 terms in your dictionary, complement the entry by a plausible interpretation that was *not* intended by the customer and state (for traceability) on which customer information you base your conclusion. (3)

Real-world example: On your way out to the supermarket, the new flatmate says "Oh, could you get me some milk from the supermarket?" As an RE-person, you would start to work on the dictionary entry 'milk' by asking "What do you mean by 'milk'? Cow, sheep, camel, almond, soy, anything else...?" All these options are plausible to the RE-person. The purpose of the question is to find out which ones the flatmate would accept (and pay) and which ones not.

(ii) Use the terms from the dictionary and prepare, with input from the customer[1], a specification of which products are considered to satisfy the given requirement and which ones not. Work on this task may include refining entries in the dictionary, identifying aspects or terms that the requirement indirectly depends on, and putting terms into relations. (3)

If cow-milk is it and 'some' means between 1 and 3 litres, the RE-person would continue to ask "Fat-degree? UHT or fresh or . . . ? Bottle or . . . ? Brand? Any bio-label?". Prompted by the questions, the flatmate may add "Oh, good that you mention 'brand': If they have the 0.5l bottles of Breisgau-Milch, please bring two of those; I'd like to use these bottles as flower vase in my room."

(iii) Summarise your findings from the previous tasks in a comprehensible, one-sentence specification that describes your understanding of the set of all solutions accepted by the customer. (1)

[1] *For this exercise, you need to interact with a real customer from the domain of student-developed video games. The task is to analyse what this customer accepts or does not accept. The customer wants to stay anonymous during this early stage of contract negotiations, hence your only way of communication with the customer is through your software engineering tutor. That is, any enquiries you send to your tutor by mail (forum enquiries will not be considered) will be forwarded to the customer and you will receive the customer's reply. Note that, as a true customer, the person may actually not yet exactly know what is accepted, may misunderstand your questions, may give answers which you do not understand, may get annoyed by impolite questions, etc. In that case, just continue to send further questions: Do not give up easily. Note that, in the end, it is* your *job to clarify the requirements, not the customer's. Please be aware that answering questions may take some time. Expect a worst-case response time of three working days outside the holiday period.*

Fine print: This exercise is not related in any way to previous, current, or future *Softwarepraktikum* courses: Similarities are purely coincidental. The customer who you communicate with is anonymous; it may be a person from the *Softwarepraktikum* team or somebody completely unrelated. For this exercise, only the information received from the customer through your software engineering tutor is authoritative for the intentions of this customer (and you document the information for traceability).

(iv) Examples can be an effective means for the validation of a specification. Describe three existing (or made up) products such that one is clearly not accepted by your understanding of the requirement, one clearly is, and one could be a corner-case, that is, one that could, on first sight, be considered to (not) satisfy the requirement while it actually does (not). In particular of the corner-case, state and argue your expectation and point out why the first sight could be misleading. (5 Bonus)

Exercise 2 – Analysis of Decision Tables (7/20 Points)

Consider the decision tables shown in Figure 1.

DT: 1	R1	R2	R3
C1	×	–	*
C2	–	*	×
C3	*	–	*
A1	×	–	–
A2	–	×	–
$\neg[\neg C1 \wedge \neg C2]$			

(a) Decision Table 1

DT: 2	R1	R2	R3	R4
C1	*	*	–	×
C2	×	–	–	–
C3	*	×	–	–
A1	×	–	–	×
A2	×	–	×	–

(b) Decision Table 2

DT: 3	R1	R2	R3
C1	×	–	*
C2	×	*	×
C3	*	*	*
A1	×	–	–
A2	–	–	×
$\neg[C1 \wedge C2]$			

Conflicting actions: A1 $\lightning$ A2

(c) Decision Table 3

Figure 1: Decision Tables for Exercise 1

(i) Are decision tables "DT1" and "DT2" *complete*? Is "DT1" relative complete? (3)

(ii) Are decision tables "DT1" and "DT2" *deterministic*? (2)

(iii) Do decision tables "DT2" and "DT3" have *useless rules*? (1)

(iv) Is decision table "DT3" *consistent* with respect to *conflicting actions* in the collecting semantics? (1)

Justify your answers with proofs or counterexamples.

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 combination. Another possible method is by 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 (6/20 Points)

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 2 kg 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 2 kg 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 5 kg effective weight. Otherwise, we use the parcel shipping method for packages of 5 kg 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 5 kg but more than 5 kg actual weight) pay the price of intermediate cities.
- Here are a few examples:
  - Shipping a box with size $12\,cm \times 5\,cm \times 30\,cm$ and 3 kg 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 $40\,cm \times 80\,cm \times 25\,cm$ and weight 1.5 kg costs 21€. Because the volumetric weight $v_s = 40 * 80 * 25/2500 = 32$ is over 5 kg, 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 10 kg 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. (5)

(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 $29.7\,cm \times 21\,cm \times 20\,cm$ and a weight of 6.25 kg? (1)