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Softwaretechnik/Software Engineering

http://swt.informatik.uni-freiburg.de/teaching/SS2016/swtvl

Exercise Sheet 3

Early submission: Wednesday, 2016-06-08, 12:00 Regular submission: Thursday, 2016-06-09, 12:00

Exercise 1 – Analysis of Decision Tables (5 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: $A1 \not\downarrow A2$

(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 2 – 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 3 – Use Cases and Sequence Diagrams (10)

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

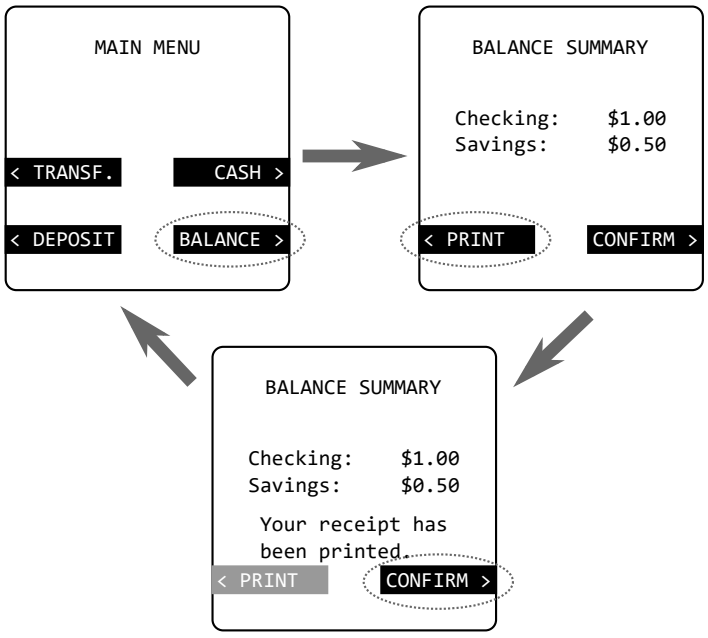

Figure 2: ATM screen example for the "Check Balances" use case.

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)

(iii) Create **universal live sequence charts (LSC)** to specify the ATM behavior for the use case above, including its exceptional cases. Remember also the "Cancel" button on the ATM's keyboard. Create your diagrams only for the cases when the user does not press it.

Hint: Don't forget to add a corresponding condition on your LSCs for the Cancel button.

Available messages are shown in the following table, also assume that all messages are instantaneous.

Source	**Destination**	**Message**
User	ATM	cancel
User	ATM	confirm
ATM	User	display_balances
ATM	User	display_error
ATM	User	display_menu
ATM	User	print_receipt
User	ATM	print_request
ATM	Bank	retrieve_balances
Bank	ATM	transaction_result

Also, for the LSCs, assume that the user has already selected the corresponding option and the balances screen is being displayed.

Hint: this means that the activation condition of the chart is that the balances *screen is being displayed and thus you do not need a prechart.*

For each LSC, give a brief description of the sequence that you want to cover with it. Also, give a brief description of how the LSCs together conform a specification of the use case.

(5)