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# Solutions for Excercise sheet 3

## Exercise 3 – Creation of Decision Tables

i 1. 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:

| Type | First kg. | Additional kg. |
|---|---|---|
| Metropolitan | 3.00 | 1 |
| Intermediate | 5 | 1.5 |
| Rural | 10.00 | 2.5 |

2. 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 |

3. 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 Euro.
4. 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.

| DT: Price calculations | r1 (1.1) | r2 (1.2) | r3 (1.3) | r4 (4) | r5 (3) | r6 (2.1) | r7 (2.2) | r8 (2.3) |
|---|---|---|---|---|---|---|---|---|
| effective weight $\leq$ 5kg | x | x | x | x | * | - | - | - |
| effective weight $>$ 5kg | - | - | - | - | * | x | x | x |
| metropolitan | x | - | - | - | * | x | - | - |
| intermediate | - | x | - | - | * | - | x | - |
| rural | - | - | x | x | * | - | - | x |
| same city as shop | * | * | * | * | x | * | * | * |
| actual weight $>$ 5kg | * | * | - | x | * | * | * | * |
| display COD option | - | - | - | - | x | - | - | - |
| price calculation | 3+w - 1 | 2.25 +1.25w -1.25 | 5 +2.75w -2.75 | 2.25 +1.25w -1.25 | - | 1 +0.75w -0.75 | 2.25 +1.25w -1.25 | 5 +2.75w -2.75 |

conflict axioms:
The adress is either metropolitan, intermediate or rural, so no other combination (e.g $metropolitan \wedge rural$) cannot happen:

$$\varphi_{confl} = \neg(metropolitan \oplus rural \oplus intermediate) \Leftrightarrow \neg(c3 \oplus c4 \oplus c5)$$

The effective weight can be exclusively either less than or more than 5 kg:

$$\psi_{confl} = (c1 \wedge c2) \vee (\neg c1 \wedge \neg c2)$$

ii shipping to the **rural** area Niederaichbach, (so **not in the same city** where the shop is located) with the dimensions 29.7cm × 21cm × 20cm and a weight of 6.25kg gives us an effective weight of 5,9896 kg (> **5 kg**) (a small package).
So we can only use the rule **r4**, which give us a price of $2.25 \cdot 1.25 \cdot 5.9896 - 1.25 \approx 8.49$€

iii The table is consistent because the interpreting function is a tautology, it has a rule for every possible combination of conditions:

$$
\begin{aligned}
& c1 \land \neg c2 \land c3 \land \neg c4 \land \neg c5 \land true \land true \\
& \lor c1 \land \neg c2 \land \neg c3 \land c4 \land \neg c5 \land true \land true \\
& \lor c1 \land \neg c2 \land \neg c3 \land \neg c4 \land c5 \land true \land \neg c7 \\
& \lor c1 \land \neg c2 \land \neg c3 \land \neg c4 \land c5 \land true \land c7 \\
& \lor \neg c1 \land c2 \land c3 \land \neg c4 \land \neg c5 \land true \land true \\
& \lor \neg c1 \land c2 \land \neg c3 \land c4 \land \neg c5 \land true \land true \\
& \lor \neg c1 \land c2 \land \neg c3 \land \neg c4 \land c5 \land true \land true \\
& \lor true \land true \land true \land true \land true \land c6 \land true \\
& \lor \neg(c3 \oplus c4 \oplus c5) \\
& \lor (c1 \land c2) \lor (\neg c1 \land \neg c2)
\end{aligned}
$$

$$
\begin{aligned}
& \Leftrightarrow \neg c2 \land c3 \land \neg c4 \land \neg c5 \\
& \lor \neg c2 \land \neg c3 \land c4 \land \neg c5 \\
& \lor \neg c2 \land \neg c3 \land \neg c4 \land c5 \land \neg c7 \\
& \lor \neg c2 \land \neg c3 \land \neg c4 \land c5 \land c7 \\
& \lor c2 \land c3 \land \neg c4 \land \neg c5 \\
& \lor c2 \land \neg c3 \land c4 \land \neg c5 \\
& \lor c2 \land \neg c3 \land \neg c4 \land c5 \\
& \lor c6 \\
& \lor \neg(c3 \oplus c4 \oplus c5) \\
& \lor (c1 \land c2) \lor (\neg c1 \land \neg c2)
\end{aligned}
$$

$$\begin{aligned}
&\Leftrightarrow \neg c2 \wedge c3 \wedge \neg c4 \wedge \neg c5 \\
&\vee \neg c2 \wedge \neg c3 \wedge c4 \wedge \neg c5 \\
&\vee \neg c2 \wedge \neg c3 \wedge \neg c4 \wedge c5 \wedge true \\
&\vee c2 \wedge c3 \wedge \neg c4 \wedge \neg c5 \\
&\vee c2 \wedge \neg c3 \wedge c4 \wedge \neg c5 \\
&\vee c2 \wedge \neg c3 \wedge \neg c4 \wedge c5 \\
&\vee c6 \\
&\vee \neg(c3 \oplus c4 \oplus c5) \\
&\vee (c1 \wedge c2) \vee (\neg c1 \wedge \neg c2)
\end{aligned}$$

$$\begin{aligned}
&\Leftrightarrow \neg c2 \wedge c3 \wedge \neg c4 \wedge \neg c5 \\
&\vee \neg c2 \wedge \neg c3 \wedge c4 \wedge \neg c5 \\
&\vee \neg c2 \wedge \neg c3 \wedge \neg c4 \wedge c5 \\
&\vee c2 \wedge c3 \wedge \neg c4 \wedge \neg c5 \\
&\vee c2 \wedge \neg c3 \wedge c4 \wedge \neg c5 \\
&\vee c2 \wedge \neg c3 \wedge \neg c4 \wedge c5 \\
&\vee c6 \\
&\vee \neg(c3 \oplus c4 \oplus c5) \\
&\vee (c1 \wedge c2) \vee (\neg c1 \wedge \neg c2)
\end{aligned}$$

because of $\psi_{confl}$ (and common sense) we can conclude that $c1 = \neg c2$ and get rid of the first (or second) row in the table ($c1$ or $c2$ in the interpreting function). The third and the fourth line differ in only one variable, so can be reduced to one line without $c7$.