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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:

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

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

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

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

because of ψ_{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 $c7$.