Reasoning and Formal Modelling for Forensic Science
2010/2011; 2nd Semester
Prof. Dr. Benedikt Löwe

Werkcollege Exercises # 5

Please start thinking about these exercises before the next *werkcollege* on Tuesday, 8 March, 5pm, room C0.110. The exercises will be discussed in class with active student participation: you will get some extra time to think about them, and then present the solutions in front of the class.

Exercise 13.

Two modellers consider the following story:

"Lily Stark is found dead in her office in downtown Philadelphia. Her boyfriend Jeff is apprehended and questioned. The police find out that Lily had a job offer from Seattle and that she planned to move next month. They find out that Jeff and Lily have been fighting about the impending move shortly before her death. In her office, there is a metal bar that according to the forensics lab is most likely the murder weapon. No other obvious candidates for the murder weapon can be found. The metal bar has fingerprint of Lily, Jeff and Lily's assistant Rose."

Modeller 1 decides to model this story as follows: She uses three individuals ℓ (for Lily), j (for Jeff) and r (for Rose), one property motive (for "has a motive"), and a relation kill (for "killed") with the tables

	motive	kill ℓ	j	r
ℓ	No	No	No	No
j	Yes	?	No	No
r	?	?	No	No.

She uses the rules $\mathrm{kill}(x,y) \to \mathrm{motive}(y)$ and $\exists x \mathrm{kill}(x,\ell)$. She then goes on to prove in that controlled situation, both Jeff and Rose are consistently the killer.

Modeller 2 uses a very different system with individuals ℓ (for Lily), j (for Jeff), r (for Rose), u (for an unknown person), b (for the metal bar) and o (for an other item). Furthermore, there is binary relation $\mathrm{fingerprints}(x,y)$ (for "x's fingerprints are on y") and a ternary relation $\mathrm{kill}(x,y,z)$ (for "x killed y with z") with

	fingerprints ℓ	j	r	u	b	o
ℓ	No	No	No	No	Yes	?
j	No	No	No	No	Yes	?
r	No	No	No	No	Yes	?
u	No	No	No	No	No	?
b	No	No	No	No	No	No
o	No	No	No	No	No	No

and $\mathrm{kill}(x,\ell,z)$ is "?" if x is j, r or u and z is b or o, and "No" in all other cases. She uses the rules $\mathrm{kill}(x,y,z) \to \mathrm{fingerprints}(x,z)$ and $\exists x \exists z \mathrm{kill}(x,\ell,z)$. She then shows that it is consistent that the bar is not the murder weapon and that Lily was killed by a person other than Jeff or Rose.

Modeller 1 says: "I believe that the metal bar is the murder weapon: it is deemed highly likely by the forensics lab, and there is no other possible murder weapon mentioned. Therefore I didn't represent the murder weapon in the formal language and focussed on the three people with fingerprints on

the bar. Jeff clearly has a motive as people have been killed over less than such a breakup. There are motives that we can imagine for Rose, but we do not know for sure."

Modeller 2 says: "Assuming that there is no other murder weapon is short sighted since it restricts the list of possible killers. It is only 'likely' that the bar is the murder weapon. Therefore I focused on the murder weapon and allowed for a different one, and then also for a different person who could have left fingerprints on the murder weapon."

Describe the arguments of the two modellers in terms of Argumentation Schemes as discussed in class. After you have identified the schemes, go through the list of critical questions for the schemes. Which model do you think fits the story better? Give an argument for your choice.

Exercise 14.

Construct two natural language stories that are examples of "Argument from Cause to Effect" and "Argument from Abduction". Discuss all critical questions with respect to the examples that you found; in particular, discuss which of the four cases (cf. slide "What do we learn from our critical questions? (1)") applies.