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1. Übung zur Vorlesung „Logische Methoden in der Wissensrepräsentation“

Exercise 1:

Consider the following puzzle:
King Henry VIII of England was born in 1491 and had 6 different wives during the 38 years of his reign (from the coronation in 1509 until his death in 1547). His sixth wife (Catherine Parr) survived him by one year and attended the crowning of his son Edward VI.

- The fourth marriage of Henry was arranged with a German princess. He allegedly found her repellent, but she was not the wife beheaded for misconduct.
- Anne Boleyn, a former maid of honor, has not been the first wife of Henry, but Catherine Howard was his fifth.
- After a divorce, Henry immediately married a commoner.
- Jane Seymour is not the wife who was a widow before marrying Henry.
- The aristocrat's daughter, who died after the birth of her first son (the later Edward VI) was married by Henry earlier than the former maid of honor, but after Anne of Cleves.
- The marriage between Catherine of Aragon and Henry was annulled, although she gave birth to several children, of which unfortunately only a single daughter survived.
- The second wife of Henry, who was beheaded for infidelity, was a cousin of another wife of Henry, who was executed as well.

A solution to this puzzle consists in a description of the six wives of Henry (including their names, social status, and reason for the end of the marriage), and of the order in which this six women have been married to Henry.

(a) Since this puzzle is given in plain English, it can (at least in this form) not be processed by a computer program. Choose an appropriate formalism, which is suitable for representing the puzzle such that it can be automatically solved by a computer program. Translate the puzzle into the chosen formalism.

(b) Describe the inference problems that can be used in order to solve the puzzle.

(c) Name a sound and complete method for solving these inference problems.

Exercise 2:

Which of the following claims are true and which are false?

(a) A problem and its complement are partially decidable if and only if the problem and its complement are decidable.

(b) A problem is decidable if and only if there exists an algorithm for this problem that is sound and terminating.

(c) If a problem is not partially decidable, then there exists no sound and terminating algorithm for this problem.

(d) There exist problems such that neither the problem nor its complement are partially decidable.

(e) Satisfiability of propositional logic formulas is partially decidable.

(f) The satisfiability of formula sets that are obtained by translating PROLOG programs into first order predicate logic (in the standard way) is decidable.

Exercise 3:

Reconsider the three PROLOG programs that compute whether two nodes of a graph are connected:

(a) $\mathsf{connected}(x,y) :- \mathsf{directly\text{-}connected}(x,y)$
$\mathsf{connected}(x,y) :- \mathsf{directly\text{-}connected}(x,z),\ \mathsf{connected}(z,y)$

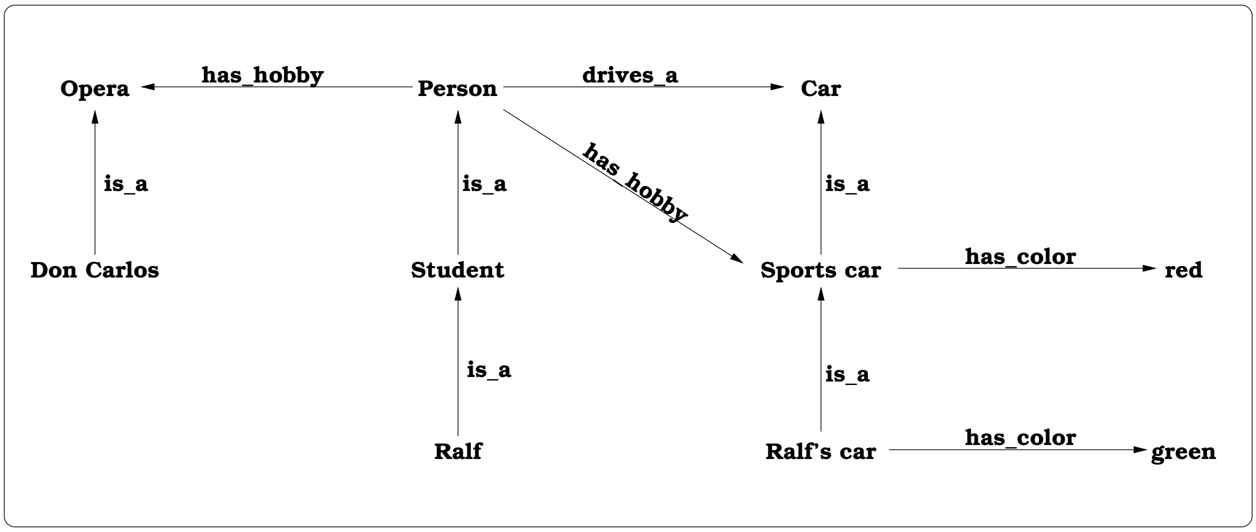
(b) $\mathsf{connected}(x,y) :- \mathsf{directly\text{-}connected}(x,y)$
$\mathsf{connected}(x,y) :- \mathsf{connected}(z,y),\ \mathsf{directly\text{-}connected}(x,z)$

(c) $\mathsf{connected}(x,y) :- \mathsf{directly\text{-}connected}(x,z),\ \mathsf{connected}(z,y)$
$\mathsf{connected}(x,y) :- \mathsf{directly\text{-}connected}(x,y)$

For each of the three programs, determine whether it is sound, complete, and terminating. Explain your statements.

Exercise 4:

Consider the following semantic network:



(a) Which nodes are concepts, which objects?

(b) Describe some possible meanings of property edges.

(c) Which color has Ralf's car?

(d) What are the communalities between sports cars and operas?

Exercise 5:

Construct a semantic network that (partially) describes a university. Use concepts such as *professor*, *assistant*, and *student*, and relationships such as *teaches*, *is–employed–by*, *has-matrikelnumber*, *attends*, and *performs-exams*. Find additional concepts and relationships.