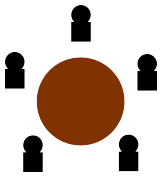
GWV – Grundlagen der Wissensverarbeitung

Tutorial 8: Propositions and Inference

Class Exercise 8.1: (Optimization & Local Search)



Sir Samuel of Ankh is holding a dinner at his mansion; invited are Lord Rust, his co-workers "Nobby" Nobbs and Carrot, and of course his wife Lady Sybil.

The butler, Willikins, is tasked with the dubious challenge of arranging the seating order around the round table. Knowing the complicated relationships some of the guests share, he assigns a value to each pair of guests, should they be seated next to each other (ranging from 4, i.e. "splendid conversation" to -4, i.e. "open warfare"):

- Sir Sam - Lord Rust: -4
- Sir Sam - "Nobby": 2
- Sir Sam - Carrot: 2
- Sir Sam - Lady Sybil: 3

- Lord Rust - "Nobby": -4
- Lord Rust - Lady Sybil: 3

- "Nobby" - Carrot: 3
- "Nobby" - Lady Sybil: 4

- Carrot - Lady Sybil: 3

For every other combination of guests, Willikins assumes a value of 0, i.e. "polite interaction".

Solve the Willikins-Seating-Problem through local search:

- Choose an appropriate representation of the relationship information given above.
- What does a node of this problems solution space look like? Give a formal description.
- Choose an appropriate starting point and perform at least two iterations of the Greedy Descent algorithm per hand. What are your results, i.e. what seating order should Willikins choose for the dinner guests?

Exercise 8.2: (CSI Stellingen)

Introduction to Diagnosis: A Murder Investigation

Apply your knowledge of propositions and inference to catch the murderer. Find a formal representation of the assumables, observations, rules and integrity constraints given below. Then compute the minimal conflict and the minimal diagnosis for the following scenario:

A millionaire has been found murdered in his villa. Both the butler and the gardener are possible suspects.

- Assumables: Your assumables are the statements by the different suspects.
  - Gardener: I have been working in the garden all day. (And thus was not able to commit the murder.)
  - Butler: I have been fixing the car in the garage all day. (And thus was not able to commit the murder.)
- Observations: Your observations are facts that you have observed during your investigation.
  - The gardener has no dirt on his hands.
  - The butler has dirt on his hands.
- Rules: Now you can use rules to deduce new facts from both your observations and the statements given by the suspects.
  - If the gardener worked in the garden all day, he will have dirt on his hands.
  - If the butler worked in the garage all day, he will have dirt on his hands.
- Integrity Constraints: Finally you can apply integrity constraints to find out which of the statements must be false.
  - The gardener has either dirt on his hands or he has no dirt on his hands.
  - The butler has either dirt on his hands or he has no dirt on his hands.

Exercise 8.3: (Diagnosis)

Figure 1 shows a diagram of an engine in a car. When the ignition key is turned a good mechanic can hear (observe) three noises produced by the starter, the fuel pump and the engine itself. In case one of the noises is not observed there is a fault in at least one component. Formalize the given diagnosis problem. You can assume that all connections (cables, pipes and mechanical links) work properly but each component (grey box) could be faulty in one way or the other: A fuel tank could be empty, a starter broken, a filter clogged and so on.

Perform a diagnosis (that is compute the minimal diagnoses) for the following sets of observations:

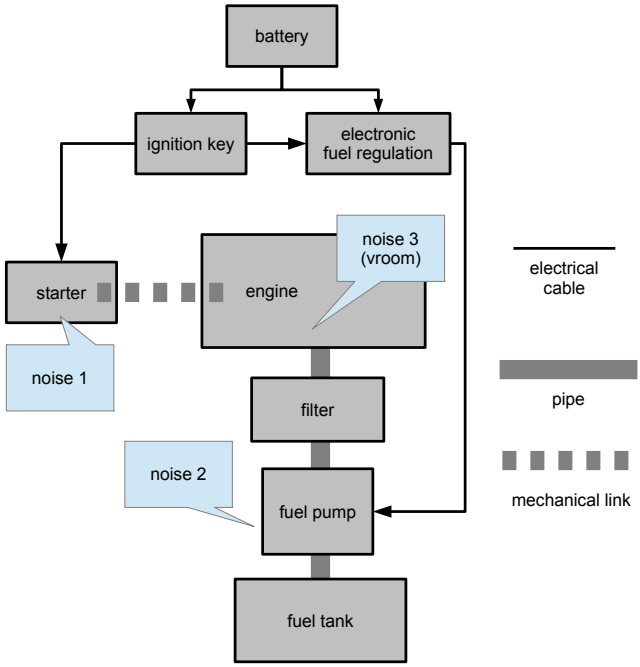


Figure 1: A car engine

- No noises
- Only noise 1
- Only noise 2
- Noise 1 and 2 but not noise 3

You can *either* do the formalization and diagnosis on paper *or* you can make an implementation in Prolog.

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Achievable score on this sheet: 12