

CMPT 411/721 - Knowledge Representation and Reasoning

Assignment 3

Due date: Nov. 15, 2019

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Important Note: Students must work individually on this, and other CMPT 411/721, assignments. You may not discuss the specific questions in this assignment, nor their solutions with any other student. You may not provide or use any solution, in whole or in part, to or by another student.

You are encouraged to discuss the general concepts involved in the questions in the context of completely different problems. If you are in doubt as to what constitutes acceptable discussion, please ask!

1. (3 marks) Consider the following rules regarding whether a car will start or not:
 - If there is an electrical problem then the engine won't turn over and the headlights won't go on.
 - If the battery is flat or there is a problem with the starter motor, then there is an electrical problem.
 - If there is no gas then the car won't start.
 - If the engine doesn't turn over then the car won't start.

Please use the following abbreviations:

- ep – there is an electrical problem
- to – the engine turns over
- l – the headlights go on
- fb – the battery is flat
- sm – there is a problem with the starter motor
- g – there is gas in the tank
- s – the car starts

Let the hypotheses (assumables) be $\{fb, sm, g\}$.

Express this as an abduction diagnosis problem (using prime implicates).

- (a) What are the diagnoses given that $\neg s$ is observed?
 - (b) What are the diagnoses given that $\neg s$ and l are observed?
2. (3 marks) Express the following assertions in ASP, and run your program. Your program should return “reasonable” answer sets.

Adults (Ad) are normally employed (E).
University students (U) are normally not employed.
Graduate students (G) are normally employed.
Every graduate student is a university student.
University students are normally adults.

Ghassan is a graduate student.
Daphne is a graduate student who is not employed.
Bill is a university student.

Notes:

- The easiest way to use ASP at the command line is via: `clingo program.lp`. As well, `gringo program.lp | clasp` does the same thing.
 - To get all answer sets, use `clingo 0 program.lp` or `gringo program.lp | clasp 0`
 - Recall that `#hide` is no longer supported. You can use `#show` to just show some of the atoms in an answer set.
3. (4 marks) Let $G = (V, E)$ be an undirected graph. A kernel of G is a subset $V' \subseteq V$ such that
- (a) no two vertices in V' are joined by an edge, and
 - (b) for every $v \in V \setminus V'$ there is a vertex $u \in V'$ such that $(v, u) \in E$.

Write an ASP program to determine whether a given instance of a graph has a kernel. Test your program on (at least) cycles of length 4 and 5.