

Human Reasoning and the Weak Completion Semantics

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Exercise 8

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Note: Please consider the equational theory to be empty for each question, unless stated otherwise.

Problem 1

Within the *WCS* framework, what is the difference between $a \leftarrow \perp$ and $\perp \leftarrow a$?

Problem 2

Give an example of a program, and a set of integrity constraints such that neither the program itself, nor the weak completion of the program have models which satisfy the integrity constraints.

Problem 3

Please recall the definition of a *complementary* pair of clauses, and answer the following questions:

- Prove the following proposition: Let $\langle \mathcal{P}, \mathcal{A}_{\mathcal{P}}, \mathcal{IC}, \models_{wcs} \rangle$ be an abductive framework, \mathcal{O} an observation, and $\mathcal{X} \subseteq \mathcal{A}_{\mathcal{P}}$ an explanation for \mathcal{O} which contains a complementary pair $c \leftarrow \top$ and $c \leftarrow \perp$. Then, $\mathcal{X}' = \mathcal{X} \setminus \{c \leftarrow \perp\}$ is also an explanation for \mathcal{O} and $\mathcal{M}_{wcs}(\mathcal{P} \cup \mathcal{X}) = \mathcal{M}_{wcs}(\mathcal{P} \cup \mathcal{X}')$.
- What is the key takeaway?

Problem 4

Please consider the following scenario:

If Jill consumes a cold beverage then she feels good. If Jill consumes a hot beverage then she feels good. If Jill consumes chocolate then she feels good. Jill mostly avoids consuming a hot and a cold beverage in one meal. The observation here is that Jill feels good. The first three lines are represented by the following program,

$$\{ \text{feelgood} \leftarrow \text{hotdrink} \wedge \neg \text{ab}_{\text{hot}}, \text{ab}_{\text{hot}} \leftarrow \perp, \\ \text{feelgood} \leftarrow \text{colddrink} \wedge \neg \text{ab}_{\text{cold}}, \text{ab}_{\text{cold}} \leftarrow \perp, \\ \text{feelgood} \leftarrow \text{chocolate} \wedge \neg \text{ab}_{\text{chocolate}}, \text{ab}_{\text{chocolate}} \leftarrow \perp \}.$$

Given the concepts of strong and weak constraints from the lecture, please choose an appropriate one for this scenario and state the reason(s) for your choice.

Hint: Consider the minimal explanation(s) for the given observation.

Problem 5

Please consider the following program:

$$\begin{aligned} &\{fly(X) \leftarrow bird(X) \wedge \neg ab_{fly}(X), \\ &ab_{fly}(X) \leftarrow kiwi(X), \\ &ab_{fly}(X) \leftarrow penguin(X), \\ &bird(tweety) \leftarrow \top, \\ &bird(jerry) \leftarrow \top\}. \end{aligned}$$

- What are the undefined (grounded) atoms?
- What are the abducibles possible for the above undefined atoms?
- What are the minimal explanations for an observation, Jerry cannot fly?

Problem 6

For each of the following, please write down a logic program \mathcal{P} , and an observation \mathcal{O} , and list one conclusion (formula) which follows:

- Only credulously.
- Only sceptically.
- Both sceptically and credulously.
- Neither sceptically nor credulously.