

# Principles of Knowledge Representation and Reasoning

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## Exercise Sheet 9

Due: December 23th, 2015

### Exercise 9.1 (NONMONOTONIC REASONING USING ABNORMALITY PREDICATES, 3)

Consider the following knowledge base KB and show that  $KB \models_{\leq} flies(c) \vee flies(d)$ . *Note:* The special version of entailment (which is called *minimal entailment* and which is denoted by  $\models_{\leq}$ ) is defined as follows:  $KB \models_{\leq} \phi$  holds iff for every interpretation  $\mathcal{I}$  such that  $\mathcal{I} \models KB$ , either  $\mathcal{I} \models \phi$  or there is an  $\mathcal{I}'$  such that  $\mathcal{I}' < \mathcal{I}$  and  $\mathcal{I}' \models KB$  (with  $\mathcal{I}' \leq \mathcal{I}$  iff  $Abnormal^{\mathcal{I}'} \subseteq Abnormal^{\mathcal{I}}$ ). Discuss how this kind of reasoning compares to reasoning under the Closed World Assumption.

$$KB = \{\forall x(Bird(x) \wedge \neg Abnormal(x) \rightarrow flies(x)), Bird(c), Bird(d), \neg flies(c) \vee \neg flies(d)\}$$

### Exercise 9.2 (EXTENSIONS IN DEFAULT LOGIC, 3)

Consider the propositional default theory  $\Delta = \langle D, W \rangle$  with

$$D = \left\{ \frac{\top : m}{m}, \frac{\top : i}{i}, \frac{m : \neg s}{\neg s}, \frac{m : b}{b}, \frac{i : s \wedge \neg b}{s \wedge \neg b} \right\}, W = \{\neg(m \wedge i)\}$$

Determine all extensions of  $\Delta$ . Which of the propositions  $s$ ,  $b$ ,  $s \vee b$ ,  $s \wedge b$  are entailed by  $\Delta$  using credulous reasoning? Which of them are entailed using skeptical reasoning?

### Exercise 9.3 (KNOWLEDGE REPRESENTATION AND REASONING IN DEFAULT LOGIC, 3 + 3)

Translate into first-order default logic and check whether the given conclusions follow credulously and/or skeptically.

- (a) *Typically, computer science students like computers. Female students who like computers are typically interested in cognitive science. Computer science students are typically female, as for example Anne; but Bob is an exception to this rule. Conclusions: Anne is interested in cognitive science. Bob is not interested in cognitive science.*
- (b) *By default, students are not lazy. But computer science students are typically intelligent, and intelligent students are usually lazy. Jim and Mary study the humanities, Anne and Bob study computer science. Conclusions: Anne and Bob are lazy; Mary and Jim are not.*