Università di Trento, Laurea Specialistica in Informatica

LOGICS FOR DATA AND KNOWLEDGE REPRESENTATION
Written Exam Session II - Monday 20-07-2009

SURNAME: ..... NAME: ..... N. .....

1. 1. What is the "expressiveness" of a representation language? Provide some examples across the logics we have seen so far.

2. What are the main steps to model a piece of world in terms of logical modelling? Explain.

2. What Venn diagram models the extension of the following proposition?

$(C \rightarrow A) \wedge (C \rightarrow B) \wedge \neg (A \wedge B)$.

3. (Adapted from Barwise and Etchemendy, 1993) Read the following text:

If the unicorn is mythical, then it is immortal, but if it is not mythical, then it is a mortal mammal. If the unicorn is either immortal or a mammal, then it is horned. The unicorn is magical if it is horned.

Can you prove that the unicorn is mythical? yes ☐ no ☐

How about magical? Horned?

4. Is every existentially quantified sentence in first-order logic true in any model that contains exactly one object? Justify your answer. yes ☐ no ☐

5. Translate into the description logic $\mathcal{ALN}$ the following proposition: "*Veal-parmesan is a meat dish with ingredient veal and exactly 9 ingredients*." (Specify meaning of concepts and roles.)

6. Represent the following propositions in an appropriate DL (define a DL KB if needed).

1. Every person has exactly one birthplace, which must be a location.
2. Paolo is a person.
3. All persons know only other persons.
4. Paolo knows John.
5. All parents of a person are adult.

7. Let TBox $\mathcal{T}$ be the following set of axioms about documents secured according to internal or external policy on members of an university.

$\{\mathsf{ICT} \sqsubseteq \mathsf{U}, \mathsf{Student} \sqsubseteq \mathsf{ICT}, \mathsf{Faculty} \sqsubseteq \mathsf{ICT}, \mathsf{PhD} \sqsubseteq \mathsf{Student}, \mathsf{Teach} \sqsubseteq \mathsf{Faculty}, \mathsf{Student}(\mathsf{Paolo}), \mathsf{DIT} \sqsubseteq \mathsf{O}, \mathsf{Public} \sqsubseteq \mathsf{DIT}, \mathsf{Internal} \sqsubseteq \mathsf{DIT}, \mathsf{Internal} \equiv \neg\, \mathsf{Public}, \mathsf{ICT} \sqsubseteq \exists \mathsf{read}.\mathsf{DIT}, \mathsf{Student} \sqsubseteq \forall \mathsf{read}.\mathsf{Public}\}$.

1. Is $\mathcal{T} \models \mathsf{PhD} \sqsubseteq \forall \mathsf{read}.\mathsf{Public} \sqcup \neg\, \mathsf{DIT}(\mathsf{Paolo})$? yes ☐ no ☐
2. Is $\mathcal{T} \models \mathsf{ICT} \sqcap \mathsf{DIT} \sqsubseteq \bot$? yes ☐ no ☐

8. Prove the following equivalences.

1. $\neg (C \sqcup D) \equiv \neg C \sqcap \neg D$ 2. $\neg \exists R.C \equiv \forall R.\neg C$

9. How can you represent the following propositions in default logic (Reiter)?

1. 'A person's hometown is almost always that of his/her spouse.'
2. 'A person's hometown is almost always where his/her employer is located.'

10. Let default theory $\Delta = (D, W)$ be defined as follows.

$$D = \Big\{\frac{A \quad : M \exists x P(x)}{\exists x P(x)}, \frac{: MA}{A}, \frac{: M \neg A}{\neg A}\Big\} \qquad W = \{A \rightarrow \exists x P(x)\}.$$

Define Δ's extensions, if any. Motivate your answer.