

Examination in CS3025 (Knowledge-based Systems)

17 December 2014

(09:00 – 11:00)

Candidates are not permitted to leave the Examination Room during the first or last half hours of the examination.

Answer TWO out of the three questions.

Appendix (including some tables and algorithms used in lectures) are available after the questions.

Each question is worth 25 marks; the marks for each part of a question are shown in brackets.

1.

(a) Explain the difference between “Unordered facts” and “Ordered facts”. [6]

(b) Write Jess code to create a list (**swimming running biking climbing**), and then print each item on the list you have created. [6]

(c) Given the following interpretation,

1. $\Delta^I = \{a, b, c, d, e, f, g, h, i, j\}$
2. $\text{Bike}^I = \{a, c, f, h\}$
3. $\text{Car}^I = \{d, e, f, j\}$
4. $\text{repair}^I = \{ \langle d, a \rangle, \langle a, b \rangle, \langle a, e \rangle, \langle c, j \rangle, \langle c, i \rangle \}$
5. $\text{partOf}^I = \{ \langle b, f \rangle, \langle a, h \rangle, \langle h, j \rangle, \langle i, j \rangle \}$

work out the interpretations of the following class descriptions and show your working. [5]

- $\text{Car} \sqcap \neg \text{Bike}$
- $\forall \text{repair}. (\text{Bike} \sqcup \exists \text{partOf}. \text{Bike})$

(d) Given the following OWL axioms:

- (1) Write down the corresponding RDF statements in N3 syntax, if they are representable in RDF [3],
- (2) Write down all the entailed RDF statements from the RDF statements you wrote above, after applying the RDF schema entailment rules [2],
- (3) Use OWL axioms (in DL syntax) to express the part of the semantic net that is not expressible in RDF [3].

[8]

1. Class (Lecturer partial Staff)
2. SubClassOf (Staff restriction(workIn someValueFrom(Organisation)))
3. EquivalentClasses (Lecturer AssistantProf)
4. DisjointClasses (Male Female)
5. ObjectProperty (primarilyTeach super(teach) domain (Lecturer) range (Course))
6. SubClassOf (L3 restriction (teach allValuesFrom (Level3Course)))
7. SameIndividual (cs3025 kbs)

TURN OVER

2.

(a) Is the following class equivalence valid? Prove your answer.

[6]

$$\exists R.(A \sqcap B) \equiv \exists R.A \sqcap \exists R.B$$

(b) Are the following two statements correct?

[6]

- RDF is a modern version of semantic networks.
- Knowledge based systems usually use the open world assumption.

Justify your answers (in the case of false, you are expected to explain why it is false; in the case of true, you are expected to explain briefly the meaning of the statement).

(c) Draw the architecture of a typical rule-based system, and explain the functionalities of each of the components in the architecture. (Note: an inference engine contains the *Pattern Matcher* and the *Agenda*.)

[6]

(d) Write a Jess function (using `deffunction`) to compute the distance between two points in a Cartesian coordinate system. The function should take four input parameters corresponding to those two points' coordinates, i.e. (x1, y1) and (x2, y2).

[7]

3.

(a) Explain how the ordering of activated rules on the agenda can be influenced by a Jess program.

[6]

(b) Compare unstructured interviews with structured interviews.

[6]

(c) Consider the ontology O consisting of the following axioms:

- `Class(Cow partial Herbivore)`
- `Class(MadCow partial (intersectionOf(Cow restriction(eat someValuesFrom(AnimalComponent))))))`
- `Class(Herbivore partial restriction(eat allValuesFrom(Vegetable)))`
- `DisjointClasses(AnimalComponent Vegetable)`

Here are your tasks:

- Transform the above ontology into DL syntax.
- Use the tableaux algorithm to check if MadCow is satisfiable.
- If MadCow is not satisfiable, which axiom(s) need to be changed to make it satisfiable.

[13]

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