

## Examination in CS3025 (Knowledge-based Systems)

16 December 2015

(9:00 – 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) is 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 how the ordering of activated rules on the agenda can be influenced by a Jess program. [4]
  - (b) Specify qualifiers for the above template, so that [4]
    - i. **name** slot can only take a string value. [1]
    - ii. The value for **gender** slot can only be 'male' or 'female'. [1]
    - iii. The value for **age** can only be integer, and if no value set, set to 25. [2]

```
(deftemplate person "the person template"
  (slot name
    ( ))
  (slot gender
    ( ))
  (slot age
    ( ))
    ( ))
  (multislot children) )
```

- (c) Given the following interpretation,

1.  $\Delta^I = \{a, b, c, d, e, f, g, h, i, j\}$
2.  $\text{Computer}^I = \{a, c, f, h\}$
3.  $\text{Mobile}^I = \{d, e, f, j\}$
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]

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

TURN OVER

(d) Given the following Book table:

[8]

bookID	hasTitle	hasPublisher
B001	Ontology-Driven Software Development	Springer
B002	Semantic Web Enabled Software Engineering	AKA

(1) Transform the two records into the corresponding RDF statements in N3 syntax, if they are representable in RDF. [3]

(2) The hasPublisher column is a foreign key pointing to the Publisher table. Can you transform this foreign key constraint into RDF/OWL? [1] If so, how? If not, why? [1.5]

(3) The bookID column is the primary key of the Book table. Can you transform this primary key constraint into RDF/OWL? [1] If so, how? If not, why? [1.5]

(e) Explain the difference between condition elements and constraints.

[4]

**TURN OVER**

2.

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

[6]

$$C \cap (D \cup E) \equiv (C \cap D) \cup E$$

(b) Are the following two statements correct?

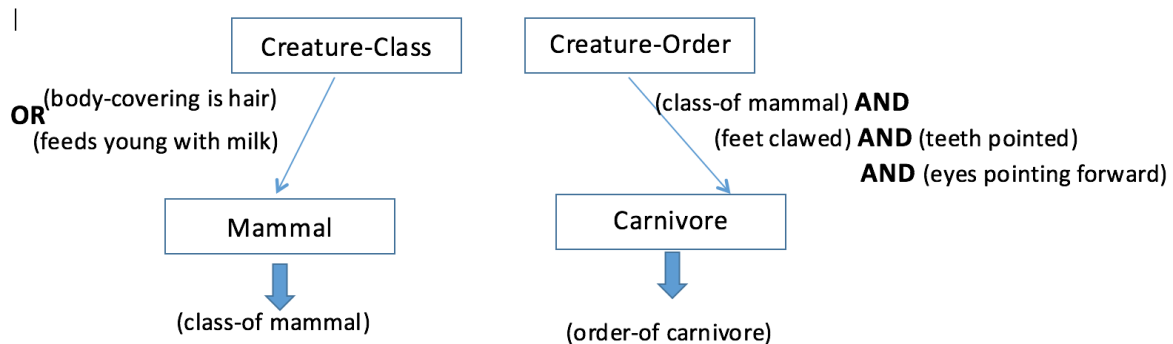
[6]

- Self report is a useful knowledge capturing approach, where experts are asked to run some programs to help generate some report for a given task. [3]
- Knowledge based systems usually use the closed world assumption, so as to make sure the reasoning procedures can terminate. [3]

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) The left part of the figure specifies what kind of creatures can be classified to the mammal class, and the right part specifies what kind of creatures can be classified to the carnivore order. Write Jess rule(s) to represent the knowledge of the figure below.

[6]



(d) Based on the partially completed rule extract-list and the facts in the working memory, work out the answers to the following questions:

[7]

```

(defrule extract-list
  (data ?first variable_A)
  =>
  Statement_1
)
  
```

Fact-1: (data red blue green yellow pink)

Fact-2: (data Fred Susan Andy Sara )

Fact-3: (data red)

WM

- Given that variable\_A is a multifield variable, complete the pattern on the LHS of the rule. NB: you may create a new name for variable\_A. [1].
- Suppose statement\_1 prints out the value of variable\_A. Write down such a statement in Jess code. [2].
- Given the facts in the WM, how many times will the rule be activated? Write down the output for all the possible activation(s)/execution(s). [4]

**TURN OVER**

3.

(a) Explain the difference between forward chaining and backward chaining of rules.

[6]

(b) Use the `while` function to write Jess code, which multiplies the numbers from 1 to 10, and then print out the result.

[6]

(c) Consider the ontology O2 consisting of the following axioms:

[13]

`Class(Cow partial Herbivore)`

`Class(MadCow partial (intersectionOf(Cow restriction(eat someValuesFrom(AnimalComponent))))))`

`Class(Herbivore partial restriction(eat allValuesFrom(Vegetable)))`

`DisjointClasses(AnimalComponent Vegetable)`

`Individual(Mary type(MadCow))`

Write down the above ontology in DL syntax [2.5] and use the tableaux algorithm to check if O2 is consistent [10.5].

**TURN OVER (APPENDIX AVAILABLE)**