SEMESTER 2, 2022 EXAMINATIONS

CITS3005

Knowledge Representation

This paper contains: **6** Pages **(including title page)**   Time Allowed: **2:00** hours

INSTRUCTIONS:

Complete this exam online in the time provided. Your solutions must be submitted before the time elapses.

You may complete this exam in a venue of your choosing. Please make sure that it is free of distractions and has reliable power and internet access.

The work you submit, must be your own work. You are not to communicate or collaborate with anyone during the exam.

This is an open book test. You may use any books or online resources you choose, provided their use does not involve direct communication.

THIS IS AN OPEN BOOK EXAMINATION

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1.

Clearly describe the differences, as you understand them, between:

- a **Database**,

- a **Knowledge Base**, and

- an **Ontology**.

For each of the above terms give a clear definition, and sufficient examples to distinguish the concepts from one another.

15 marks

2.   (15 marks)

(a) Describe the main steps in *SLD Resolution*, and show how those steps are applied in the following prolog program, which is used to determine if a binary tree is *inorder*, i.e. every leaf element in the left subtree is less than every leaf element in the right subtree.

```
%inorder takes a recursive binary tree, where the leaves are numbers,
%and is true if the tree is inorder
inorder(tree(L,R)) :- !, inorder(L), inorder(R), right(L,X), left(R,Y), X<Y.
inorder(_).

%Z is the rightmost leaf in the tree.
right(tree(_,Y),Z) :- !, right(Y,Z).
right(Z,Z).

%Z is the leftmost leaf in the tree.
left(tree(X,_),Z) :- !, left(X,Z).
left(Z,Z).
```

10 marks

(b) Show the SLD tree for the query `inorder(tree(tree(1,3),tree(2,4)).`

5 marks

3.   (15 marks)

Design an ontology to represent the content of the unit *CITS3005 Knowledge Representation*. You should include the concepts:

- Topic *e.g. logic programming*

- Lecture *e.g. lecture 3: first order logic*

- Laboratory *e.g. laboratory 6: OWL*

- Workshop *e.g. workshop 3: recursion*

- Assessment *e.g. homework 2*

- Reference *e.g. Simply Logical chapter 4*

- Tool *e.g. protègè.*

You may include additional concepts.

(a) Given a clear description of each class in your ontology.

5 marks

(b) Describe the relationships between the classes, including description logic axioms.

5 marks

(c) Give an example instance of each class and relationship in your ontology, using the content from CITS3005.

5 marks

4.

(a) Describe the key differences between *Prolog* and *ProbLog* (or more generally, *logic programming* and *probabilistic logic programming*). Particularly describe:

- the similarities and differences in programming syntax.
- the differences in the way programs are interpreted.
- the different applications each has.

5 marks

(b) Use ProbLog2 to write a probabilistic logic program representing a Bayesian Network representing the following scenario:

- if you studied hard for the exam, and you got enough rest, then you are well-prepared for the exam.
- if you are well-prepared for the exam or the lecturer is kind, then you will pass the exam.
- if you studied hard for the exam, then the lecturer will be kind.

For each of these axioms propose a conditional probability table, and show how this is implemented in ProbLog.

5 marks

(c) In the scenario from Part (b), suppose that you are unsure of how much *studying hard* will effect the *kindness of the lecturer*. Demonstrate how you could learn the values in the conditional probability tables based on observations of the lecturer's class. That is, for each student in the class we know if they studied hard, if they got enough rest, and if they passed the exam.

5 marks

End of Paper