THE UNIVERSITY OF WESTERN AUSTRALIA

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SAMPLE EXAMINATION

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

SUPPLIED STATIONERY	**ALLOWABLE ITEMS**
None. Students are do supply all stationery they deem necessary.	**Students are allowed to use any physical existent object, provided the possession and use of that object does not constitute a crime in the student's current location.**

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1.

A key challenge in artificial intelligence is *learning* in an *open environment*, and discovering *new concepts* that were not anticipated when the artificial intelligence was designed.

Discuss how *machine learning* and *knowledge representation and reasoning* may be able to be used to implement learning in an open environment, and what challenges still need to be overcome.

15 marks

2. (15 marks)

(a) Explain the key elements of prolog syntax, including

- clauses
- predicates
- functions
- cuts
- queries.

5 marks

(b) Explain the concepts of *unification* and *resolution*, and demonstrate how they would be applied in the following program

```
%gcd(X,Y,Z) is true if Z is the greatest common divisor of X and Y.
gcd(0,X,X).
gcd(A,B,C) :- D is B mod A, gcd(D, A, C).

%equal_frac(X,Y) is true if
%a) X and Y are equal integers
%b) X and Y are both fractions over equal value
%c) One of X and Y is an integer, Z, and the other is a fraction equal to Z/1.
equal_frac(X,X).
equal_frac(A,fraction(B,1)):- !, equal_frac(A, B).
equal_frac(fraction(A,B),C) :- gcd(A,B,X), !,
                               Y is A//X,
                               Z is B//X,
                               equal_frac(C, fraction(Y,Z)).
```

10 marks

3. (15 marks)

Design an ontology to describe the taxonomy of first order logics considered in CITS3005, Knowledge Representation. For example, clausal logic, description logic and the situation calculus may all be considered to be fragments of first order logic.

- Each logic has a syntax and a semantic interpretation.
- For each logic there may be one or more reasoning methodologies (e.g. Tableau, or Resolution)
- For each logic there may be one or more tools for representation and reasoning.

Describe a set of classes, relations and axioms to represent this information, and demonstrate it using concepts taken from the course.

15 marks

4.

Spoof is a gambling game where each player conceals a quantity of coins, or no coins at all, in their closed fist, extended into the circle of play. The initial player calls what they think is the total number of coins in play. Play proceeds clockwise around the circle until each player has made their guess of the total number of coins. After all players have made their calls, they open their fists and display their coins for the group to count the total.

If a player guess correctly they win.

(a) Write a ProbLog2 program to simulate a game of Spoof. Assume that there are three players, and each player hides either zero, one or two coins in their hand (chosen randomly). Assume that players guess randomly.

5 marks

(b) Suppose the players are playing *strategically*, so that, the player will take into account the number of coins they are holding, and the estimates of the other players coins when they make their guess.

Describe how this information can be used to condition each players guess.

5 marks

(c) Modify your ProbLog2 from part one so that it now implements strategic play, as described in part two.

5 marks