**Artificial Intelligence Coursework**

**(Marking Scheme)**

**Part A:**

1. Assume that the universe of discourse is the set of people studying or working at the University of Greenwich. Rewrite the following statements in the form of predicate logic.
2. Each person is either a student or a staff.
3. Each lecturer teaches some courses.

#### Some hard-working people are not boring.

1. Hard-working people are respectable.
2. Everyone knows some hard-working people.

**[10 marks]**

**Answer:**

1. ∀x (Student(x) V Staff(x))
2. ∀x (Lecturer(x) → ∃y(Course(y) ∧ Teaches(x, y)))
3. ∃x(Hard-working(x) ∧ ¬Boring(x))
4. ∀x(Hard-working(x) → Respectable(x))
5. ∀x∃y(Hard-working(y) ∧ Knows(x, y))

**(2 marks for each)**

2. (a) Use truth table to verify the following equivalence:

A → B ≅ ~A ∨ B

and use an example to explain your understanding of the actual meaning of “A materially implies B” in propositional logic.

**[8 marks]**

**Answers:**

A B ~A A → B ~A ∨ B

T T F T T

T F F F F

F T T T T

F F T T T

**A → B is equivalent to “Either notA or B”, which is different from “If A then B” used in command languages.**

**(4 marks for correct table; 4 marks for reasonable explanations with an appropriate example)**

(b) Distinguish between *deductive*, *inductive* and *abductive* reasoning; give an example of the appropriate use of each.

**[9 marks]**

**Answer:**

**(3 marks for each reasoning methods: 2 for reasonable explanations to the concept and 1 for the appropriate example)**

(c) List the four main representation schemas learnt from this course and give a typical example(s) for each of them.

**[8 marks]**

**Answer:**

1. Logical Representations, e.g., Propositional Logic or Predicate Logic;
2. Procedural Representations, e.g., Production Systems;
3. Network Representations, e.g., Semantic Networks;
4. Structured Representations, e.g., Frames.

**(2 mark for each with reasonable explanations)**

3. (a) Express the following knowledge as a Prolog rule(s):

*X is Z’s grandparent if X is Y’s father or mother, and Y is Z’s father or mother.*

**[5 marks]**

**Answer:**

grandparent(X, Z) :-

(father(X, Y); mother(X, Y)),

(father(Y, Z); mother(Y, Z)).

**(5 marks)**

(b) Consider the following Prolog program/database:

a(X):- b(X), c(X), d(X).

a(X):- c(X), d(X).

a(X):- d(X) .  
b(1).

b(a).

b(2).

b(3).

d(10).

d(11).

c(3).

c(4).

Given the query ?- a(X). What are the successive variable bindings that the variable X gets when the above query is run. Separate bindings by a comma (i.e., 1, a, 5, ...).

**[8 marks]**

**Answer:**

1, a, 2, 3, 3, 4, 10, 11

**(1 mark for each)**

(c) Explain what the following program does:

element(Element, [Element|Tail]) :- !.

element(Element, [Head|Tail]) :- element(Element, Tail).

**[6 marks]**

**Answer:**

The program uses the “recursion” technique to check if a given item is an element of a list or not, or to display the elements of a list.

**(3 marks)**

However, the use of “cut”, i.e., “!”, will prevent backtracking as soon as Element is found in the list.

**(3 marks)**

(d) What is the actual meaning of “no”s in Prolog? Explain the so-called “*negation as failure*” strategy used in Prolog.

**[6 marks]**

**Answer:**

“no”s in Prolog mean “impossible to prove”, not “proved false”.

**(2 mark)**

“*negation as failure*” is a problem solving strategy which assumes the world as “closed” -- all knowledge in the world is assumed to have been represented. Therefore any fact that is not in it and cannot be derived from the database, is assumed to be false. Hence, if it is unable to prove a goal to be true, then it returns a result of false. Such a strategy may cause problems when the knowledge base is incomplete.

**(4 marks)**

**Part B:**

**4.**

Write a research report on temporal logics and/or their application in the domain of Artificial Intelligence. It can be about any relevant theoretical and / or practical issues, such as:

* Time Theories and/or Models

 Temporal Knowledge Representation and Management

 Temporal Data Mining or Case-Based Reasoning

 Time Series and/or State Sequences

 Temporal Database Management

 Reasoning about action, event and change

 Prediction/Planning

 Diagnosis/Explanation

 Industrial Process Control

 Natural Language Understanding

Again, you may make use of materials which you find in the lectures notes, textbooks and the Internet, but you should adapt them to your essay and give full citations and references to sources each time copied material is used. The contents of the report must be related to the key words “Time” and/or “temporal”, in terms of a well-presented literature review/survey (10 marks), together with your own understanding, observations, critical analysis and evaluation of temporal logics and/or their applications in the domain of Artificial Intelligence (10 marks). The report should be around 5 pages using Times New Roman Font, 12 point, with 1.5 spacing, including references and Web/Book citations. Longer submissions will not be penalized, but will not necessarily draw extra credit.

**[20 marks]**

**Answers:**

**10 marks for well-presented literature review/survey of applications of Artificial Intelligence techniques to games; and 10 marks for own understanding and evaluation of various Artificial Intelligence techniques that can be applied to games, and/or concrete game examples that, as benchmarks that accurately reflect real-life problems, AI researchers can benefit from.**

**5.**

AI research and games are a mutually beneficial combination. On the one hand, AI technology can provide solutions to an increasing demand to add realistic, intelligent behaviour to the virtual creatures that populate a game world. On the other hand, as game environments become more complex and realistic, they offer a range of excellent test beds for fundamental AI research.

Write a literature review report on the topic of applying Artificial Intelligence techniques, such as learning, search and planning, to games. It may focus on past and recent applications, open problems and promising avenues for future research, and/or on resources available to people who would like to work in this space (10 marks). The report should provide your understanding and evaluation of various Artificial Intelligence techniques that can be applied to games, and/or concrete game examples that, as benchmarks that accurately reflect real-life problems, AI researchers can benefit from (10 marks). You may make use of materials which you find in the lectures notes, textbooks and the Internet, but you should adapt them to your report and give full citations and references to sources each time copied material is used. The report should be around 3 pages using Times New Roman Font, 12 point, with 1.5 spacing, including references and Web/Book citations. Longer submissions will not be penalized, but will not necessarily draw extra credit.

**[20 marks]**

**Answers:**

**10 marks for well-presented literature review/survey; and 10 marks for own understanding, critical analysis and evaluation of temporal logics and/or their application in the domain of Artificial Intelligence in terms of observations and/or application examples.**