DEPARTMENT: Computer Engineering

MONTH: March

YEAR: 2013

DATE: 01/03/2013   TIME: 11:30-14:30

TIME ALLOWED: 3 hours

COURSE INSTRUCTOR: Mr. Nyanga B.

COURSE CODE & NUMBER: CEF409

COURSE TITLE: Introduction to Artificial Intelligence.

CREDIT VALUE: 4

INSTRUCTIONS: **Read through EACH question before you answer it. Follow instructions for EACH Section. Time is allocated for a MAXIMUM POSSIBLE MARK of 70. Programs assumed to be in Standard Prolog. State any assumptions made. Penalty for poor English or poor presentation of work.**

ATTEMPT <u>ALL</u> QUESTIONS FOR AT MOST 70 MARKS

Q1)   **(24 = 4*(1+1.5+1.5+2) Marks)**

    i)   The following 4 views (inter alia) have been used to define Artificial Intelligence (AI): acting humanly, thinking humanly, thinking rationally, and acting rationally. From the standpoint of these views do the following: (a) Define AI, then indicate (b) the strengths and (c) weaknesses in the definition and (d) state and explain the purpose of exactly one distinct area of AI emphasised by the definition (or view).

Q2)   **(18 = 2, 4, 4+4, 4 Marks)**

    i)   Define the terms knowledge and knowledge representation?

    ii)   Briefly state and explain TWO main issues to overcome by knowledge representation schemes.

    iii)   Briefly describe, with the aid of diagrams: (a) a general architecture of Rule-based systems (i.e., Production Systems) and how they work, and (b) the structure of Semantic Networks and how they work.

    iv)   Contrast the approaches in (iii) to the use of logic in knowledge representation by giving their relative advantages. Your answer should state TWO <u>main</u> contrasting features or attributes.

Q3)   **(19 = 3+3+3+3, 4, 3 Marks)**

    i)   What do the following quantified sentences mean in English (natural language), assuming that uses(x,y) means "[person] x uses [tool] y". <u>Your answers must NOT have/be literal translations [into English] of quantifier symbols/variables found.</u>

    (a) $\forall x\, \exists y \bullet uses(x,y)$; (b) $\exists y\, \forall x \bullet uses(x,y)$; (c) $\forall y\, \exists x \bullet uses(x,y)$; (d) $\exists x\, \forall y \bullet uses(x,y)$.

    ii)   Express the following in propositional logic, and give truth tables for the clauses so obtained. [**Hint:** Respect English punctuation in order to get correct meanings.]

a. I will have Kwacoco, or fufu with dried meat.
b. John fails his test means I eat my head.

iii) Write the following in Negation Normal Form (NNF), Conjunctive Normal Form (CNF) and Disjunctive Normal form (DNF): $\neg (p \vee q) \wedge \neg (r \wedge s)$.

iv) Apply resolution to the boxed set of clauses adjacent to determine whether it is unsatisfiable or satisfiable. Show all steps in your solution.

1. $p \vee q \vee s$
2. $p \vee \neg q$
3. $\neg s \vee q$
4. $\neg q \vee \neg r$
5. $\neg p \vee r$

For Question Q4, give programs/procedures in STANDARD Prolog. Use comments in order to clarify program logic or state assumptions.

Q4)   **(15 = 3+3, 9 Marks)**

i) Define the following terms and briefly explain *how* they are important in determining which problems are solvable in Artificial intelligence: (a) completeness, (b) complexity.

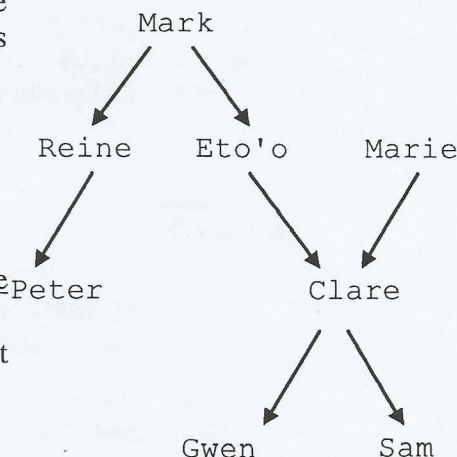ii) Write a Prolog procedure to append an item to the beginning of a list.

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iii) With respect to family trees, assume you already have the following Prolog procedures with the meanings as given:
a. mother(x,y) ≡ x is the mother of y;
b. father(x,y) ≡ x is the father of y.
c. sister(x,y) ≡ x is the sister of y;
d. brother(x,y) ≡ x is the brother of y.

Give Prolog procedures, <u>in terms of the above where applicable</u>, for the following relationships:
(a) sibling(x,y) ≡ x is a sibling (brother or sister) to y, but not to itself.
(b) child(x,y) ≡ x is a child to y.
(c) cousin(x,y) ≡ x is a cousin to y.
(d) uncle(x,y) ≡ x is an uncle (parent's brother) to y;
(e) descendant(x,y) ≡ x is a descendant (child, grandchild, great grandchild, …) to y.

iv) For each of the procedures you wrote in (iii), give one valid assertion from the family tree above. (Arrowheads point to children.) Convert names to respect Prolog syntax, if need be.

ALL THE BEST!

THE END