

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCE
COMPUTER SCIENCE DEPARTMENT
AUGUST EXAMINATION SUPPLEMENTARY 2004

SUBJECT: ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS
CODE: SCS5203 and SCS4101

INSTRUCTION TO CANDIDATES

Answer all questions in Part A and 2 out of 4 questions in Part B.

Time: 3 hours

PART A – Answer all questions in this section.

QUESTION ONE

Knowledge Representation

- (a) Define a semantic net for 'computer' using the relationships: isa, has_property, has_color, and part_of. [5]
- (b) Define a Frame structure for 'computer' capturing the same information as in the semantic net above. Indicate additional information capable through the Frame structure. [5]

QUESTION TWO

Agents

Construct a diagram of a general model of a learning agent and discuss its components. [10]

QUESTION THREE

Inference Rules

Give examples of the following rules:

- a) Give an example of "Generalised Modus Ponens". [4]
b) Existential Instantiation [3]
c) De Morgan's rule for unquantified sentences [3]

QUESTION FOUR

Expert Systems

- (a) Explain the difference between forward chaining and backward chaining. Give an example of each with three levels of chaining [6]
(b) What is Conflict Resolution? [4]

QUESTION FIVE

First-Order Predicate Calculus

- (a) Convert each of the following English sentences into First-Order Predicate Calculus, using reasonably named predicates, functions, and constants. If you feel a sentence is ambiguous, clarify which meaning you're representing in logic.

1. *Everyone of African descent should work to unite Africa.* [2]
2. *There are at least 2 cities in Zimbabwe larger than Mutare* [2]
3. *Harare is the largest city in Zimbabwe.* [2]

- (b) Consider the following sentences:
- i. Cats and dogs are not always friends.
 - ii. Every cat in this room has an owner.
 - iii. Anyone who owns an dog has a friend.
 - iv. Everyone in this room has a dog and a cat.

Let L be a first-order language containing the following predicates:

- $c(X)$ --- X is a cat.
- $d(X)$ --- X is a dog.
- $a(X)$ --- X is an animal.
- $o(X,Y)$ --- X owns Y.
- $r(X)$ --- X is in the room.
- $f(X,Y)$ --- X is a friend of Y.

State each of the sentences (i) -- (iv) in L. [4]

QUESTION SIX

Uncertainty

Given that Rule A below has a certainty factor of 0.9 and Rule B has a certainty factor of 0.8, A has certainty 0.9, B has certainty 1.0, and C has certainty of 0.8,

- a) what is the certainty of D? [5]
- b) what is the certainty of K? [5]

Rule A: IF (A or B or C) THEN D

Rule B: IF (B and D) THEN K

QUESTION SEVEN

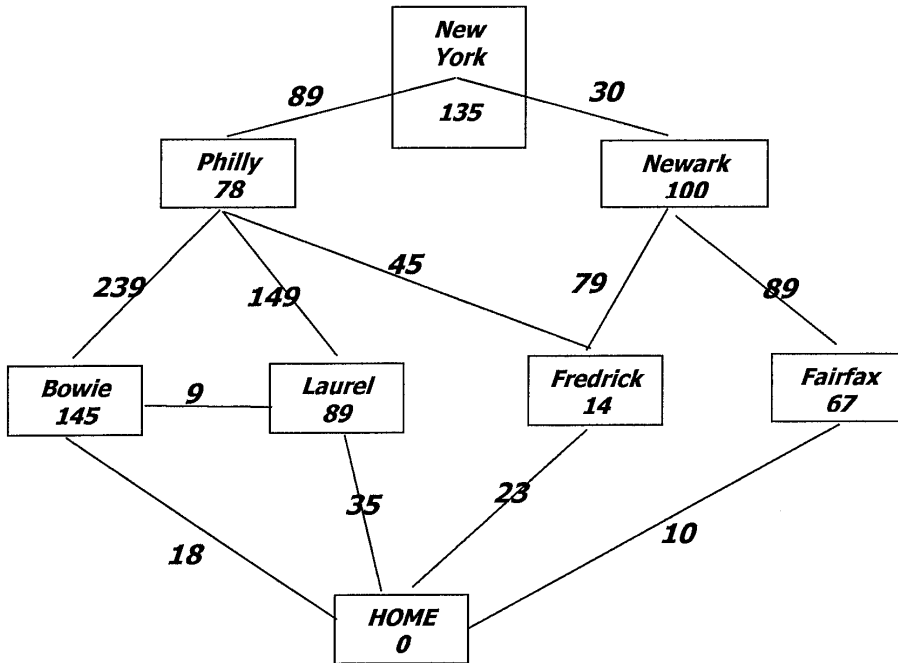
Knowledge Acquisition

- (a) Compare and contrast the three different levels of interviewing. Indicate the advantages and disadvantages of each type of interview [5]
- (b) Discuss the repertory grid. Construct one comparing and contrasting four different types of animals. [5]

QUESTION EIGHT

Search

Consider the Search Tree below. You are trying to reach HOME. The numbers in the boxes indicate the straight line distance that each city is from HOME and the numbers on the paths are the miles between the respective cities.



What will be the sequence of cities visited using the following search methods:

- a) Depth-first _____ [3]
- b) A* _____ [3]
- c) Greedy Best-First _____ [4]

**PART B – answer 2 questions in this section.
Each question is worth 10 marks**

QUESTION ONE

- (a) Discuss three different Conflict Resolution strategies [5]
(b) What are the components of an expert system? Explain the structure and function of each component. [5]

QUESTION TWO

- (a) Give an example of 'Universal Instantiation.' [5]
(b) Give an example of 'Implication Elimination'. [5]

QUESTION THREE

Discuss how each component of an Expert system contributes to distinguishing an Expert System from other Software systems? [10]

QUESTION FOUR

- (a) What is case-based reasoning? [5]
(b) How does it differ from rule-based reasoning? [5]

END OF QUESTION PAPER

GOOD LUCK!