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UNIVERSITI SAINS MALAYSIA

Supplementary Examination
Academic Session 1999/2000

April 2000

CPP302/CSE401 - Artificial Intelligence

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **SIX** questions in **EIGHT** printed pages before you start the examination.
- Attempt **ALL** questions.
- You are required to **RETURN BACK** the **complete question paper** with the answer script.
- Attempt Question 2 on the question paper.
- If you choose to answer the questions in English, at least one question must be answered in Bahasa Malaysia.

ENGLISH VERSION OF THE QUESTION PAPER

1. Give short answers to the following questions:

   (a) In a MinMax search algorithm, briefly describe the notion of Heuristic Measuring Conflict. You may use an example to clarify.

   (3 marks)

   (b) In the description of Dempster-Shafer theory, what do you understand by the term "frame of discernment"?

   (3 marks)

   (c) Logical problem-solving mechanisms rely on the unification algorithm. What do you understand about the unification algorithm and how does it work? Give an example of unification?

   (3 marks)

   (d) Give 5 preference heuristics that are typically used in a case-based reasoning system to help organise the storage and retrieval of cases?

   (3 marks)

   (e) What are the two types of parsing algorithms and what is their operational behaviour?

   (3 marks)

   (f) In a frame, the slots can contain procedural information. What do you understand from this statement and what is the kind of procedural information that can be contained in the slot?

   (3 marks)

   (g) What are the three main phases of the knowledge base development process?

   (3 marks)

   (h) What are the four distinguishing characteristics of neural networks that enable us to distinguish one neural network from another?

   (3 marks)

   (i) What is the purpose of the supervisor in a supervised learning algorithm? What activities is the supervisor responsible for?

   (3 marks)

   (j) Explain the stages of language analysis? Give an example, if possible?

   (3 marks)

2. State whether the following statements are True or False.

(Note: Negative marking applies. -1 for each incorrect answer. Answer on the question paper.)

		TRUE	**FALSE**
(a)	In the alpha-beta search procedure, the alpha value associated with MAX nodes, can never increase, and the beta value, associated with MIN nodes can never decrease.	_____	_____
(b)	In a Kohonen map, the winning unit will have its weight vector closest to the input vector.	_____	_____
(c)	In natural language processing, the analysis of the intent of a dialogue is known as prosody.	_____	_____
(d)	Analogical inference is the process of transforming knowledge from a known entity S to a similar but less known entity T.	_____	_____
(e)	In Bayes theorem, the confidence factor (CF) ranges from 1 to -1.	_____	_____
(f)	A good heuristics can eliminate search entirely.	_____	_____
(g)	The error produced by a neural network is independent of its connection weights.	_____	_____
(h)	The representation language has no influence on the knowledge engineer's model of the domain.	_____	_____
(i)	In parsing sentences, backtracking can be used for rule selections.	_____	_____
(j)	Cases can be represented as situation-action rules.	_____	_____

(10 marks)

3. (a) There is much talk that the Y2K bug is expected to hit the banking system. An expert system has been developed to determine the conditions under which the transaction system for *People's Bank* will come to an halt on the 1st January 2000. The rules for the expert system are as follows:

RULE 1
IF database breakdown AND database not Y2K compliant
OR ATM breakdown AND communication network down
THEN bank's system down (0.7)

RULE 2
IF improper ATM maintenance OR excessive cash withdrawl
AND breakdown of cash dispensing utilities AND no cash backup services
THEN bank's system down (0.3)

RULE 3
IF no cash in ATM OR no connection with database
THEN ATM breakdown (0.5) AND communication network down (0.2)

RULE 4
IF daily cash transcations > 100 OR no withdrawl policy
THEN cash withdrawls > RM 10000 (0.6) AND ATM breakdown (0.3)

RULE 5
IF cash withdrawls > RM 10000 AND widespread speculation
THEN excessive cash withdrawl (0.8) AND no cash backup services (0.5)

RULE 6
IF communication network down AND cash withdrawls > RM 10000
THEN breakdown of cash dispensing utilities (0.4)

Using the above rules and the case-specific facts (given below), employ the FORWARD CHAINING inferencing strategy to find out <u>whether the bank's system will be down or not</u>. Use the STAMFORD CERTAINTY Method to calculate the confidence factors for the derived conclusions. Show the complete trace for forward chaining and the calculations of the confidence factors.

Case-Specific Facts

1. no cash in ATM (0.6)
2. daily cash transcations > 100 (0.3)
3. widespread speculation (0.9)
4. database breakdown (0.3)
5. excessive cash withdrawl (0.7)
6. ATM breakdown (-0.2)

(8 marks)

(b) What is case-based reasoning? Explain in detail the structure of a case-based reasoning system and its inherent processes?

(7 marks)

4. Given below is the incomplete and partially incorrect knowledge base for a computer workstation allocation expert system:

KNOWLEDGE BASE

os(computer, operating system). os(sun, unix). os(hp, unix). os(mac1, mac-os). os(mac2, mac-os). os(mac3, mac-os). os(dell, windows). os(compaq, windows).	**on(computer, network).** on(sun, fddi). on(dell, fddi). on(hp, fddi). on(mac1, appletalk). on(mac2, fddi). on(laser_printer, ethernet). on(bubble_jet, ethernet). on(proprinter, ethernet).	**runs(computer,software).** runs(hp, framemaker). runs(mac1, ms-excel). runs(mac3, ms-excel). runs(mac2, pagemaker). runs(compaq, ms-excel). runs(vax, framemaker). runs(sun, framemaker). runs(dell, ms-word).
processor(device, proc_name). processor(sun, risc). processor(proprinter, risc). processor(laser_printer, intel). processor(xerox, intel).	**resolution(device, quality).** resolution(proprinter, high). resolution(laser_printer, high). resolution(xerox, high). resolution(bubble_jet, medium).	**connect(network1, network2).** connect(fddi, ethernet). connect(appletalk, ethernet). connect(appletalk, fddi).
speed(computer, speed). speed(hp, high). speed(xerox, high). speed(bubble_jet, low).	**memory(device, quantity).** memory(mac1, medium). memory(sun, large). memory(hp, large). memory(compaq, medium). memory(dell, large).	

Rules:

suitable(X, Application) :- runs(X, Application), communicate(X, Y),
isa(Y, high-quality-printer).

communicate(X,Y) :- on(X,Y), on(Y,Z).

communicate(X,Y) :- on(X,Z), on(Y,V), connect(Z,V).

isa(X, high-quality-printer) :- isa(X, printer), speed(X, high), resolution(X, high).

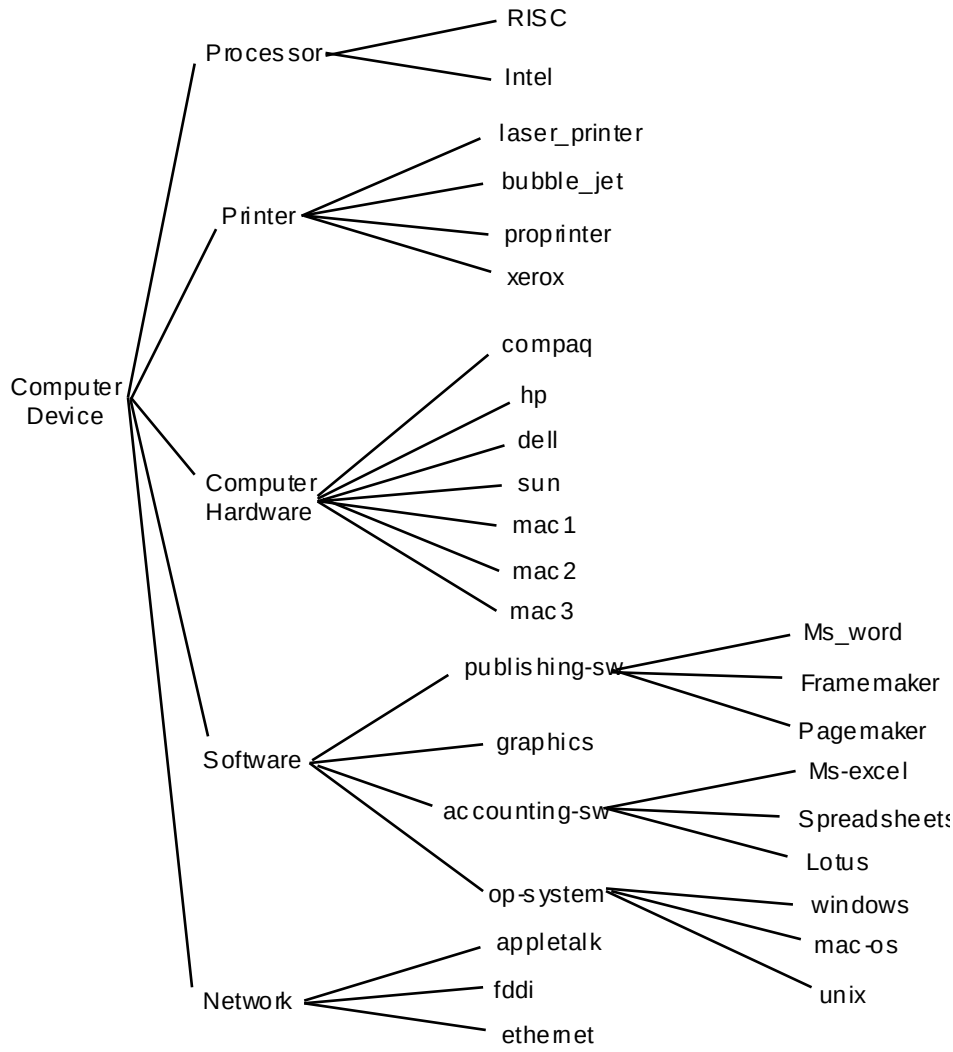
isa(X, low-quality-printer) :- isa(X, printer), speed(X, low), resolution(X, medium).

runs(X,Y) :- runs(X,Z), memory(X, large), isa(Z,Y).

runs(X,Y) :~ os(X,Z).

speed(X,Y) :~ processor(X, Z).

Semantic Network (Describing the inheritance relationships)



(a) Using the above information, build a plausible justification tree to prove the following statement:

suitable(mac2, accounting-sw).

Show:

(i) the entire inferring activity involving analogy, inductive prediction and deduction, and

(ii) the unification of the various variables.

(12 marks)

(b) Based on the above solution, show the possible improvements to the given knowledge base.

(3 marks)

5. (a) Given below are a set of rules for giving investment advice. Draw the AND/OR graph for these rules and use it to suggest the proper investment for a particular individual, i.e. the goal is the predicate expression *investment(X)*. The case-specific data is as follows:

- The individual has two dependents.
- $20,000/- in savings.
- Steady income of $30,000/-.

Rules:

(1) saving_account(inadequate) -> investment(savings)

(2) saving_account(adequate) AND income(adequate)-> investment(stocks)

(3) saving_account(adequate) AND income(inadequate)-> investment(combination)

(4) amount_saved(X) AND dependents(Y) AND greater(X, minsavings(Y)) > saving_account(adequate)

(5) amount_saved(X) AND dependents(Y) AND NOT greater(X, minsavings(Y)) > saving_account(inadequate)

(6) earning(X, steady) AND dependents(Y) AND greater(X, minincome(Y)) -> income(adequate)

(7) earning(X, steady) AND dependents(Y) AND NOT greater(X, minincome(Y)) -> income(inadequate)

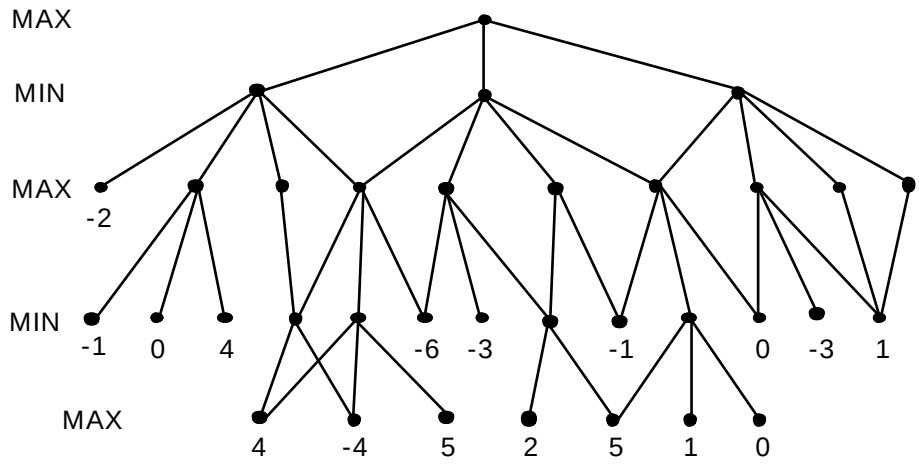
(8) earning(X, unsteady) -> income(inadequate)
minincome(X) = 15,000 + (5000 * X)
minsavings(X) = 6000 * X

(7 marks)

(b) The logical operator □ is read "if and only if". P □ Q is defined as being equivalent to (P □ Q) 3 (Q □ P). Based on this definition show that P □ Q is logically equivalent to (P £ Q) □ (P 3 Q).

(4 marks)

(c) Apply the MinMax search procedure on the given tree to determine the backed-up heuristic values of the states. The leaf states show the given heuristic values.



(4 marks)

6. (a) Show the architecture of a Back Propagation neural network.

(2 marks)

(b) Give the complete learning algorithm for the Back Propagation neural network? Identify the forward and backward phase of the learning algorithm?

(10 marks)

(c) Prove that the given propositional expression is a well-formed formula (wwf).

$$((A \square B) \pounds (A \ 3 \ \neg C)) \square (\neg B \pounds (\neg C \square B))$$

(3 marks)

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