UNIVERSITI SAINS MALAYSIA

Supplementary Examination
Academic Session 1998/99

April 1999

CPP302/CSE401 - Artificial Intelligence

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **SIX** questions in **TEN** printed pages before you start the examination.
- Attempt **ALL** questions.
- **You are required to return back 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. State whether the given statements are true or false:
(Note: Negative marking applies, i.e. -1 for each incorrect answer. Answer on the question paper and return.)

		TRUE	FALSE
(1)	Neural networks carry out computations in a parallel manner as opposed to sequential processing.	_____	_____
(2)	In a neural network, the input units do not process information.	_____	_____
(3)	In a neural network, knowledge of the world is defined by the network's parameters.	_____	_____
(4)	In a case base reasoning system extensive understanding of the subject domain is not required.	_____	_____
(5)	Breadth-first search is more common in data-driven reasoning strategies.	_____	_____
(6)	In propositional calculus we can access the individual components of a proposition.	_____	_____
(7)	Binary resolution is applied to two clauses when both of them contain the same literal, leading to the generation of a Resolvent from the remaining literals.	_____	_____
(8)	A frame-based system follows the associationist theory of representation.	_____	_____
(9)	An expression X logically follows from a set of predicate calculus expressions S if every interpretation that satisfies S also satisfies X.	_____	_____
(10)	We can attach procedural code to frames.	_____	_____
(11)	If two states have the same heuristic evaluation, it is preferred to examine the state that is furthest from the root node.	_____	_____
(12)	The Dempster-Shafer theory makes a simple assumption that separates 'confidence for' from 'confidence against' a certain hypothesis.	_____	_____

(13) In Bayes theorem, the confidence factor (CF) ranges from 1 to –1. _____ _____

(14) A good heuristics can eliminate search entirely. _____ _____

(15) Case based reasoning systems are not capable of providing a good explanation of the solutions recommended by them. _____ _____

		TRUE	**FALSE**
(16)	The error produced by a neural network is independent of its connection weights.	_____	_____
(17)	The representation language has no influence on the knowledge engineer's model of the domain.	_____	_____
(18)	Data-driven search involves the generation of subgoals to move from the data to the goal.	_____	_____
(19)	In parsing sentences, backtracking can be used for rule selections.	_____	_____
(20)	Cases can be represented as situation-action rules.	_____	_____
(21)	Bayes theorem understands a relationship between the premise and conclusion of a rule.	_____	_____
(22)	In Dempster-Shafer theory, suppose we have two hypotheses h1 and h2. If we have no evidence supporting either hypothesis then they will each have the belief-plausibility range of [-1, 1].	_____	_____
(23)	In a case-based reasoner, one cannot modify existing cases rather the modifications are introduced as a new case.	_____	_____
(24)	In a sigmoid function if the slope approaches infinity the function becomes a threshold function.	_____	_____
(25)	In a Kohonen map, the winning unit will have its weight vector closest to the input vector.	_____	_____
(26)	Rule based reasoning is related to the problem of learning through analogy.	_____	_____
(27)	Neural networks can not have negative weighted connections between units.	_____	_____
(28)	Testing a learnt BP network involves just the backward phase of the learning algorithm.	_____	_____

(29) In a neural network employing the distributed representation scheme, we need to modify the structure of the neural network to add new concepts/entities. _____ _____

(30) Neural networks follow the sub-symbolic approach of artificial intelligence. _____ _____

(31) BP networks can have only a single hidden layer. _____ _____

		TRUE	FALSE
(32)	In a BP network, the error produced at the output layer is a consequence of the desired output.	_____	_____
(33)	The working memory retains no information of the previous consultation session.	_____	_____
(34)	Expert systems should be used for problems that humans can solve through symbolic reasoning.	_____	_____
(35)	The Perceptron learning algorithm uses the error value to update the connection weights.	_____	_____

(35 marks)

2. (a) Use the heuristic search algorithm to illustrate the trace (i.e. the solution path) from the initial state to the goal state.

2	**8**	**3**
1	**6**	**4**
7	**X**	**5**

Initial State (X is the tile that is to be moved around)

1	**2**	**3**
8	**X**	**4**
7	**6**	**5**

Goal State

The heuristics to be used is "the sum of the distance of the tiles out of place". Your trace should show the heuristic estimate of each derived state.

(6 marks)

(b) 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)

3. (a) Use Resolution on the following statements:

□ aa (X, arg1) Δ □ bb (X, arg2) Δ cc (X)
□ dd (Y) Δ aa (Y,Z)
□ dd (W) Δ aa (W,V)
□ dd (arg3)
dd(arg3)
□ dd (U) Δ bb (U, arg2)

to prove:

cc(arg3)

(4 marks)

(b) Given the following statements:

ahmad plays football
all those who play football need to exercise
someone can exercise by jogging
jogging can be done at the stadium

Use Modus Ponens to prove that:

ahmad will go to the stadium.

(6 marks)

(c) Draw conceptual graphs for the following statements:

(i) The dog fido is of white colour and its size is large.

(ii) Mary gave John the book.

(iii) The boy ate his meal with his spoon.

(3 marks)

4. (a) A person is having problems in starting his car. Use Bayes theorem to find out the probability of the car to have Battery Problems (+BP) given that the car's battery has a Low Voltage (+LowVol), i.e. find out P(+BP|+LowVol). Use the given probabilities and calculate the missing ones that are needed in Bayes theorem.

P(+BP) = 0.25	25 cars out of 100 have battery problems
P(+LowVol |+BP) = 0.60	60 cars out of 100 who have +BP will have +LowVol
P(-LowVol |-BP) = 0.80	80 cars out of 100 who have -BP will have a -LowVol

(7 marks)

(b) Use Dempster-Shafer theory to solve the following medical diagnosis problem. Suppose H represents the domain of focus, containing four hypothesis:

- The patient has cold (C).
- The patient has flu (F).
- The patient has allergy (A)
- The patient has pneumonia (P)

Suppose we get our first piece of evidence: *The patient has fever*, which means the belief

M1{ F, C, P } with support level (0.6)

Next, we get our second piece of evidence: *The patient has a runny nose*, which means the belief

M2{ A, F, C } with support level (0.8)

Task 1

Apply Dempster-Shafer rule to compute the combination of M1 and M2, which is defined as the belief M3.

Task 2

Suppose we now get some more evidence: *The patient has allergy,* which means the belief

M4 {A} with support level (0.9)

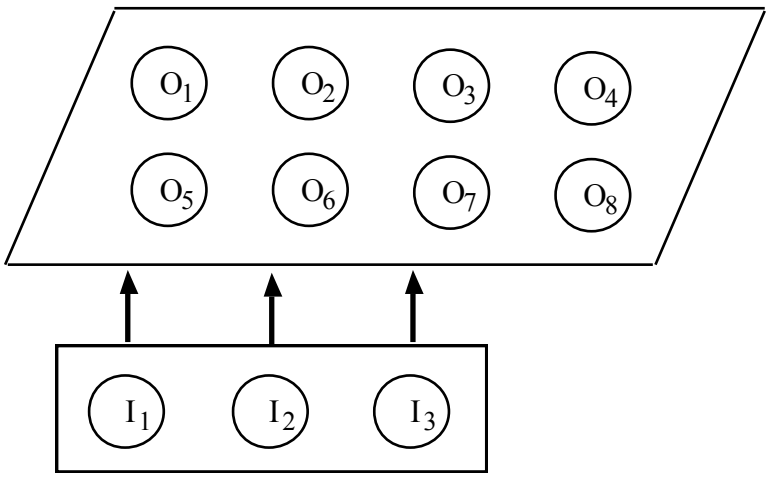
Combine the beliefs M3 and M4 to get the final combined belief M5.

(6 marks)

5. (a) Given a Kohonen Map (KM) that has to learn 1 input pattern. Show the complete trace of the first cycle, where you have to: (i) present the given input; (ii) find out the image unit and (iii) calculate the new weight values for the relevant units. The relevant parameters for the KM are:

Kohonen Map Input layer = 3 units

Kohonen Map Output layer = 8 units



Input vector:

IP = (0,1,0)

Learning rate = 0.3

Neighbourhood Size = 1

Initial weight matrix =

0.2	0.8	0.7
0.8	0.9	0.2
0.5	0.7	0.4
0.3	0.3	0.3
0.2	0.5	0.7
0.9	0.1	0.5
0.1	0.8	0.1
0.3	0.6	0.4

(9 marks)

(b) In a backpropagation network if the input layer has 9 units, the output layer has 8 units and the hidden layer has 5 units. Then, how many connections are there between (i) the input and hidden layers and (ii) hidden and output layers. Also, give the dimension of the weight matrix for input-hidden layers and hidden-output layers.

(4 marks)

6. (a) Given below is a set of concepts and their properties. Organise the given knowledge as a semantic network:

Concept: **Animal**
Properties: (1) An animal can breathe. (2) An animal can eat. (3) An animal can move.

Concept: **Bird**
Properties: A bird is-a animal
(1) A bird has feathers. (2) A bird has wings. (3) A bird can fly. (4) A bird lays eggs.

Concept: **Fish**
Properties: A fish is-a animal
(1) A fish has gills. (2) A fish has scales. (3) A fish can swim. (4) A fish lays eggs.

Concept: **Canary**
Properties: A Canary is-a bird.
(1) A canary can sing. (2) A canary has colour yellow. (3) A canary has children.

Concept: **Hornbill**
Properties: A hornbill is-a bird.
(2) A hornbill can eat fish. (2) A hornbill has colour yellow. (3) A canary has children.

Concept: **Shark**
Properties: A Shark is-a fish
(1) A shark is dangerous. (2) A shark has sharp teeth. (3) A shark has children.

Concept: **Wiley**
Properties: Wiley is an instance of a shark
(1) Wiley lives in the aquarium. (2) Wiley is of white colour. (3) Wiley has two children

Concept: **Timmy**
Properties: Timmy is an instance of a canary
(1) Timmy lives in a cage

(6 marks)

(b) Using augmented transition network parsers develop a parse tree for the given sentence. Use the structures for sentence, noun phrase, verb phrase and the terminals.

Sentence is **"The man drove a car"**

Grammar

sentence	∅	noun_phrase verb_phrase
noun_phrase	∅	noun
noun_phrase	∅	article noun_phrase
verb_phrase	∅	verb
verb_phrase	∅	verb noun_phrase
article	∅	the
article	∅	a
noun	∅	man
noun	∅	car
verb	∅	drove

Structures are:

Sentence
Noun Phrase:
Verb Phrase:

Noun Phrase
Determiner:
Noun:
Number:

Verb Phrase
Verb:
Number:
Object

Part_of_Speech: article
Root: a
Number: singular

Part_of_Speech: article
Root: the
Number: singular or plural

Part_of_Speech: noun
Root: car
Number: singular

Part_of_Speech: noun
Root: man
Number: singular

Part_of_Speech: verb
Root: drove
Number: singular

(7 marks)

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