

UNIVERSITI SAINS MALAYSIA

First Semester Examination  
Academic Session 1997/98

September 1997

**CSE401 - Artificial Intelligence**

Duration : [3 hours]

---

**INSTRUCTION TO CANDIDATE:**

- Please ensure that this examination paper contains **ELEVEN** questions in **EIGHT** printed pages before you start the examination.
  - Attempt **ALL** questions in **SECTION A**.
  - Attempt any **SIX** questions from **SECTION B**.
  - 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

**SECTION A**

1. Give brief answers (5 - 7 lines) to the following questions. Attempt any **FIVE (5)** questions:

- (a) What is artificial intelligence? List **three** commercial technologies of artificial intelligence.
- (b) Briefly describe Aristotle's **three** laws of tradition logic?
- (c) What is the fundamental difference between conventional programming and programming in prolog?
- (d) What is an artificial neural network? List the components of a neural network?
- (e) Briefly describe an expert system? Also show the architecture of an expert system?
- (f) What are the two main areas of natural language processing?

(10 marks)

2. Fill in the blanks.

- (a) To implement the breadth-first search algorithm, the Open list is maintained as a \_\_\_\_\_ data structure.
- (b) In prolog, the \_\_\_\_\_ predicate is used to control backtracking.
- (c) Conceptual graphs allow us to represent specific but unnamed individuals by the use of a unique token called a \_\_\_\_\_ .
- (d) In a neural network, the \_\_\_\_\_ representation scheme represents each concept/entity by a single, unique unit.
- (e) The \_\_\_\_\_ is the person who designs, builds and tests the expert system.
- (f) The two strategies for expert system inferencing are \_\_\_\_\_ and \_\_\_\_\_ .
- (g) In natural language processing, \_\_\_\_\_ is an activity that checks the ordering of the linguistic tokens against a grammar.
- (h) The Universal Quantifier indicates that the sentence is True FOR \_\_\_\_\_ values of the variable.
- (i) Each frame is similar to the \_\_\_\_\_ data structure.
- (j) Expert systems are also called \_\_\_\_\_ systems.

(10 marks)

3. Fill in the blank by choosing the correct answer from the answers given with each question.
- (a) \_\_\_\_\_ is a strategy for selectively searching the problem space as opposed to exhaustive search.  
(A) Heuristics  
(B) Depth-First  
(C) Forward chaining  
(D) Hill climbing
- (b) An \_\_\_\_\_ is the smallest unit of information in prolog.  
(A) Atom  
(B) Fact  
(C) Predicate  
(D) Rule
- (c) A prolog query finds information using \_\_\_\_\_.  
(A) Logical Deduction  
(B) Unification  
(C) Backtracking  
(D) Resolution
- (d) In a neural network learning algorithm the \_\_\_\_\_ determines the speed of learning.  
(A) Activation function  
(B) Learning rate  
(C) Number of units  
(D) Number of layer
- (e) Knowledge in a neural network is stored in the \_\_\_\_\_.  
(A) Units  
(B) Connections  
(C) Activation Function  
(D) Layers
- (f) In a conceptual graph, a marker is written as a number preceded by the symbol \_\_\_\_\_.  
(A) @  
(B) %  
(C) ?  
(D) #
- (g) The nodes of a conceptual graph represent \_\_\_\_\_.  
(A) Relations  
(B) Associations  
(C) Concepts  
(D) Records
- (h) Expert systems model the reasoning process of humans using a technique called \_\_\_\_\_.  
(A) Inheritance  
(B) Unification  
(C) Predicate Calculus  
(D) Inference

- (i) In natural language processing, the analysis of the meaning of words and sentences is known as \_\_\_\_\_ .  
 (A) Prosody  
 (B) Semantics  
 (C) Pragmatics  
 (D) Morphology
- (j) A transition network parser represents a grammar as a set of \_\_\_\_\_ .  
 (A) Grammar rules  
 (B) Finite-state machines  
 (C) Nodes and arcs  
 (D) Parse trees

(10 marks)

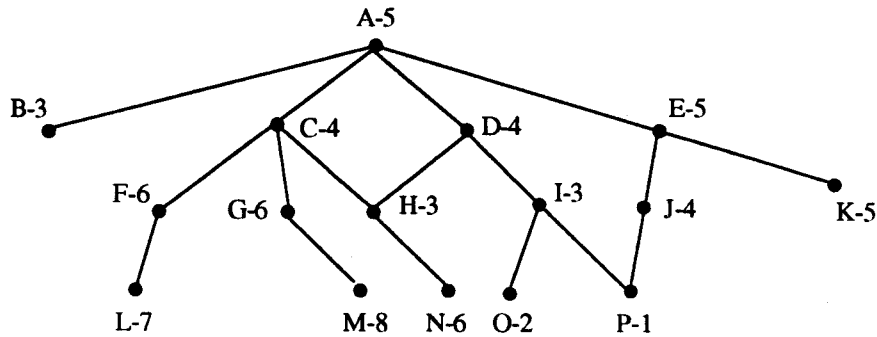
4. Determine whether the given statements are **True or False**.  
 [Note: Negative marking applies for this question (-1 for each incorrect answer)]

	TRUE	FALSE
(a) The breadth-first search is more efficient for search spaces with many branches.	_____	_____
(b) Goal Driven Search is also called Backward Chaining.	_____	_____
(c) Prolog is a programming language for numeric and procedural computation.	_____	_____
(d) Prolog has no type definitions.	_____	_____
(e) In a neural network each unit can have more than one output line.	_____	_____
(f) Conceptual graphs have labelled arcs.	_____	_____
(g) Using the Stanford Certainty factor, two confidence measures can be tied together with the following confidence factor calculation : $CF(H E) = MB(H E) + MD(H E)$ .	_____	_____
(h) Structurally, knowledge bases are generic in nature and can be used with other expert systems inference engine.	_____	_____
(i) If the order of the terminals in a parse tree is the same as that of the original sentence then it is regarded as a legal sentence.	_____	_____
(j) In natural language processing, the analysis of the intent of a dialogue is known as prosody.	_____	_____

(10 marks)

**SECTION B**

5. (a) Show the complete trace of Best-First Search algorithm for the given graph. The desired goal is the state P.



- (b) Write the pseudo code for the depth first algorithm.
- (c) Given the 8-puzzle (shown below), what are the possible heuristics to solve the puzzle and also determine which heuristics is the best.

2	1	3
6		5
8	7	4

(10 marks)

6. (a) Determine using truth tables whether the following two expressions are equivalent or not?

EXPRESSION 1:  $(P \vee \neg Q) = (P \Rightarrow Q)$

EXPRESSION 2:  $(\neg P \vee Q) = (\neg P \Rightarrow \neg Q)$

- (b) Use Resolution on the following statements:

$\neg aa(X, \text{arg1}) \vee \neg bb(X, \text{arg2}) \vee cc(X)$

$\neg dd(Y) \vee aa(Y,Z)$

$\neg dd(W) \vee aa(W,V)$

$\neg dd(\text{arg3})$

$dd(\text{arg3})$

$\neg dd(U) \vee bb(U, \text{arg2})$

to prove:

$cc(\text{arg3})$

(c) 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.

(10 marks)

7. (a) Write simple prolog programs to:

- (i) Delete an item (say X) from a list, say L1.
- (ii) Concatenate two list, say L1 and L2 to give a new list L3.
- (iii) Given two lists X= [a,b,c,d,e] and Y = [e,f,g,c,b], generate a new list Z that only contains the common elements between list X and Y.

(b) Given below are some facts representing a database of suppliers and parts.

```
% SUPPLIER(SUPPLIER_NUMBER, SUPPLIER_NAME, CITY).
supplier(10, john, penang).
supplier(20, ali, johor).
supplier(35, lee, kulim).
```

```
% PART(PART_NUMBER, PART_NAME, PRICE).
part(g100, gearbox, 200).
part(t350, tyre, 90).
part(a230, axle, 600).
```

```
% SUPPLIER_PART(SUPPLIER_NUMBER, PART_NUMBER)
supplier_part(10, g100).
supplier_part(20, t350).
supplier_part(20, a230).
supplier_part(35, a230).
```

```
%PART_POSTAL_CHARGES(PART_NUMBER, CITY_FROM, CITY_TO,
CHARGES)
part_postal_charges(g100, penang, johor, 20).
part_postal_charges(g100, penang, kulim, 50).
part_postal_charges(t350, johor, penang, 20).
part_postal_charges(t350, johor, kulim, 60).
```

Using the above facts, write a rule to:

- (i) Find out the name of the supplier (SUPPLIER\_NAME) and his city (CITY) when the name of the part (PART\_NAME) is given as input.
- (ii) Find out the TOTAL PRICE (PRICE + PART\_POSTAL\_CHARGES) of a part. The input given is the PART\_NUMBER, CITY\_FROM & CITY\_TO.

- (c) Write the three possible rules to find an item X in a binary dictionary? (10 marks)
8. (a) Draw a semantic network to relate three entities Ali, Ahmad and Hasan by the fact "Ali is older than Ahmad but younger than Hasan".
- (b) Draw conceptual graphs for the following statements:
- The dog fido is of white colour and its size is large.
  - Mary gave John the book.
  - The boy ate his meal with his spoon.
- (c) Briefly describe the various types of information the slots in a frame may contain? (10 marks)
9. (a) Show the complete trace of Backward Chaining Inference Strategy for the given situation.

Assume a patient comes to doctor and after listening to the patient the doctor believes that the patient has fever. Use the given system rules to show a complete trace of the Backward Chaining Inference Strategy to model the doctor's diagnostic procedure.

**RULE 1**  
 IF There are signs of cough  
 AND There is signs of a runny nose  
 AND There are signs of headache  
 THEN patient has a fever

**RULE 2**  
 IF The patient's chest is congested  
 THEN There are signs of cough

**RULE 3**  
 IF The patient's eyes are burning  
 THEN there are signs of a virus

**RULE 4**  
 IF There are signs of a virus  
 THEN There are signs of a runny nose

IF The patient cannot concentrate  
 THEN There are signs of headache

- (b) Illustrate the flow chart for forward chaining inference strategy? (10 marks)

10. Explain the backpropagation (BP) learning algorithm. Also, give the various mathematical formulas used in the algorithm? (10 marks)
11. (a) Given a simple grammar containing a number of rewrite rules and words (terminals), develop a Parse Tree for the following sentence.

**"The old man quickly wrote a nice story"**

Grammar		
sentence	-->	noun_phrase verb_phrase
noun_phrase	-->	noun
noun_phrase	-->	article noun_phrase
noun_phrase	-->	adjective noun_phrase
verb_phrase	-->	verb
verb_phrase	-->	verb noun_phrase
verb_phrase	-->	adverb verb noun_phrase
article	-->	the
article	-->	a
noun	-->	man
noun	-->	story
verb	-->	wrote
adverb	-->	quickly
adjective	-->	old
adjective	-->	nice

- (b) Draw the transition networks for the simple grammar given below?

Sentence	-->	noun_phrase verb_phrase
Noun_phrase	-->	noun
Noun_phrase	-->	adjective noun
Noun_phrase	-->	article noun
Noun_phrase	-->	article noun_phrase
Verb_phrase	-->	verb
Verb_phrase	-->	verb noun_phrase
Noun	-->	man
Noun	-->	dog
Noun	-->	lady
Article	-->	a
Article	-->	the
Verb	-->	saw
Verb	-->	stroked
Adjective	-->	big
Adjective	-->	young

(10 marks)