UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)
Academic Year 2007/2008 – 3rd Year Examination – Semester 5

IT5302: Intelligent Systems

Structured Question Paper
6th April 2008
THREE HOURS

To be completed by the candidate

BIT Examination Index No: .....

Important Instructions:

- The duration of the paper is **3 (Three) hours**.
- The medium of instruction and questions is English.
- This paper has **4 questions** and **12 pages**.
- **Answer ALL questions**. **Each of the four questions carries 25 marks.**
- **Write your answers** in English using the space provided **in this question paper**.
- Do not tear off any part of this answer book. Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.
- Note that questions appear on both sides of the paper.
  If a page is not printed, please inform the supervisor immediately.

Questions Answered

Indicate by a cross (X), e.g. [X] the question numbers of the questions answered.

To be completed by the candidate by marking a cross (X).	1	2	3	4	
To be completed by the examiners:					

Index No: ……...

1) (a) State the main difference between the weak AI philosophy and the strong AI philosophy.

(04 marks)

ANSWER IN THIS BOX

Weak AI is the school of thought which claims that machines cannot be made to think. For example a machine that behaves intelligently isn't considered conscious in weak AI. On the other hand strong AI is the school of thought which claims that machines can be made to posses consciousness. For example in strong AI a machine which exhibits intelligent behavior is regarded as having consciousness.

(b) Name the famous 2 experiments used to promote the ideas of strong AI and weak AI respectively.

(02 marks)

ANSWER IN THIS BOX

Turing test and Chinese room experiment

(c) Can a chess playing program which always wins be regarded as an ideal rational agent? Justify your answer.

(03 marks)

ANSWER IN THIS BOX

yes

In order to win always the program must play in an optimal way, which means there should be an ideal mapping of inputs to outputs.

(d) Consider an expert system involved in medical diagnosis. Define the environment of this application using its variables.

(10 marks)

ANSWER IN THIS BOX

inaccessible – Diagnosing a disease involves externally observing the symptoms.

non-deterministic – Similar symptoms may lead to different diseases.

non-episodic – Diagnosis shows continuity over time.

dynamic – The patient situation could change while diagnosing.

continuous – There isn't a finite set of actions for diagnosis.

(e) Consider the following sentence.

'Saman and Mala play cricket and badminton respectively'

What is the class of automation required to parse the above sentence? Justify your answer.

(02 marks)

ANSWER IN THIS BOX

linear bound automata

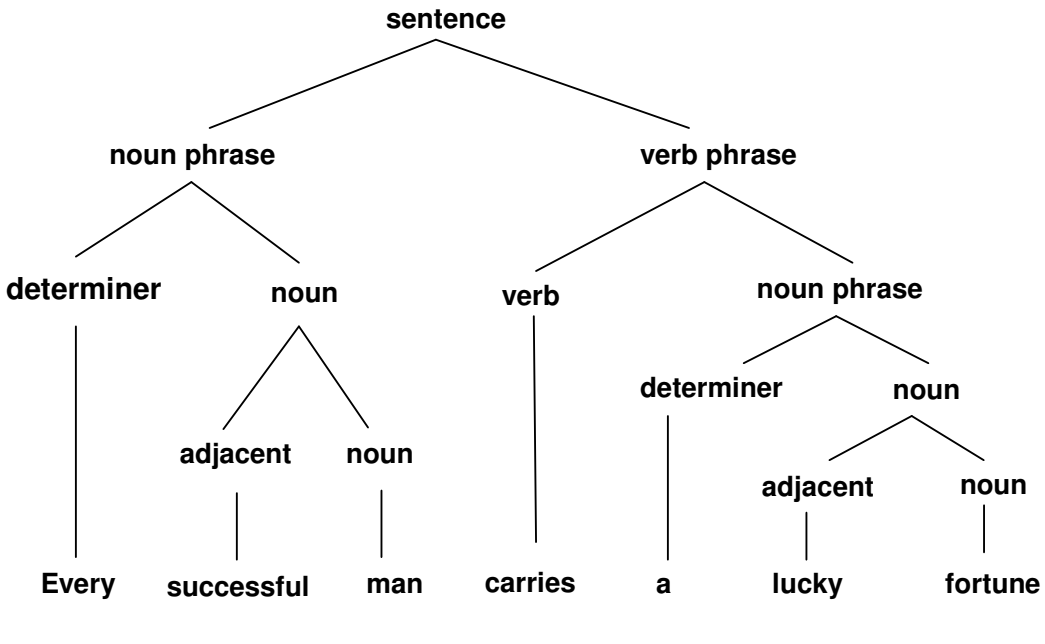
because the sentence is context sensitive

(f) Draw a parse tree for the sentence 'Every successful man carries a good fortune' by using the following grammar.

sentence → noun phrase + verb phrase
verb phrase → verb + noun phrase
noun phrase → determiner + noun
noun → adjective + noun
determiner → Every
determiner → a
adjective → successful
adjective → lucky
noun → fortune
noun → man
verb → carries

(4 marks)

ANSWER IN THIS BOX



2) (a) Represent the following statements in Prolog.

(i) 12 is an integer.
(ii) If a number is an integer and positive it is called a positive integer.
(iii) Some one is an ancestor if he or she is either a parent or a parental predecesor.

(05 marks)

ANSWER IN THIS BOX

(i) integer(12).

(ii) positive_integer(X) :- integer (X), positive(X).

(iii) ancestor(X,Y) :- parent(X,Y).

ancestor(X,Y) :- parent(Z,Y), ancestor(X,Z).

(b) Consider the following Prolog code fragment.

```
modulex([],L,L).
modulex([H|T],L2,[H|Y]) :- modulex(T,L2,Y).
```

What will be the output produced for the following input?

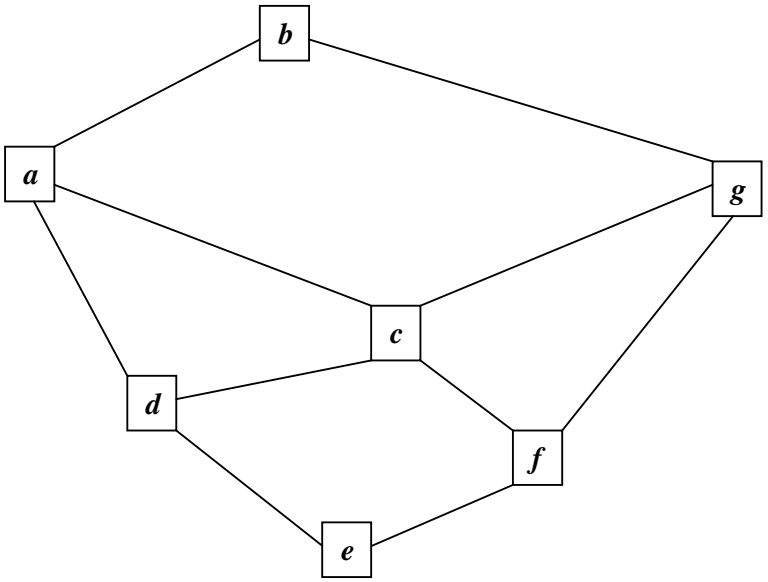
Q : modulex([a,b,c,d],[e,f,g,h],X).

(03 marks)

ANSWER IN THIS BOX

X = [a, b, c, d, e, f, g, h].

Consider the following graphical representation of a road network and answer the questions (c), (d) and (e). The labels ***a, b, c, d, e, f*** and ***g*** in the diagram are the towns and the lines are the roads which connect the towns.



Suppose you are given the task of finding a route from ***a*** to ***g***.

(c) State the search strategy you should apply if the route you find will be used on a regular basis? Justify your answer.

(03 marks)

ANSWER IN THIS BOX

breadth first search

because the shortest path will be found and over time fuel will be saved.

(d) How could the searching be improved if you were given information about straight-line distances to ***g*** from every town other town?

(04 marks)

ANSWER IN THIS BOX

Straight-line distance can be used as a heuristic and an informed search technique can be used.

(e) Consider the following tables. Table 1 provides the distances between the towns while Table 2 provides the estimated cost to town g from every other town.

towns		distance between towns (km)
a	b	11
a	c	16
a	d	10
b	g	25
c	g	18
c	f	5
c	d	8
d	e	8
e	f	6
f	g	18

Table 1

town	estimated cost to town g (Rs.)
a	25
b	30
c	20
d	20
e	30
f	12

Table 2

(i) Using cost as a heuristic, name a search technique which could be used to solve the problem optimally?

(ii) Find the optimal route from town ***a*** to town ***g*** using the technique you mentioned for part (i) above.

(10 marks)

ANSWER IN THIS BOX

(i) A* search

(ii) The algorithm proceeds by evaluating b, c and d, which yield the following results: b = (11 + 30), c = (16 + 20) and d = (10 + 20).
d is chosen because it yields the minimum value.

The algorithm proceeds by evaluating c and e, which yield the following results: c = (30 + 20) and e (30 + 30).
c is chosen because it yields the minimum value.

The algorithm proceeds by evaluating g and f, which yield the following results: g = (50 + 0) and f (50 + 12).
g is chosen because it yields the minimum value and the algorithm stops here as the destination has been found.

Path found: a, d, c and g.

3) (a) Consider the following scenario.

'A patient has come to a doctor to get some medicine. The doctor starts examining the patient by using a stethoscope. Then the doctor prescribes medication and receives payment. The nurse at the dispensary delivers the drugs when the patient produces the prescription. The patient may undergo lab tests if necessary.'

Complete the following script using the information given in the description above.

(06 marks)

ANSWER IN THIS BOX

entry conditions	**patient present, doctor present, nurse present, drugs available**
result	**doctor receives payment, patient gets medicine**
props	**stethoscope**
roles	**doctor, nurse, patient**
scenes	**patient arrives, doctor treats, patient pays, nurse issues drugs**
tracks	**patient undergoes lab tests**

(b) Express the following sentences in predicate logic.

(i) There is a woman behind every successful man.

(ii) Everybody loves everyone unless somebody hates someone.

(06 marks)

ANSWER IN THIS BOX

(i) $\forall X \exists Y\ [man(X) \Lambda successful(X)) \rightarrow woman(Y)]$

(ii) $\forall X\ \forall Y\ [(love(X,Y) \rightarrow\ love(Y,X)) \text{ V } \exists X\ \exists Y\ (love(X,Y) \rightarrow\ \sim love(Y,X))]$

(c) Consider a software which diagnoses heart disease by analyzing an ECG. Can we consider this software as an expert system? Justify your answer.

(02 marks)

ANSWER IN THIS BOX

Yes.

Diagnosis of heart disease is performed by an expert in the medical field and

software which mimics such expertise can be regarded as an expert system.

(d) State 3 issues that can arise when using production rules to construct a rule-based expert system.

(03 marks)

ANSWER IN THIS BOX

less flexible

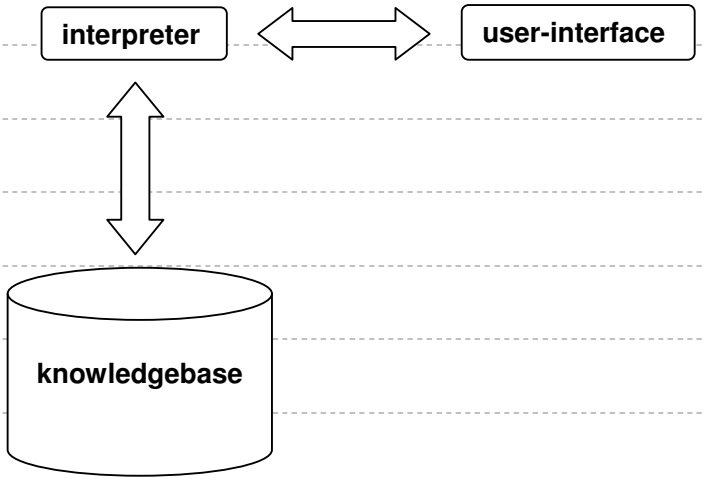
conflict between rules

Lot of rules may be required if the problem domain is complex.

(e) Sketch a named diagram showing the main components of an expert system.

(03 marks)

ANSWER IN THIS BOX

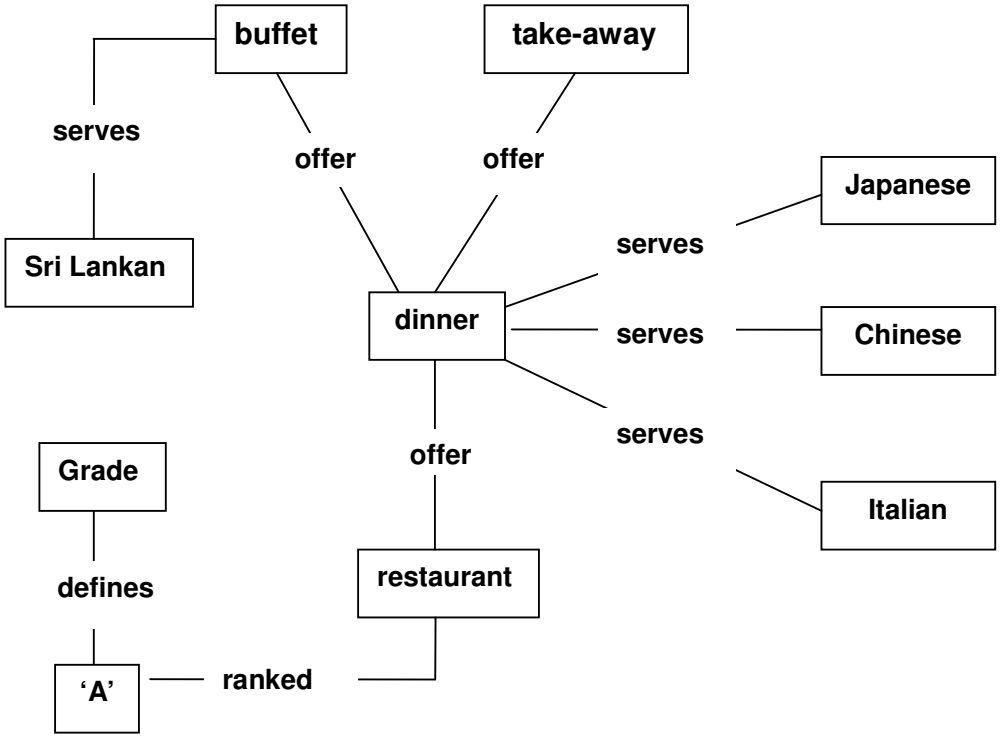


(f) Draw a semantic network to represent the following scenario.

'An 'A'-grade restaurant offers 2 options for dining: a buffet and a take-away menu. It offers Japanese, Chinese and Italian cuisine for dinning but Sri Lankan cuisine only in the buffet.

(05 marks)

ANSWER IN THIS BOX



4) (a) Can the backpropagation algorithm be guaranteed to converge to a globally optimal solution?

(04 marks)

ANSWER IN THIS BOX

No it can't. The backpropagation algorithm implements gradient search and only achieves locally optimal solutions.

(b) What is the main reason why it is unwise to use a neural network that has many more hidden units than are necessary for a given learning problem?

(04 marks)

ANSWER IN THIS BOX

because the neural network will easily over-fit to noise in the training data and hence reduce its generalization capabilities

(c) There is a MLP with 26-50-5 nodes (26 input nodes, 50 hidden nodes and 5 output nodes) and also trained to an application for classification. What will happen to the trained MLP if one removes 2 hidden nodes from it?

(04 marks)

ANSWER IN THIS BOX

The MLP will exhibit graceful degradation in performance rather than catastrophic failure. This is because the information representation is distributed over the network instead of being stored in a specific place in the MLP.

(d) What is meant by a winning neuron in the Kohonen's self organizing feature map network? Explain why it is necessary to have a winning neuron in the Kohonen weight update rule?

(04 marks)

ANSWER IN THIS BOX

The winning neuron has the smallest Euclidean distance to the pattern presented to the network. The winning neuron defines the network neighborhood for updating the weight vectors of the network.

(e) Some modifications of the Error back-propagation algorithm uses the momentum term in the weight update rule.

(i) What is the role of the momentum term in the weight update rule?

(03 marks)

ANSWER IN THIS BOX

It allows the network to learn more quickly when plateaus in the error surface exist. The approach is to alter the learning rule to include some fraction of the previous weight update.

(ii) Show how the standard weight update rule is changed when the momentum term is used. Hint: standard weight update rule: $\underline{\mathbf{w}}(t+1) = \underline{\mathbf{w}}(t) + \Delta\mathbf{w}(t)$.

(03 marks)

ANSWER IN THIS BOX

$\underline{\mathbf{w}}(t+1) = \underline{\mathbf{w}}(t) + (1-\alpha)\Delta w(t) + \alpha\Delta w(t-1)$ where $0 \leq \alpha \geq 1$.

(f) Explain a technique one can use to get a better performance when the amount of data available for training a neural network is small.

(03 marks)

ANSWER IN THIS BOX

We can use n-fold cross validation technique in such a situation.

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