**THE OPEN UNIVERSITY OF SRI LANKA**
**DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING**

**FINAL EXAMINATION 2012/2013**
**BACHELOR OF SOFTWARE ENGINEERING**



**ECI 6265 Artificial Intelligence Techniques**

**Date: 7th August 2013** **Time: 9.30 – 12.30 hrs**

***Answer* ONLY FIVE *questions:***

**Question 1**

(a) Software itself is a useful invention by humans. In this sense how do you argue that intelligent software is more useful and provide more natural sense for problem solving? (3 marks)

(b) Distinguish between the procedural and declarative knowledge. (4 marks)

(c) "Machine learning techniques are able to model real world problems that could not be solved otherwise. From the inception, machine learning has been a major branch of Artificial Intelligence". What is meant by machine learning? (3 marks)

(d) What is reasoning and why is study of reasoning important when solving problems in AI? (4 marks)

(e) Distinguish between deterministic reasoning and non-deterministic reasoning giving examples. (6 marks)

**Question 2**

(a) Express the following English sentence in First Order Logic (predicate logic), using the given notation: (10 marks)

(i) *A good actor learns something from every director.*
*(A(x): x is an actor; L(y,z): y learns from z; D(k): k is a director)*

(ii) *A person may steal something if the person is a thief and the person likes the thing and the thing is valuable.*
*(T(x): x is a thief; S(y,z): y steals z; L(p,q): p likes q; V(k): k is valuable)*

(b) Consider the following sentences.

*If the animal has feathers then it is a bird.*
*Peacock has feathers.*

(i) Write each sentence is First Order Logic (FOL). (4 marks)
(ii) Convert each FOL sentence to clausal form. (2 marks)
(iii) Prove that *peacock is a bird* using resolution refutation. (4 marks)

*Notation: $\forall x$ – for all, $\exists y$ - there exists, $\vee$ - or, $\wedge$ - and, $\rightarrow$ - material implication*

**Question 3**

(a) Differentiate between exhaustive search and heuristic search. (2 marks)

(b) What are the drawbacks of Depth First Search? (3 marks)

(c) Compare and contrast Uniform Cost and A* search algorithms. (6 marks)

(d) For the following 3 cases what is the most appropriate search technique to use? Justify your answer. (9 marks)

*(i) We have a very large state space with a large branching factor and with possibly infinite paths. We have no heuristic. We want to find paths to the goal with minimum numbers of state.*

*(ii) Our state space is a tree of fixed depth and all the goals are the leaves of the tree. We have a heuristic and we want to find any goal as quickly as possible.*

*(iii) We have a state space with a manageable number of states and costs of links and an admissible heuristic. We want to find shortest path to the goal.*

**Question 4**

(a) Semantic networks, Frame based representation and rule based representation are different knowledge representation techniques used in expert systems. Compare and contrast these 3 techniques and give a suitable application to use each method.

(12 marks)

(b) Represent the following relationships given in sentences by a Semantic Network. (3 marks)

- Football is a ball game
- Rugby is a ball game
- Tennis is a racket games
- Both racket games and ball games are sports
- Senuth likes Tennis

(c) What is meant by 'Knowledge based system'? Briefly describe using a block diagram. (3 marks)

(d) What is the value of having the knowledge of an expert system separate from its inference?

(2 marks)

**Question 5**

(a) Translate the following English sentences into Prolog. (6 marks)

*(Natural moons are called Satellites. Moon is earth's satellite)*

Moon orbits around Earth
Earth orbits around Sun
Deimos orbit around Mars
Phobos orbit around Mars
A planet orbits around Sun
A *Satellite* orbits around a planet

(b) Write goals to extract the following information (6 marks)

What orbits around Earth?

Find two *Satellites* that orbit around same planet

(c) Consider the following program

```
f (1, one).
f (S(1), two).
f (S(S(S((X), N))):-f(X, N)
```

How will Prolog answer the following questions? (3 marks)

(i) ? _f(S(1),A).

(ii) ?_f(S(S(1), two).

(iii) ? _f(S(S(S(1))),C).

(d) Find the $n^{th}$ element of a list (5 marks)

e.g *find_n([a,b,c,d,e,f], 3,X)* should give X= c

**Question 6**

(a) When designing an agent the *task environment* must be specified. What are the major factors that task environment consists of? (8 marks)

(b) Distinguish between agent program and agent function. (3 marks)

(c) What are the advantages of multi-agent approach? (4 marks)

(d) What are the programming languages that can support programming of agents? What are the specific features available in these languages that make them suitable to create agents? (5 marks)

**Question 7**

(a) "A neural network cannot show the reasoning for a solution it is giving". Do you agree with this statement? Justify your answer. (2 marks)

(b) A neural network that you have just finished training performs poorly on the validation set. List possible causes why this would happen and suggest solutions to overcome the problem. (6 marks)

(c) Provide an example where neural network technology is best suited to model the problem with justification. (2 marks)

(d) A fully connected feed forward layered network has 4 input nodes, 2 hidden layers where one has 2 neurons and the other has 4 neurons. Output is a single neuron. Construct an architectural graph of this network. (5 marks)

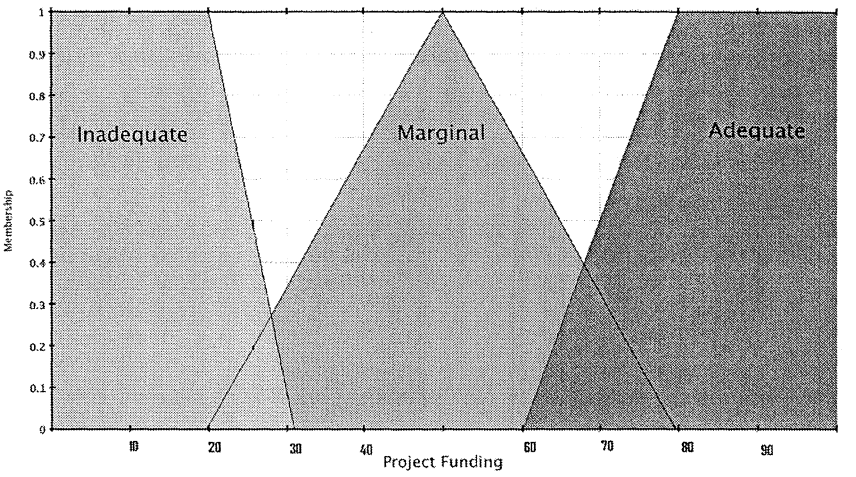
(e) Output neuron *o* of the network above (in C), receives 4 inputs from neurons whose activity levels are 15, -25, 6 and -4. The respective connection weights of neuron *o* are 0.8, 0.2, 1.0, and 0.9. Calculate the output of neuron *o*, if it is represented by Perceptron.

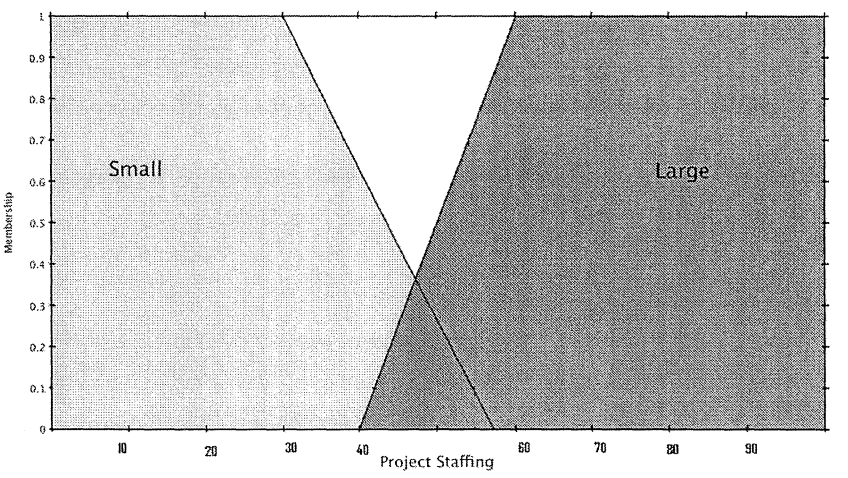
[Hint: Activation function of a perceptron is a Step Function] (5 marks)

**Question 8**

A part of a fuzzy application to estimate the level of risk involved in a software engineering project is given here. For simplicity here we consider only **two inputs**: **project funding** and **project staffing**.

The sets defined for ***project_funding*** are **inadequate**, **marginal** and **adequate**. The sets defined for ***project_staffing*** are **small** and **large**.




(a) What are the fuzzy membership grades for the membership functions when the project funding is 70%? (3 marks)

(b) What are the fuzzy membership grades for the membership functions when the project staffing is 40%? (3 marks)

(c) Find the fuzzy values for ***risk*** in following rules ($\mu_{risk}$ =low(z), $\mu_{risk}$ = normal(z), $\mu_{risk}$ = high(z)). (If the project funding is 70% and project staffing is 40%) (8 marks)

i. If *project_funding* is **adequate** OR *project_staffing* is small then risk is **low**.
ii. If *project_funding* is **marginal** AND *project_staffing* is large then risk is **normal**.

(d) Business intelligent systems based on fuzzy logic have achieved remarkable advantages in many aspects. Briefly explain 3 benefits of fuzzy systems. (6 marks)