National University

of Computer & Emerging Sciences Peshawar Campus

Student Name: _____ Roll No: _____

Program: CS-13 (A&B)
Semester: SPRING – 2016
Time Allowed: 3:00 hours
Course: Artificial Intelligence (AI)

Examination: **Final**
Total Marks**: 110** Weightage**: 50**
Date: 23-05-2016
Instructor: Dr. Hafeez Ur Rehman

NOTE: Attempt all questions.

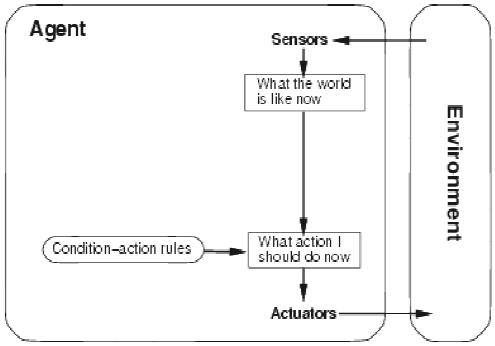
Question # 01: **[Marks: 5+5+5]**

A. Suppose you want to design an artificially intelligent agent how will you specify its **task environment?** List measures and describe those measures using example of an agent.

B. Characterize the following agents into their respective task environments:

Agents / Environment Types	Deterministic/ Stochastic	Static/Dynamic/ Semidynamic	Episodic/Sequential	Discrete/ Continuous
CROSS WORD				
CHESS				
HUMANOID ROBOT				
POKER				
PART PICKING ROBOT				

C. Consider the following reflex agent model. Modify it (add/remove modules) to make it a complete **learning agent**.



Question # 02:

A. Suppose you are presented with some AI search problem X. How will you decide if X is appropriate for A* search? What is the practical problem associated with A* search and how will you counter it? List at least two ways. [**Marks: 5**]

B. Consider the 4-Queen problem that you would like to solve using Genetic Algorithm (GA). The idea is to find a configuration in which no queen attacks the other. A random configuration of the problem is shown below: [**Marks: 2+2+3+4+2+2**]

			Q4
	Q2		
		Q3	
Q1			

In the above context answer the following:

a. How will you turn it into a maximization problem? Write objective function.
b. What will be the maximum fitness value that your algorithm will try to achieve?
c. Why will you prefer GAs over Simulated Annealing for this problem?
d. Start with a random population of two and list the steps involved using GA in generating the first generation of states?
e. What will be the effect on the algorithm, if mutation probability is set to $1x10^{-5000}$ (i.e., very low)?
f. Generate a goal state of the above problem.

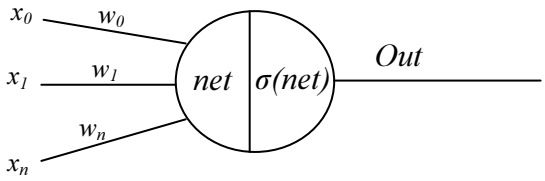
Question # 03: **[Marks: 5+5+10]**

A. Give example of a perceptron with two inputs A and B and *converged weights* that implement a Boolean ($A \wedge \neg B$) function.

B. Design a two-layer network of perceptrons and *converged weights* that implement the XOR function.

C. Derive a *gradient descent training rule* for the following unit with inputs $x_0, x_1, \ldots, x_n$ (including bias) as well as output *Out* which is a sigmoid function.

Whereas, *net* = $w_0+w_1x_1+w_1x_1^2+\ldots\ldots+w_nx_n+w_nx_n^2$



Question # 04: **[Marks: 10 + (part B: 5 + 10)]**

A. Consider a two-layer feedforward ANN with two inputs A and B, one hidden unit C, and one output unit D. This network has five weights (namely, w_{OC}, w_{AC}, w_{BC}, w_{OD}, w_{CD}), where w_{OX} represents the threshold weight for unit x. Initialize these weights to the values (0.1, 0.l, 0.l, 0.l, 0.1), then **give their values after each of the first two training iterations** of the BACKPROPAGATION algorithm. Assume learning rate η=0.3, incremental weight updates, and the following training examples:

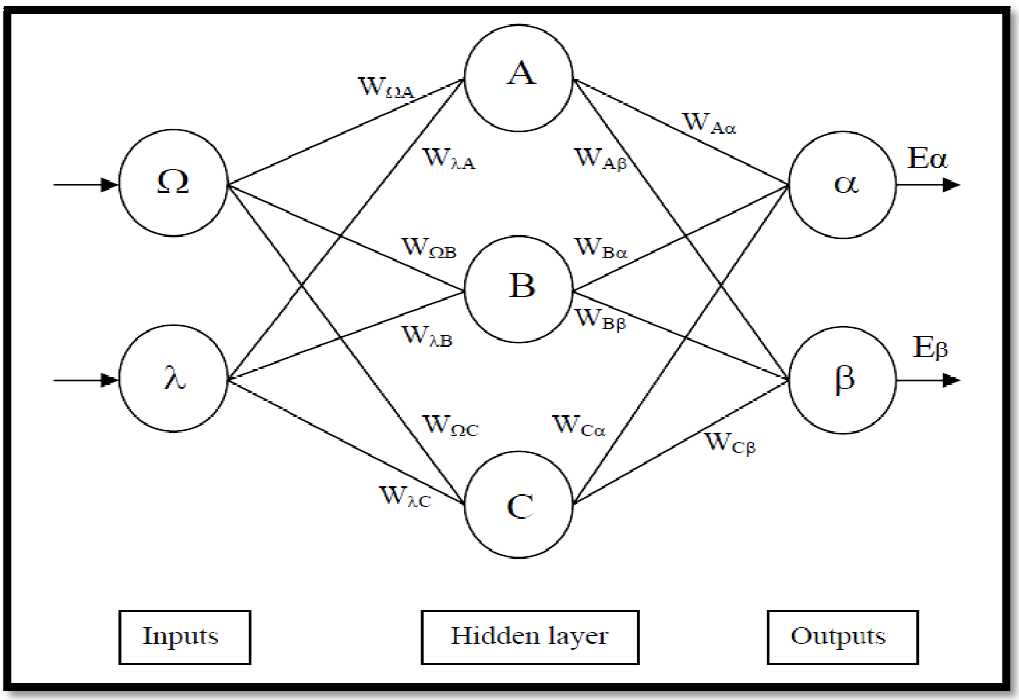
A	B	**T**
1	0	**1**
0	1	**0**

B. Consider a multi-layer perceptron network as shown in the following diagram. Also, assume that each perceptron p has two functions namely, net_p which is the linear sum of all inputs & weights, and output O_p which is equal to a **Squashing** function i.e. $O(net_p)= tanh(net_p)$, used as activation function. Write ***simplified*** **expressions (with your comments + proof)** to:

i. Calculate weight update ($\Delta W_{C\beta}$) for output layer nodes.

ii. Calculate weight update ($\Delta W_{\Omega B}$) for Hidden layer nodes. Let the error terms of each perceptron at the output layer be δ_α and δ_β respectively.

[**Hints**: $tanh'(x) = 1 - tanh^2(x)$. The network error is $E = \frac{1}{2}\sum_{d\in D}\sum_{i=\alpha}^{\beta}(t_{di} - O_{di})^2$, D is training data]



Question # 05: Give short answers (max 4 lines) of the following: **[Marks: 30]**

1. How will you define **Autonomy of an agent**?
2. What are the **problems** associated with AI's Turing test?
3. Why we introduce **randomness** in Local search algorithms?
4. What is the difference between a **state** and a **node** for an agent?
5. What is a *consistent* hypothesis?
6. Difference between *classification* and *regression*?
7. What is the effect of the size of k (too large or too small) in KNN classifier?
8. Why we put *negative sign* (-) with gradient descent weight update (Δw) rule?
9. What is the remedy for dealing with high biasness and high variance in a classifier?
10. Describe at least 3 activation functions that can be used with gradient descent search?
11. What is linear regression?
12. In short words, state the problem with RBFS search?
13. What will be the size of a *hypothesis space* with d number of features (assuming binary features) and 50 target classes?
14. In KNN classifier, state cases in which you will use Euclidean distance, Manhattan distance, and Hamming distance among feature vectors?
15. Comment on the statement: "A classifier trained on less training data is more likely to Overfit".

----- Good Luck! -----