Cairo University
Faculty of science
Mathematics Department
120 minutes

Final Exam (Jun. 2014)
Artificial Intelligence
Comp 691-b

Answer the following questions. The total credit is 100. **The Exam is in <u>Eight</u> Pages**

Question (1) (30 points)

A. **(10 points)** Complete the following statements

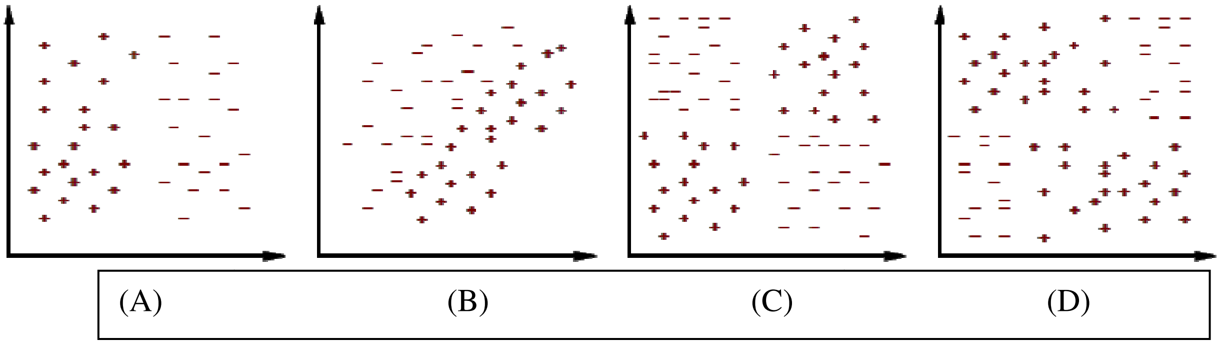
1. ID3 Algorithm uses a measure called ………………based on the notion of entropy
2. A single-layer neural network, that is a network with all the inputs connected directly to the outputs is called …………………
3. Binary functions in which there is a line separating all points that take one value from others are called ……………….
4. A five layer ANN has a number of …………… hidden layers.
5. The neuron fires an output if the sum of its inputs exceeds the value of the ……………

B. **(12 points)** Short answer: (Just write True or False)

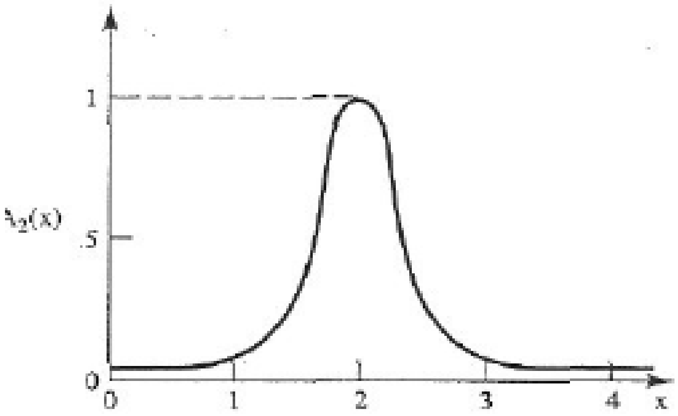
1. (……) Induction is a symbolic approach of learning
2. (……) The ID3 algorithm builds the shortest tree
3. (……) Decision Tree Learning is unsupervised.
4. (……) Neural networks can be set up to output only zero and one values.
5. (……) Links in recurrent neural nets go in one direction.
6. (……) The higher the entropy the more information content we have.

C. **(8 points) Multiple choice:**

1. Simmon's definition describes learning as allowing the system to perform …. next time.
   - **a.** more advanced
   - **b.** faster
   - **c.** better
   - **d.** None of them
2. Which of the following is not a fuzzy set
   - **a.** $A = \frac{0.4}{1} + \frac{1.0}{2} + \frac{1.0}{3} + \frac{0.4}{4}$
   - **b.** $A = \frac{0.4}{1} + \frac{0.4}{2} + \frac{0.4}{3} + \frac{0.4}{4}$
   - **c.** $A = \frac{0}{1} + \frac{0}{2} + \frac{0}{3} + \frac{0}{4}$
   - d. None. (i.e. All of them are fuzzy sets)



3. Which are correctly classifiable by a perceptron?
   - **a.** Only (A)
   - **b.** Both (A) and (B)
   - **c.** Both (C) and (D)
   - **d.** None of them



4.

Which of the following is true
   - a. Its support is bounded
   - **b.** The zero-cut (i.e. α=0) is not a closed set
   - **c.** The zero-cut (i.e. α=0) is a closed set
   - **d.** The core is empty

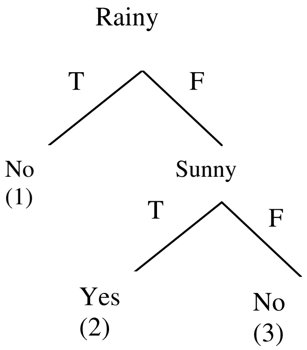
Question (2) (27 points)

A. **(4 points)** Consider two triangular fuzzy number *A=(-3,2,4), B=(-1,0,6)* , find their sum.

B. **(6 points)** What is the purpose of hedges in fuzzy sets? Give an example of a discrete fuzzy set and define a hedge on it.

C. **(17 points)** Consider the problem of deciding whether or not to go on a trip, based on various attributes of the day. Here is a set of examples, classified according to whether it was or was not a good idea to go on the trip. And next to it one possible decision tree for this problem

Example	Rainy	Sunny	Warm	Summer	Friday	Trip
Day1	T	F	F	F	F	No
Day2	F	T	F	F	T	Yes
Day3	F	T	T	T	T	No
Day4	F	T	T	F	T	No
Day5	T	F	F	F	T	No
Day6	F	T	F	F	T	No



i. (2pts) For this tree, which day(s) are false positives? (i.e. the decision “No” in the tree matches the decision No in the table)

ii. (2pts) For this tree, which day(s) are false negatives? (i.e. the decision “No” in the tree does not match the decision No in the table)

iii. (2pts) (True / False) The function represented by the decision tree shown above can be represented by a Two-layer neural network using sufficient hidden units. <u>Explain why</u>

iv. (2pts) (True / False) There is a consistent decision tree for this training set. Explain why

v. (3pts) Suppose you could turn one leaf into a new attribute test; which would it be, the leaf marked (1) or leaf marked (2) or leaf marked (3)?

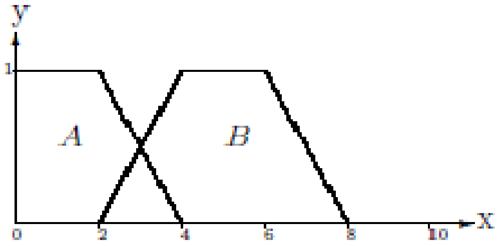
vi. (6pts) Which new attribute test (Warm or Summer or Friday) provides the highest information gain?

Question (3) (27 points)

A. **(6 points)** What is the difference between the three types of learning: supervised, unsupervised and reinforcement?

B. **(5 points)**What are the subjects of soft computing? How does it differ from conventional (hard) computing?

C. **(16 points)** Consider the following fuzzy sets:



And consider the *standard t-norm* and *t-conorm* (i.e. min and max). Find each of the following:

i. (4pts) The membership function of *A* and *B*.

ii. (2pts) The membership function of the *t-norm* of A and B

iii. (2pts) The membership function of the *t-norm* of A and B

iv. (1pts) The support of B

v. (1pts) The core of the *t-conorm* of A and B

vi. (6pts) The α-cuts of the *t-conorm* of A and B

Question (4) (20 points)

A. **(6 points)** Show that the algebraic sum $u(a,b)=a+b-ab$ the four t-conorm axioms.

B. **(4 points)** Give an example of a fuzzy set A such that the following does not hold $A \cap A^c \neq \emptyset$, You may choose any of the famous *t-norms* for the intersection.

C. **(10 points)** Choose one of the following questions to answer:

a. In competitive learning; Briefly, explain how does the Winner-Take-All algorithm work. What happens if we replaced the Euclidean distance by just $X - W$; Where X is the input pattern and W is the weight vector.

b. Briefly explain how does Kohonen algorithm work; indicating explicitly how the unsupervised learning be performed

c. In Support Vector Machine (SVM): Explain briefly how dose the SVM algorithm works? Does the learning in SVM supervised or unsupervised

d. In Hopfield network: Explain briefly an algorithm for the Hopfield network. How can updating the network be done?

Best Wishes
Areeg Abdalla