CSE4403 3.0 & CSE6002E - Soft Computing
Winter Semester, 2011

THE BIG ASSIGNMENT

Due: 22 March 2011 (in class)

Logic, Fuzzy Logic & Sets

1. Andrew, Bernard, Claude, Donald, and Eugene have summer houses along the Atlantic coast. Each wanted to name his house after the daughter of one of his friends - that is, Anne, Belle, Cecilia, Donna, and Eve (but not necessarily in that order). To be sure that their houses would have different names the friends met to make their choices together. Claude and Bernard both wanted to name their house Donna. They drew lots and Bernard won. Claude named his house Anne. Andrew named his house Belle. Eve's father hadn't come, and Eugene phoned to tell him to name his house Cecilia. Belle's father named his house Eve.

What is the name of each friend's daughter? What is the name of his house?

2. Fuzzy logic has been successfully used in control systems methodology. How does fuzzy logic differ from conventional control systems methods?

Rough Sets

3. Name five features that rough sets theory allows:

4. Given the following information system

Make_model	Cyl	Door	Displace	Compress	Power	Trans	Weight	Milage
USA	6	2	medium	high	high	auto	medium	medium
USA	6	4	medium	medium	medium	manual	medium	medium
USA	4	2	small	high	medium	auto	medium	medium
USA	4	2	medium	medium	medium	manual	medium	medium
USA	4	2	medium	medium	high	manual	medium	medium
USA	6	4	medium	medium	high	auto	medium	medium
USA	4	2	medium	medium	high	auto	medium	medium
USA	4	2	medium	high	high	manual	light	high
Japan	4	2	small	high	low	manual	light	high
Japan	4	2	medium	medium	medium	manual	medium	high
Japan	4	2	small	high	high	manual	medium	high
Japan	4	2	small	medium	low	manual	medium	high
Japan	4	2	small	high	medium	manual	medium	high
USA	4	2	small	high	medium	manual	medium	high

The genetic algorithm (in Rosetta) generates four reducts. What are they?

What is the core?

Neural Networks & Perceptrons

5. How much information does it take to describe a two-input perceptron? The classical description uses a vector of three real-valued parameters: $\mathbf{w} = \langle w_0, w_1, w_2 \rangle$. But the perceptron's decision boundary is a line, which can be uniquely specified with just two parameters, e.g., slope and intercept.

Jack says: "A perceptron can be described with less information than three real numbers. Here's how I would do it: set $s_0 = w_0/w_2$, and $s_1 = w_1/w_2$. From the description $\langle s_0, s_1 \rangle$, I can construct a weight vector $\langle s_0, s_1, 1 \rangle$ that describes a line with the same slope and intercept as the one described by **w**. So it should behave the same as **w** for all inputs."

Jill replies: "A perceptron requires more than that to describe. A line is not an inequality. Consider the case where w_2 is negative. How will that effect the results of your transformation?"

(a) Whose claim is correct, and why? **(b)** How much information does it really take to correctly describe a two-input perceptron? (Don't worry about the case where $w_2 = 0$.)

6. Perceptrons cannot handle tasks which are not separable. A set of points in n-dimensional space are linearly separable if there is a hyper-plane of (n-1) dimensions that separates the sets. In 2-d space, the sets can separated by a straight line.

Can a perceptron learn to classify the following problem correctly? Why?

Input x1	Input x2	output
0	0	0
1	1	0
0	1	1
1	0	1

Genetic Algorithms and Evolutionary Computing

7. With regards to Genetic Algorithms

a) Describe a parent selection technique and describe the algorithm.

b) Explain the concept of mutation with regard to GA's. Why is it important to have such an operator?

c) If you were developing a GA for The Travelling Salesman Problem (TSP), what type of crossover operator would you use? Show how this crossover method works and explain why you would use it in preference to other crossover operators?

8. a) Given the following parents, P_1 and P_2, and the template T

P_1	A	B	C	D	E	F	G	H	I	J
P_2	E	F	J	H	B	C	I	A	D	G
T	1	0	1	1	0	0	0	1	0	1

Assume that C_n, are crossover points where $C_n = 0$ means that the crossover point is at the extreme left of the parent.

Show how the following crossover operators work
- one point crossover (using $C_1 = 4$)
- two point crossover (using $C_2 = 2$ and $C_3 = 8$)
- uniform crossover
- order-based crossover

with regards to genetic algorithms

b) Why is mutation important with regards to genetic algorithms? Give an example to demonstrate your point.

c) Genetic algorithms are an example of a population based approach to problem solving. Give your ideas as to other potential population based approaches that could be used.

General (extra credit)

9. a) Describe and show a hill climbing algorithm?

b) Describe the idea behind simulated annealing?

c) How would you change the algorithm developed in (a) so that simulated annealing can be used as a search method?

d) Show, by way of an example, how changing the parameters to the simulated annealing algorithm, affect whether it will accept a given move?