CPSC 625-600 Exam #2 (11/30/2010, Tue)[1]

Last name: _____, First name: _____

Time: **2:20pm–3:35pm (1 hour 15 minutes)**, Total Points: **100**

Subject	Score
Uncertainty and Probabilistic reasoning	/30
Neuroevolution	/10
Learning	/50
Sensorimotor learning	/10
Total	/100

- You may use a calculator.
- This is a closed book/closed note exam.
- Be as **succinct** (i.e. brief) as possible.
- Read the questions carefully to see what kind of answer is expected (*explain blah* **in terms of ...** *blah*).
- Solve all problems.
- Total of _6_ pages, including this cover. **Before starting, count the pages and see if you have all _6_.**

[1] Instructor: Yoonsuck Choe.

1 Uncertainty and Probabilistic Reasoning

Question 1 (10 pts): (1) Explain why

$P(Earthquake|GroundShaking) > P(Earthquake|GroundShaking \wedge NuclearDetonation)$.

(2) What is this called?

Question 2 (10 pts): There are several different ways to use Bayesian belief networks for probabilistic inference. Explain two specific ways.

Question 3 (10 pts): Why is it important to know the probability of events? Explain in reference to decision theory.

2 Neuroevolution

Question 4 (10 pts): (1) Explain what "competing conventions" mean (explain in terms of why it occurs when evolving whole neural networks), and (2) explain how advanced neuroevolution algorithms such as ESP or NEAT overcome this.

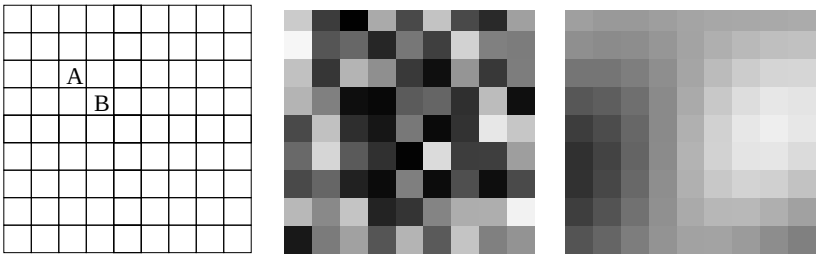
3 Learning

Question 5 (10 pts): In multilayer feedforward networks, the error function E is a function of the connection weights. That is, given two connections with weights w_0 and w_1, changing these weights will result in different error and these error values for all possible (w_0, w_1) pairs can be seen as forming a 2D surface embedded in 3D space (x axis = w_0, y axis = w_1, z axis = E).

(1) If the training input set changes, does the error surface also change? (2) Explain why or why not. (Hint: think about two training sets for two different boolean functions, and think about the error surfaces.)

Question 6 (10 pts): In decision tree learning, is it possible that checking with a certain attribute results in zero information gain? Explain why or why not.

Question 7 (10 pts): Redundancy in the input samples is necessary for unsupervised learning algorithms to extract meaningful structure from the input samples. Explain why this is the case, using the following example bitmap image (a), focusing on the relationship between (1) dependence of pixel values at neighboring locations (e.g., A and B), (2) structure in the image, and (3) redundancy in the image. (Hint: compare the two images b and c, below, and think about which one has more pixel-wise dependence, redundancy, structure, and think which input would be better for unsupervised learning.)



(a) (b) (c)

Question 8 (10 pts): What are the quantitative error measures for SOM and explain how they relate to the properties/capabilities of SOM learning.

Question 9 (10 pts):

In a two-layer backpropagation network (inputs x and y, one hidden layer, and one output layer), (1) what is the smallest number of hidden units needed to correctly learn to classify the following input set? (2) Explain your rationale. (Hint: plot the table below in x-y plane).

x	y	target
4	5	+
7	5	−
3	0	−
6	1	−
7	5	−
8	8	−
2	9	−
4	7	−
5	5	+
9	4	−
5	4	+
4	4	+
1	2	−
7	9	−

4 Sensorimotor Learning

Question 10 (10 pts): Neural spikes can be decoded using the Bayes rule: $P(I|S) = \frac{P(S|I)P(I)}{P(S)}$, where I represents the input stimulus and S represents the neural spike. (1) Explain why the brain itself cannnot use this kind of method to decode the meaning of the spike S. (2) Explain how the brain itself can figure out the meaning of the spike S based on just S.