

CPSC 636 Exam#2

(4/26/12, Thursday, 9:35am–10:50am)¹

Last name: _____, First name: _____

Subject	Score
RBF	/15
Biologically inspired models	/10
Understanding the internal state	/10
Self-Organizing Maps	/15
Neurodynamics	/15
Support vector machines	/10
PCA	/10
Information-theoretic models	/10
Intrinsic semantics	/5
Total	/100

- Be as **succinct** as possible.
- Read the questions carefully to see what kind of answer is expected (*explain blah in terms of ... blah*).
- Some problems have multiple subproblems, indicated by (1), (2), etc. Solve all subproblems for full credit.
- You may reference one sheet of hand-written note.
- Calculators are allowed but may not be necessary.

¹ Instructor: Yoonsuck Choe.

1 RBF

Question 1 (8 pts): Explain why learning the linear weight (RBF layer to output layer weight) in RBF or GRBF is a one-shot process (i.e., there's no iterative weight update). Discuss the cases of RBF and GRBF separately.

Question 2 (7 pts): Explain why learning or setting the right values for the RBF center and spread is important.

2 Biologically inspired models

Question 3 (5 pts): Explain what an orientation map is and what are the properties.

Question 4 (5 pts): What kind of learning rule is used by the LISSOM algorithm?

3 Self-Organizing Maps

Question 5 (10 pts): Explain (1) the relationship between redundancy, uncertainty, and structure/organization in input and (2) how these are relevant to unsupervised learning such as SOM.

Question 6 (5 pts): What are the differences between SOM and LVQ? Explain in terms of (1) learning paradigm (supervised, unsupervised, ...) and (2) the learning rule.

4 Neurodynamics

Question 7 (5 pts): In what sense is Hopfield network learning (1) “one-shot” (i.e., no iterative adjustment) and (2) Hebbian?

Question 8 (5 pts): How do you set the input for the Hopfield network and how do you read out the output?

Question 9 (5 pts): In what sense is Hopfield network’s energy function acting like a Lyapunov function? Hint: how does the energy change over time?

5 Support vector machines

Question 10 (5 pts): Perceptron and SVM are both single layer and they depend on the linear separability of the input set for error-less learning. What is the main difference between the two? Hint: Are the solution(s) found by perceptron or SVM unique, given varying simulations conditions but the same input data set?

Question 11 (5 pts): In what sense can we say that SVM learning is constrained optimization? Hint: first discuss what is the cost function (to be minimized) and what is(are) the constraint(s).

6 PCA

Question 12 (10 pts): Explain the relationship between PCA and Hebbian learning.

7 Information-theoretic models

Question 13 (10 pts): In ICA, the goal is to find a demixing matrix so that the resulting outputs are maximally independent from each other. Explain why non-Gaussianity can be a good measure of independence. Hint: This is related to the central limit theorem and the fact that the original sources are assumed to be independent.

8 Intrinsic semantics

Question 14 (5 pts): Explain how the brain can understand what its spikes mean, without peeking outside of the brain.