

# CPSC 636 Exam#2

(4/26/12, Thursday, 9:35am–10:50am)<sup>1</sup>

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
<b>Total</b>	<b>/100</b>

- 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.

---

<sup>1</sup> 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.