# CompSci 182 / CogSci 110 / Ling 109
## **Midterm Examination, Spring 2005**
Profs. Jerome Feldman, Srini Narayanan

Name: _____ SID: _____ Section: _____

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
|---|---|---|---|---|---|---|---|---|
| Score | | | | | | | | /50 |

1. (10 points total)

   (a) i. (3 pts) Why is Hebbian learning not a complete story for how we learn generally?
   ii. (2 pts) How does it work biologically?

   (b) i. (3 points) Why is backprop a highly effective learning mechanism?
   ii. (2 points) Why is it a bad model of biological learning?

**Students in the Computation option SKIP this question**

2. (10 points total) Consider the sentences

   (a) Jan sold the book to Pat for 10 dollars.

   (b) Jan bought the book from Pat for 10 dollars.

   (a) (6 Points) Describe the frame semantics of the concepts *sell* and *buy*, as exemplified by the sentence above. List any semantic roles, constraints that apply to them, and role bindings for the input sentences.

   (b) (4 Points) b) Use your frame to illustrate the difference between *buy* and *pay*.

**Students in Computational option DO this question**

3. (10 points total)

   (a) (6 points) Consider the following pseudo-code for the standard backpropagation algorithm that performs per-pattern training.

```
while (n <= maxEpochs) {
   if (currentError <= errorCriterion) {
      done
   }
   else {
      for each training pattern {

         feedfoward()                          (1)

         for each node at output layer         (2)
            computeWeightChange()

         for each node at hidden layer         (3)
            computeWeightChange()

         for each node at output layer         (4)
            updateWeights()

         for each node at hidden layer         (5)
            updateWeights()

      }

      currentError = computeError()            (6)

      n = n + 1;
   }
}
```

   A standard modification to the backpropagation algorithm is the addition of a *momentum* term.

   i. (3 points) Why use a momentum term?

   ii. (3 points) Which one(s) of the labelled segments in the code would have to change to incorporate the momentum term (Mark the changes in the pseudo-code above; you may make up one new function if you need to)

   (b) (4 points) In *abstract terms,* explain how computational power in a neural network is augmented by the addition of each hidden layer. Assume a sigmoid function. Note that you may give examples for clarification, but they are not sufficient.

4. (10 points total)

   (a) (6 points) Give an image schema analysis of the following examples. Indicate the trajectors, landmarks and other schema roles. You can either give a diagram or a feature structure. In either case, show the appropriate role bindings.

   - ”out of” as in ”The syrup splled out of the can”
   - ”through” as in ”Jack ran through the room”

   (b) (4 points) Give a force dynamic analysis for the following example. Indicate the interacting entities and and draw the force situation being depicted.

   - *let* in “The professor let the students enter”.

5. (10 points total) Consider the following concepts:

   - stroll
   - fish
   - furniture

   (a) (4 points) Discuss for each concept whether it is a basic-level, superordinate or subordinate category. Support your answers with relevant criteria.

   (b) (6 points) How do you think these concepts are embodied in the neural circuitry of the brain? What evidence is there on this?

6. (10 points total) Briefly justify your answers

   (a) (2 points) Why was the color story important in the development of Cognitive Science?

   (b) (2 points) What are mirror neurons in monkeys and why are the important for Cognitive Science?

   (c) (2 points) Could Regier's system learn the relation "larger than"? Why or why not?

   (d) (2 points) Briefly describe an experiment that illustrates spreading activation in language processing.

   (e) (2 points) What are triangle nodes in connectionis models?