

Homework #2

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RELEASE DATE: 10/03/2011

DUE DATE: 10/17/2011, BEFORE THE END OF CLASS

Unless granted by the instructor in advance, you must turn in a printed/written copy of your solutions (without the source code) for all problems. For problems marked with (), please follow the guidelines on the course website and upload your source code and predictions to designated places.*

Any form of cheating, lying, or plagiarism will not be tolerated. Students can get zero scores and/or fail the class and/or be kicked out of school and/or receive other punishments for those kinds of misconducts.

Discussions on course materials and homework solutions are encouraged. But you should write the final solutions alone and understand them fully. Books, notes, and Internet resources can be consulted, but not copied from.

Since everyone needs to write the final solutions alone, there is absolutely no need to lend your homework solutions and/or source codes to your classmates at any time. In order to maximize the level of fairness in this class, lending and borrowing homework solutions are both regarded as dishonest behaviors and will be punished according to the honesty policy.

You should write your solutions in English with the common math notations introduced in class or in the problems. We do not accept solutions written in any other languages.

2.1 No Free Lunch

- (1) (5%) Do Exercise 1.7(a) of LFD.
- (2) (5%) Do Exercise 1.7(b) of LFD.
- (3) (5%) Do Exercise 1.7(c) of LFD.
- (4) (5%) Do Exercise 1.7(d) of LFD.
- (5) (5%) Do Problem 1.9(b) of LFD.
- (6) (5%) Do Problem 1.9(c) of LFD.
- (7) (5%) Do Problem 1.9(d) of LFD.
- (8) (5%) Do Problem 1.9(e) of LFD.

2.2 Multiple Coins and Bins

- (1) (5%) Do Exercise 1.10(a) of LFD.
- (2) (10%) Do Exercise 1.10(b) of LFD.
- (3) (10%) Do Exercise 1.10(c) of LFD.
- (4) (10%) Do Exercise 1.10(d) of LFD.
- (5) (5%) Do Exercise 1.10(e) of LFD.

2.3 Learning Games

- (1) (5%) Do Exercise 1.11(a) of LFD.
- (2) (5%) Do Exercise 1.11(b) of LFD.
- (3) (5%) Do Exercise 1.11(c) of LFD.

- (4) (5%) Do Exercise 1.11(d) of LFD.
- (5) (10%) Do Exercise 1.12 of LFD by providing a convincing explanation.

2.4 Noisy Target

- (1) (5%) Do Exercise 1.13(a) of LFD.
- (2) (5%) Do Exercise 1.13(b) of LFD.

2.5 Adaptive Perceptron Learning (*)

- (1) (15%) Do Problem 1.4(a) of LFD.
- (2) (15%) Do Problem 1.4(b) of LFD.
- (3) (15%) Do Problem 1.4(c) of LFD.
- (4) (15%) Do Problem 1.4(d) of LFD.
- (5) (20%) Run the algorithm with $\eta = 1$ and $\eta = 0.01$ and $\eta = 0.0001$ on the following set for training:

http://www.csie.ntu.edu.tw/~htlin/course/ml11fall/data/hw2_train.dat

From the three hypothesis obtained, pick the one with minimum E_{i_n} as the “best.” If there are multiple best choices, pick the one that comes from the smallest η . **Report the η that corresponds to the best hypothesis in your homework.** Then, use the best hypothesis to predict the label of each example within the following test set:

http://www.csie.ntu.edu.tw/~htlin/course/ml11fall/data/hw2_test.dat

Submit your predictions to the designated place (to be announced on the course website)—*note that you can only submit once.*

2.6 Bonus or Bogus?

- (1) (Bonus 10%) The following news appeared a couple days ago about a challenging prediction task:
http://tw.nextmedia.com/rnews/article/SecID/105/art_id/77044/IssueID/20110928
 We can form the task as a learning problem. In particular, consider learning with one single example

$$\mathbf{x}_1 = (5, 3, 2), y_1 = 151022$$

to get a hypothesis. Then, when given a test example $\mathbf{x} = (7, 2, 5)$, we want to use the hypothesis to predict its associated label y . In the following news,

<http://www.youtube.com/watch?v=IZ96DeENnFQ>

there is a hypothesis

$$g(\mathbf{x}) = x_1 \cdot x_2 \cdot 10000 + x_1 \cdot x_3 \cdot 100 + x_1 \cdot x_2 + x_1 \cdot x_3 - x_2$$

that was claimed to be “the” correct answer that can be discovered by only 2% of the population on earth. The hypothesis leads to $g((7, 2, 5)) = 143547$. Do you think 143547 is the correct answer? Do you think g is close to the underlying truth f ? Do you think the distinguished 2% really learned something? Why or why not?