Homework 1
MLE, MAP estimates; Linear and Logistic Regression

CMU 10-701: Machine Learning (Spring 2017)

OUT: Jan 31
DUE: Feb 10, 11:59 PM
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Part A: Multiple Choice Questions

1. For each case listed below, what type of machine learning problem does it belong to?

   (a) Advertisement selection system, which can predict the probability whether a customer will click on an ad or not based on the search history.
   Answer:

   (b) U.S post offices use a system to automatically recognize handwriting on the envelope.
   Answer:

   (c) Reduce dimensionality using principal components analysis (PCA).
   Answer:

   (d) Trading companies try to predict future stock market based on current market conditions.
   Answer:

   (e) Repair a digital image that has been partially damaged.
   Answer:

   Type of machine learning problem:

   A. Supervised learning: Classification

   B. Supervised learning: Regression

   C. Unsupervised learning

2. For four statements below, which one is wrong?

   A. In maximum a posterior (MAP) estimate, data overwhelms the prior if we have enough data.

   B. There are no parameters in non-parametirc models.

   C. $P(X \cap Y \cap Z) = P(Z|X \cap Y)P(Y|X)P(X)$.

   D. Compared with parametric models, non-parameter models are flexible, since they don't make strong assumptions.

   Answer:

3. There are about 12% people in U.S. having breast cancer during ehir lifetime. One patient has a positive result for the mdeical test. Suppose the sensitivity of this test is 90%, meaning the test will be positive with probability 0.9 if one really has cancer. The false positive is likely to be 2%. Then what is the probability this patient actually having cancer based on Bayes Theorem?
   A. 90% B. 61% C. 38% D. 11%
   Answer:

4. What is the most suitable error function for gradient descent using logistic regression?

A. The negative log-likelihood function

B. The number of mistakes

C. The squared error

D. The log-likelihood function

Answer:

Part B, Problem 1: Bias-Variance Decomposition

Part B, Problem 2: Linear Regression

Part B, Problem 3: MLE, MAP and Logistic Regression

Part B, Problem 3: Programming Exercise