Korea Advanced Institute of Science and Technology

School of Electrical Engineering

EE488 Introduction to Machine Learning Spring 2018

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**Homework 4**

1. **Problem 1**
2. ***Problem 1-i***

Applying Bayesian rule, we have:

has high-grade watermelons while has high-grade watermelons, so:

is times more accessible than , hence:

Therefore, the probability that the second watermelon was bought from store equals to:

1. ***Problem 1-ii***

Let assume that

Using result of Problem 1-i:

Applying Bayesian rule:

Therefore:

Finally:

1. ***Problem 1-iii***

* Step 1: Initialize
* Step 2: Compute
* Step 3: Find
* Step 4: Assign then repeat step 2 and 3 until doesn’t change much

1. **Problem 2**
2. ***Problem 2-i***

The log likelihood :

The first term is given as:

The second term can be expressed by using :

1. ***Problem 2-ii***

Let

is the probability of class 1 in data set *D*

* Expectation step
* Maximization step

1. **Problem 3**
2. ***Problem 3-i***
3. ***Problem 3-ii***

Let fix . We must maximize

Now is held fixed and maximize with respect to .

It causes the lower bound to increase, unless it is already maximum, which will cause the corresponding log likelihood to increase. Because still using the old value , hence is nonzero.

1. **Problem 4**
2. ***Problem 4-i***

The given Hidden Markov Model has two states , presenting using the fair and load die respectively. Let , presents state at the time .

Because the casino switches die with probability of irrespective of the die, state transition probability distribution is:

For the fair die, all numbers between 1 through 6 have equal probability of appearing while for the load die, . Hence, observation symbol probability distribution in state is expressed as follow:

Where stand for observation at time .

The probability that the casino starting with a fair die is , so the initial state distribution like below:



1. ***Problem 4-ii***

The probability of using the fair die at the second roll is:

1. ***Problem 4-iii***

Assume that is the sequence of states.

The probability that the casino rolls 4 at the second roll is:

1. ***Problem 4-iv***

Where



It is noticeable that the most probable sequence is

1. ***Problem 4-v***

The probability of that casino rolls 3 in 100th roll is:

1. ***Problem 4-vi***

Applying Bayesian rule:

Hence:

1. ***Problem 4-vii***

