**Name:**

**ID:**

**Date:**

**ITU, Computer Engineering Dept.**

**BLG527E, Machine Learning HW1**

**Due: October 17, 2019, 23:00 through Ninova. NO LATE SUBMISSION WILL BE ACCEPTED. DO NOT SUBMIT THROUGH E-MAIL.**

# Instructors: Yusuf Yaslan (yyaslan@itu.edu.tr)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Q1 | Q2 | Q3 | Q4 | Q5 | Total |
| Grade | Max | 1 | 1 | 1 | 1 | 1 | 5 pts |
| Expected |  |  |  |  |  |  |

**Grading: You must complete the table below according to what you expect to get out of each question. At the beginning of your report you should give the following table.**

# Policy:

# Please do your homeworks on your own. You are encouraged to discuss the questions with your class mates, but the code and the hw you submitted must be your own work. Cheating is highly discouraged for it could mean a zero or negative grade from the homework.

# If a question is not clear, please let me know (via email or in class). Unless we indicate otherwise, do not use libraries for machine learning methods. When in doubt, email me.

There will be 5 homeworks this term. Each hw is worth 5 points and each question will be evaluated on a 0/1 basis.

**Q1)**

**Make sure that you read Appendix A of the textbook and the resources on matrices, linear algebra and probability and statistics on Ninova.**

Given the table of joint probabilities between two discrete random variables X and Y evaluate:

**Q1a)** P(X=1|Y=0)

**Q1b)** Are X and Y independent random variables, why or why not?

|  |  |  |  |
| --- | --- | --- | --- |
|  | X=-1 | X=0 | X=1 |
| Y=-1 | 0.2 | 0.1 | 0.05 |
| Y=0 | 0.15 | 0.3 | 0.20 |

**Q1c)** What is the expected value of 5\*X + 3\*Y\*Y?

**Q2)** Do this exercise in matlab/python/C/java. Submit your code in ninova with instructions on how to run it.

**Q2a)**Given the following data points, compute least squares regression line that passes through them.

**Q2b)**What are your predictions for x=-3, x=5?

**Q2c)** Compute the least squares model for a polynomial of degree 4 and compare the variances of the linear and degree 4 polynomial model by leaving one data point out at a time.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **t** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **x(t)** | **0.2** | **0.5** | **0.4** | **0.7** | **0.8** | **0.9** | **1.0** |
| **y(t)** | **0.0** | **0.4** | **0.5** | **0.6** | **0.7** | **0.9** | **1.1** |

**Q3)** A secret government agency has developed a scanner which determines whether a person is a terrorist. The scanner is fairly reliable; 95% of all scanned terrorists are identified as terrorists, and 95% of all upstanding citizens are identified as such. An informant tells the agency that exactly one passenger of 100 aboard an airplane in which you are seated is a terrorist. The agency decides to scan each passenger and the shifty looking man sitting next to you is the first to test positive. What are the chances that this man is a terrorist?

**Q4)** For a novel input x, a predictive model of the class c is given by p(c=1|x) = 0.7, p(c=2|x) = 0.2, p(c=3|x) = 0.1. The corresponding utility matrix U(ctrue,cpred) has elements:

In terms of maximal expected utility, which is the best decision to take?

(Hint: Read 3.3 Losses and Risks from Ethem Alpaydın’s book)

**Q5)** a)A continuous random variable x has the Laplace distribution

* Plot
* What is the probability that x > 2?

b) A discrete random variable has the binomial distribution

What is the E[x] = ? and E[x2] = ? Show their derivations step by step.