

Name:

ID:

Date:

ITU, Computer Engineering Dept.

BLG527E, Machine Learning, Oct 11, 2013, HW3

Due: October 23, 2013, 22:00 through Ninova.

Instructors: Zehra Cataltepe (cataltepe@itu.edu.tr), Sinan Sarac (ssarac@itu.edu.tr)

Grading:

Please complete the table below according to what you expect to get out of each question.

Time spent row will not affect your grade in any way. It is there for me and you to see how much time is spent on what topic.

		Q1	Total
Grade	Max	5	5 pts
	Expected		
Time Spent	Reading& Understanding		
	Coding		
	Running Program		
	Writing Report		

Policy:

You are encouraged to have a group mate for each project. If you prefer, you can do your homework on your own. You and your group mate work together and submit a single report and get the same grade. So, it is crucial that you communicate with each other. **For each homework you should have a different group mate.**

Collaboration in the form of discussions is acceptable, but you should write your own answer/code by yourself (and your group mate). 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, during office hour or in class).

Unless I indicate otherwise, do not use libraries for machine learning methods.

When in doubt, email me.

Each hw will be evaluated on a 0/1 basis.

There will be a total of 11 hws, your top 8 homeworks (each worth 5 points) will be used to compute the 40% of your grade from the course.

In order to be able to take the final exam for BLG527E you have to have a **weighted average score of 30 (over 100) for midterm and homeworks.** Otherwise you will get a VF from the course.

Make sure that you read Chapters 4 and 5 of the textbook.

Q1) [Ch5] [5 point]

Optical character recognition (OCR) is the automated conversion of scanned images of handwritten or printed text into machine-coded text and it is an important problem in machine learning. Your mission in this homework, should you choose to accept it, is to formally **compare the performance of the multivariate classification approach** under two **different assumptions** for the

covariance matrices. Should you or any member of your homework group is caught red handedly **using the test or validation fold in training**, we (your instructors) will disavow any knowledge of your attendance in BLG527. This word document will self-destruct in ...

Seriously,

You will compare two **multivariate classifiers** under the assumptions:

1. **Shared, diagonal covariance matrices** ($\mathbf{S}_i = \mathbf{S}$, with $s_{ij} = 0$).
2. **Full covariance matrices and different for each class**.

By this time you already know that there is no best method for all problems. So we can only talk about the performance for a specific problem. In this case our **test-bed** will be Optical Recognition of Handwritten Digits Data Set:

<http://archive.ics.uci.edu/ml/datasets/Optical+Recognition+of+Handwritten+Digits>

Specifically you'll need **optdigits.tra** (training set) and **optdigits.tes** (test set) files from the data folder. Both of them are CSV files where first 64 columns are features (integers in range 0..16) and the last column (65th column) is the class label (ten possible classes with labels 0..9). You can check **optdigits.names** file for a more detailed explanation of the dataset.

You will perform a **10-fold cross validation on the training set** and compare the two classifiers with an **appropriate test**. Specifically you need to determine if the **two methods perform significantly different with 95% confidence**. You should **choose** the **appropriate statistical test** for this setup.

Your **measure of performance** will be the **accuracy**.

$$accuracy = \frac{\text{\# of Correctly Classified Samples}}{\text{\# of Total Classified Samples}}$$

Then you should test the classifiers with the test set (optdigits.tes). **Check how well your accuracy estimates from 10-fold cross validation generalized to the test**. Discuss your findings in your report.

You can implement in C, Java, Python, Matlab or R.

You should submit a report along with your code. Your report should include:

- **Table of results of your 10-fold cross validation** for both methods.
- **A confusion matrix for the test set evaluation**. Since you are performing a 10-class classification, it will be a 10x10 matrix.
- Result of your **significance test** along with a short discussion of why you have chosen that specific test. You should report your **p-value**.

Good Luck and İyi bayramlar, Eid Mubarak, Bonne fete, Alles gute zum Opferfest, Feliz eid, etc.

Sinan, Zehra