ECE 6376 – Pattern Recognition
Spring 2016
Course Project

Instructions

1. Read and follow the instructions carefully. By submitting your project, you indicate that you have read and followed these instructions.
2. The project will entail setting up and validating a pattern recognition system (both feature extraction and classification) for a high dimensional dataset.
3. Some parts of the project require using code you have already written for homework assignments – for these parts, you must use the code you wrote for the corresponding homework submission – no other code will be considered during grading.
4. Some parts of the project may involve validating advanced algorithms – for these algorithms, you may use code available in a public toolbox such as PRTools or existing MATLAB provided functions for these algorithms. ***You may only use external Matlab code for tasks that are clearly indicated as such in the project assignment.***
5. For advanced problems wherein you need to utilize an external toolbox or existing Matlab functions for these algorithms, you will be assigned a team member – you are encouraged to work in teams to solve problems related to "advanced" algorithms in instruction 4 above – specifically, the team-work can involve discussing and debugging the code, understanding the algorithm and the code and discussing how it can be applied for pattern recognition. No other collaboration is permitted – once you have the advanced algorithms working, you must apply them to the project dataset yourself without any collaboration.
6. No collaboration whatsoever for other all other tasks.
7. Your project deliverable will be a professionally written report that summarizes the literature, your approach and the key results, as well as conclusions, in a standard IEEE template. You must write your own report without any collaborations. You must provide clearly labeled figures and plots as appropriate. You will be required to submit the Matlab code for your project as a zip file as well.
8. The project is due on Wednesday, May 3, 2016 by 9am. Late submissions will not be accepted.
9. The dataset provided to you is solely for use in this project.

Write your name and sign below to indicate you have read and followed these instructions. This cover sheet must be attached to your project.

Name

Signature

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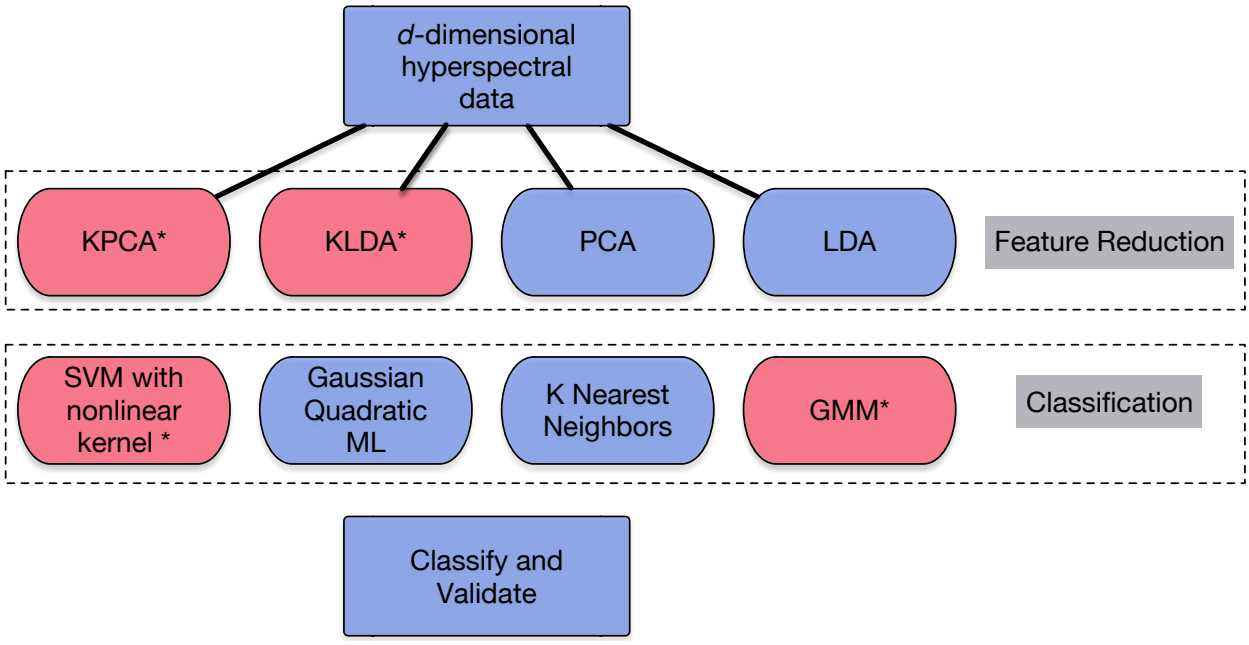
The dataset: You have been provided with a hyperspectral dataset for this project. The samples in the dataset are pixels from a hyperspectral image. Hyperspectral images are data-cubes of size *m* by *n* by *d*, where *m* and *n* are spatial dimensions of the image, and *d* is the number of spectral channels in the image (e.g. in traditional color images, *d*=3). We have extracted pixels (samples) from a hyperspectral image for this project, and the data that is being provided to you has two components:

- Training data (of size: 750 samples/pixels by 144 channels/dimensions)
- Testing data (of size: 12197 samples/pixels by 144 channels/dimensions)

Your task is to setup and validate pattern recognition systems (including feature extraction, and classification) that use training data (samples/pixels) to learn the models (e.g. feature extraction projections, classifier models etc.), and apply them to classify testing data (samples/pixels). Since pixels have already been extracted and assigned to training and test data, your raw (input) feature space will be a *d*-dimensional space representing the spectral response across the *d*-channels, and all training and test pixels will reside in this space.

The problem: You are required to read in the dataset, apply a feature reduction algorithm, classify the data and validate the results, as indicated in the diagram below. You must ***report results with each combination of feature reduction and classification algorithm***.



Algorithms shaded in blue: must be implemented and validated individually - no collaboration is permitted during coding and validating these methods. For algorithms that were part of a homework submission, your homework submission will be reviewed – points will be deducted for each method that was not implemented and submitted as homework.

Algorithms shaded in salmon color (and starred): may be implemented and validated in teams of two – your team partner has been assigned to you by me. Your collaboration can include

discussing the algorithm details from the text and any relevant literature, understanding and discussing the code/documentation and trying to debug any issues you may face during implementation – no collaboration is allowed to generate accuracies and report and explain your results - that must be an individual effort. Additionally, for the algorithms shaded in salmon (and starred), you may use external toolkits (including PRTools or Matlab built-in functions), but your report needs to demonstrate that you have understood the method and applied it correctly.

Choice of parameters: As you validate these methods, you will notice that the system performance (accuracy) is sensitive to the choice of parameters you use. Be sure to study performance over a range of parameters to be sure you have "tuned" the parameters appropriately, and explain your observations in the report.

Sample size: To study how well the methods perform under varying sample size, use a range of training samples, and report the accuracies corresponding to: (1) 10 samples per class, (2) 20 samples per class, (3) 30 samples per class, and (4) all available training data. In each case, use all of the available test (validation) data.

Deliverable: You must submit a typed report written in an IEEE format – you should use an IEEE template to accomplish this – it is available to download for Microsoft Word here: http://www.ieee.org/publications_standards/publications/conferences/2014_04_msw_usltr_format.doc . Your report must have the following sections:

1. Introduction – an overview of the algorithms you are studying
2. Algorithms
    a. Have a sub-section for each algorithm, and describe **in your own words** the algorithm. Include any equations necessary for describing the algorithm, and be sure to define your notations.
3. Experimental Setup – Explain your overall pattern recognition work-flow and tabulate or plot your results as appropriate.
4. Conclusions – Describe and summarize the key conclusions that can be drawn from your project.

Grading: You will be graded on the following aspects:

- Correct Matlab implementation and usage of the algorithms
- Detailed description of the experimental setup and how you set up the various algorithms, how you chose the system parameters etc.
- Timely submissions of corresponding homework assignments related to algorithms used in this project.
- Detailed reporting of the results and your observations/conclusions
- A clear and detailed explanation of the algorithms in your own words in the report.