B.Tech ICT Sem III, Monsoon 2018

Joint project outline

Subjects

- Computer Organization: Pratik Trivedi
- Linear Algebra: Ratnik Gandhi
- Signals and Systems: Mehul S Raval

TA's: Bhasha Shah, Vandit Gajjar, Harshil Shah, Jeet Trivedi, Akhil Sharma, Yash Goenka

Preamble: The purpose of the project is to develop firmware models for important transforms namely; Principal Component Analysis (PCA), Singular Value Decomposition (SVD), and Linear Discriminant Analysis (LDA). The students are expected to traverse journey from software to hardware through these projects. The aim for project is to also develop libraries of such firmware models which can be used in off the shelf mode to create projects of larger scope. The subsequent batches may improvise the hardware design and increase the size of library

Title of the projects

Problem 1 – Principal Component Analysis: The purpose of PCA is to reduce the dimensionality of a data set which consists of large number of interrelated variables, while retaining as much variation as possible in the data set.

Problem 2 – Singular Value Decomposition: It is a factorization of a real or complex matrix. It is also the generalization of the eigendecomposition to rectangular matrix. SVD is useful for pseudo inverse computation, low rank matrix approximation etc.

Problem 3 – Linear Discriminant Analysis: Like PCA it is a linear transformation technique that is used for dimensionality reduction. PCA can be described as an "unsupervised" algorithm, since it "ignores" class labels and its goal is to find the directions (the so-called principal components) that maximize the variance in a dataset. In contrast to PCA, LDA is "supervised" and computes the directions ("linear discriminants") that will represent the axes that maximize the separation between multiple classes.

Input – [32x32] gray scale image matrix (Constant)
Output – Corresponding vectors over Hardware.

Duration: 30th July 2018 to 16th November 2018
Evaluation Weight: 30% in each course (10% for mid-semester and 20% for end semester)

Team Size: 5 students (**Groups formed in the class**)

Weeks	Activity
July 30 – Aug 12	Matrix Multiplication and Signals as vectors
Aug 13 – Aug 26	Eigenvalues and Eigenvectors / Complex exponential as Eigen function.
Aug 27 – Sept 7	Principal Component / LDA / SVD concepts
Sept 17 – Sept 29	Matlab Scripting + Comparison with inbuilt functions of PCA, SVD and LDA
Oct 1	**Midterm Evaluation (10% Weight)** Presentation 10 Mins. and 2 page Latex report
Oct. 8 – Oct. 21	Behavioral Simulation + Synthesis Result
Oct. 22 – Oct. 28	Post route Simulation Results + Matlab Scripting
Oct. 29 – Nov. 15	Basic Implementation + Matlab Simulation + Comparison of Mean Square Error(MSE) between hardware and computed components.
12 - 16 Nov.	**Final Submission:** (**20% Weight**) Working Model Implementation on FPGA, Simulations and comparison in hardware and software. Team Presentation (15 Mins.), Report(5 page) and Demonstration in lab

Evaluation Criteria: Implementation efforts, Results and analysis, presentation, report, Initiatives in the implementation

Format of Latex Report

2 column format
Title of the project
Group member names and ID's
Abstract: 150 words max
Keywords: (3 to 5)
Section I Introduction about the problem
Section II Literature review
Section III Results of simulation through scripting and inbuilt Matlab functions. Compare the approaches

Section IV Conclusion
References

Format for presentation
Title slide with group number, members name and ID
Introduction
Existing approaches
Results
References

References

I.T. Jolliffe, Principal Component Analysis, Springer, 2nd Edition.
Online:
http://cda.psych.uiuc.edu/statistical_learning_course/Jolliffe%20I.%20Principal%20Component%20Analysis%20%282ed.,%20Springer,%202002%29%28518s%29_MVsa_.pdf

Golub and Van Loan, Matrix Computation, 3/e, John Hopkins University Press,
Online:
http://web.mit.edu/ehliu/Public/sclark/Golub%20G.H.,%20Van%20Loan%20C.F.-%20Matrix%20Computations.pdf