Principal Components Analysis (PCA) and Robust PCA for Modern Datasets: Theory, Algorithms, and Applications

Overview

In today's big and messy data age, there is a lot of data generated everywhere around us. Much of it is streaming data that cannot be stored for too long. Examples include texts, tweets, network traffic, changing Facebook connections, or video surveillance feeds coming in from one or multiple cameras. Before processing any big dataset, the first step is to perform dimension reduction and noise/outlier removal. The most popular way to do this is via principal component analysis (PCA). A popular approach to also simultaneously do noise/outlier removal is via solving the robust PCA problem. PCA is often the first step in various types of exploratory data analysis, predictive modeling, classification and clustering problems. It finds applications in biomedical imaging, computer vision, process fault detection, recommendation systems' design and many more domains. Classical PCA, without constraints, and for clean data, is a solved problem. On the other hand, robust PCA, which refers to the problem of PCA in the presence of outliers, is much harder and one for which provably correct solutions have started to appear only recently.

Moreover, when data is streaming (cannot be stored forever), standard solutions do not apply and new approaches are needed. For very long data sequences, the subspace from which the true (clean) data is generated itself changes over time. This necessitates a study of solutions for dynamic robust PCA and dynamic PCA.

(Look out for a Proceedings IEEE Special Issue to appear in August 2018 on above topics and more: http://proceedingsoftheieee.ieee.org/upcoming-issues/pca/)

Who should attend	1. You would like to get introduced to recent and ongoing research in statistical Machine Learning, AND 2. You have sufficient mathematical maturity (have taken at least an undergraduate level course in linear algebra and probability) **Typical Audience** - M.Tech or Ph.D. student in Mathematics or Applied Mathematics, Statistics, Computer Science or Communications and Signal Processing (within Electrical / Electronics Engineering deptt.) - Faculty member or lecturer or industry researcher in above areas - An enthusiastic and mathematically mature final year B.Sc or B.Tech student with sufficient background **For a sampler of some of above topics, see** http://www.ece.iastate.edu/~namrata/MachineLearning_class/
Modules	Dates: December 18, 2017 to December 22, 2017 A. Mathematical background (recap): probability, linear algebra, basic optimization concepts – DAY 1 B. Introducing PCA and Robust PCA along with Applications – DAY 1 C. Robust PCA and Dynamic Robust PCA solutions – DAY 2 D. Streaming PCA and PCA with speed and memory constraints – DAY 3 E. Finite Sample Guarantees for B, C, D. – DAY 3 and 4 - Mathematical Preliminaries: advanced linear algebra, random matrix theory, - This module will include a discussion of the correlated-PCA problem
Fees	The participation fees per person for attending the course is as follows: **Participants from abroad : US $300** **Industry/ Research Organizations: Rs. 6000/-** **Academic Institutions:** **Students: Rs. 2000/- (For SC/ST students course fee is Rs. 800/- only)** **Non-Students: Rs. 4000/-** **For five days Lunch, each participant will be charged Rs. 750/- only in addition to the course fees.** The above fees include all instructional materials and free internet facility.

The Faculty

Namrata Vaswani received a B.Tech. from the Indian Institute of Technology (IIT-Delhi), in 1999 and a Ph.D. from the University of Maryland, College Park, in 2004, both in Electrical Engineering. During 2004-05, she was a postdoc and research scientist at Georgia Tech. Since Fall 2005, she has been with the Iowa State University where she is currently a Professor of Electrical and Computer Engineering and a courtesy Professor of Mathematics. Her research interests lie at the intersection of statistical Machine Learning, signal and information processing, and computer vision and bio-imaging. Her most recent work has been on provably correct and practically useful algorithms for dynamic robust PCA, dynamic compressive sensing, and structured phase retrieval.

Prof. Vaswani has served one term as an Associate Editor for the IEEE Transactions on Signal Processing (2009-2012) and is currently serving her second term. She is also the lead guest editor for a forthcoming Proceedings IEEE Special Issue on Rethinking PCA for Modern Datasets (to appear in August 2018). Vaswani is a recipient of the Harpole-Pentair Assistant Professorship at Iowa State (2008-09), the Iowa State Early Career Engineering Faculty Research Award (2014) and the IEEE Signal Processing Society Best Paper Award (2014) for her Modified-CS paper (IEEE Trans. Sig. Proc. 2010).

Anubha Gupta received her B.Tech and M.Tech from Delhi University, India in 1991 and 1997 in Electronics and Communication Engineering. She received her PhD. from Indian Institute of Technology (IIT), Delhi, India in 2006 in Electrical Engineering. She did her second Master's as a full time student from the University of Maryland, College Park, USA from 2008-2010 in Education with concentration: Higher Education Leadership and Policy Studies. She worked as Assistant Director with the Ministry of Information and Broadcasting, Govt. of India (through Indian Engineering Services) from 1993 to 1999 and, as faculty at NSIT-Delhi (2000-2008) and IIIT-Hyderabad (2011-2013), India. Since Dec. 2013, she is working as Associate Professor at IIIT-Delhi. Apart from this, she worked in USA from 2009 to 2011- first as a researcher (in education) at University System of Maryland in the office of Associate Vice-Chancellor, Academics, and later as Director of Assessment in the office of the Provost at Bowie State University, Maryland, USA. Her current research interests include biomedical signal and image processing including fMRI, MRI, EEG, ECG signal processing, genomics signal processing in cancer research, Wavelets in deep learning, wavelet transform and applications, and signal processing for communication engineering.

Dr. Gupta is a senior member of IEEE Signal processing Society and a member of IEEE Women in Engineering Society. She is an expert member of ECE for National Board of Accreditation (NBA), India responsible for the accreditation of UG and PG programs of Engineering in India. She has been working as UG Program Chair at IIIT-Delhi since July 2016. Dr. Gupta hosted a symposium (along with Dr. Selin Aviyente, MSU and Dr. Namrata Vaswani, ISU) on "Big Data Analysis and Challenges in Medical Imaging" at IEEE GlobalSIP 2016 held in Washington DC, USA from Dec. 7 - 9, 2016.

Course Coordinator

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For Registration:

For more details: