APPLIED LINEAR ALGEBRA FOR SIGNAL PROCESSING, DATA ANALYTICS AND MACHINE LEARNING

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TYPE OF COURSE : New | Both | UG/PG
COURSE DURATION : 12 Weeks (18 Jan’ 21 - 09 Apr’ 21)
EXAM DATE : 25 Apr 2021

INTENDED AUDIENCE :
• Students in Electrical Engineering, Electronics and Communication Engineering, Mathematics, Economics, Computer Science
• Practicing engineers
• Technical and Non-technical managers of Telecomm companies
• Students preparing for Competitive Exams with focus on Wireless Communication, Signal Processing, Machine Learning
• Students pursuing projects or research in Machine Learning, Data Analytics and Signal Processing/ Communication

INDUSTRIES APPLICABLE TO : Qualcomm, Intel, Samsung, Google and other technology companies

COURSE OUTLINE :
This course aims to introduce students to all the basic and advanced concepts in Linear Algebra with a strong focus on applications. Linear Algebra is one of the fundamental tools that has applications in diverse fields such as Machine Learning, Data Analytics, Signal Processing, Wireless Communication, Operations Research, Control and Finance. The course is suitable for all UG/PG students and practicing engineers/ scientists/ managers from the diverse fields mentioned above and interested in learning about the novel cutting edge applications of linear algebra in various fields such as Machine Learning, Data Analytics, Signal Processing, Wireless Communication.

ABOUT INSTRUCTOR :
Prof. Aditya K. Jagannatham received his Bachelors degree from the Indian Institute of Technology, Bombay and M.S. and Ph.D. degrees from the University of California, San Diego, U.S.A. From April ’07 to May ’09 he was employed as a senior wireless systems engineer at Qualcomm Inc., San Diego, California, where he was a part of the Qualcomm CDMA technologies (QCT) division. He was awarded the CAL(IT)2 fellowship at the University of California San Diego and the Upendra Patel Achievement Award at Qualcomm.

COURSE PLAN :
Week 1: Introduction to vectors, properties and applications
Week 2: Introduction to matrices and Applications Circuits, Graphs, Social Networks, Traffic flow
Week 3: Eigenvalue decomposition, properties and Applications Principal component analysis (PCA), Eigenfaces for facial recognition
Week 4: Singular value decomposition (SVD) and Applications Beamforming in MIMO, Dimensionality reduction, Rate maximization in wireless, MUSIC algorithm
Week 5: Linear regression and Least Squares. Applications: System identification, linear regression, Support vector machines (SVM), kernel SVMs
Week 6: Optimal linear MMSE estimation. Applications MMSE Receiver, Market prediction and forecasting, ARMA models
Week 7: Data analytics: Recommender systems, user rating prediction, NETFLIX problem
Week 8: Structure of FFT/ IFFT matrices, properties, System model for OFDM/ SC-FDMA, Signal processing in OFDM systems
Week 9: Modeling of Dynamical systems Examples: Robots, Chemical plants. Solution of autonomous linear dynamical systems (LDS), solution of with inputs and outputs
Week 10: Unsupervised learning: Centroid based clustering, probabilistic model based clustering and EM algorithm
Week 11: Linear perceptron. Training a perceptron stochastic gradient. Compressive sensing, orthogonal matching pursuit for sparse signal estimation
Week 12: Discrete time Markov chains Applications: supply chain management, forecasting, Operations research resource and inventory management.