APPLIED OPTIMIZATION FOR WIRELESS, MACHINE LEARNING, BIG DATA

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TYPE OF COURSE : Rerun | Core | UG/PG
COURSE DURATION : 12 weeks (20 Jul' 20 - 9 Oct' 20)
EXAM DATE : 17 Oct 2020

PRE-REQUISITES : Basic knowledge of - Calculus, Probability, Matrices

INTENDED AUDIENCE : Intended audience -Students in Electrical Engineering, Electronics and Communication Engineering, Mathematics, Economics, Computer Science

INDUSTRIES APPLICABLE TO : Most companies in Electronics, Communication and Signal Processing. Examples are Qualcomm, Broadcom, Intel, MediaTek, Samsung etc. Companies in Machine Learning, AI, Big-Data and Finance will also find the content useful

COURSE OUTLINE :
This course is focused on developing the fundamental tools/ techniques in modern optimization as well as illustrating their applications in diverse fields such as Wireless Communication, Signal Processing, Machine Learning, Big Data and Finance.

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 worked on developing 3G UMTS/WCDMA/HSDPA mobile chipsets as part of the Qualcomm CDMA technologies division.

COURSE PLAN :

Week 1**:** Introduction to properties of Vectors, Norms, Positive Semi-Definite matrices, Gaussian Random Vectors

Week 2**:** Introduction to Convex Optimization – Convex sets, Hyperplanes/ Half-spaces etc. Application: Power constraints in Wireless Systems

Week 3**:** Convex/ Concave Functions, Examples, Conditions for Convexity. Application: Beamforming in Wireless Systems, Multi-User Wireless, Cognitive Radio Systems

Week 4**:** Convex Optimization problems, Linear Program, Application: Power allocation in Multi-cell cooperative OFDM

Week 5**:** QCQP, SOCP Problems, Application: Channel shortening for Wireless Equalization, Robust Beamforming in Wireless Systems

Week 6**:** Duality Principle and KKT Framework for Optimization. Application: Water-filling power allocation, Optimization for MIMO Systems, OFDM Systems and MIMO-OFDM systems

Week 7**:** Optimization for signal estimation, LS, WLS, Regularization. Application: Wireless channel estimation, Image Reconstruction-Deblurring

Week 8**:** Application: Convex optimization for Machine Learning, Principal Component Analysis (PCA), Support Vector Machines

Week 9**:** Application: Cooperative Communication, Optimal Power Allocation for cooperative Communication, Geometric Program

Week 10**:** Application: Cooperative Communication, Optimal Power Allocation for cooperative Communication, Geometric Program (Cont'd)

Week 11**:** Application: Radar for target detection, Array Processing, MUSIC, MIMO-Radar Schemes for Enhanced Target Detection

Week 12**:** Application: Convex optimization for Big Data Analytics, Recommender systems, User Rating Prediction, Optimization for Finance