CSE6392
Advanced Topics in Scalable Searching and Optimization
Dept. Computer Science and Engineering
Dr. Junzhou Huang

[Administrative Basics | Course Description | Outline of Lectures]

Administrative Basics

Lecture	GS 233 | Friday 4:00-6:50 PM
Instructor	Junzhou Huang | ERB 650 | Office hours: Tu& Th 2:00-3:30 PM
Request	Basic math and programming background; Basic learning and vision background preferred
Textbook	None

Course Description

This course will provide an overview of the current state-of-the-art of big data searching techniques in computer vision, machine learning and data mingearning by studying a set of cutting-edge advanced topics in these areas. Several selected research topics reflect the current state in these fields. The main objective of this course is to review cutting-edge searching& learning research in big data through lectures covering the underlying statistical & mathematical concepts and representative algorithms, paper reading, and implementation. The instructor will work with students on building ideas, performing experiments, and writing papers. Students can decide to submit his/her results to a learning/mining/vision related conference, or just play with funs.

The course is application-driven and includes advacnced topics in imaging, learning and vision, such as different imaging techniques and advanced learning tools in different applications. It will also include selected topics relating to the emerging compressed sensing and sparse learning theory and techniques. The course will provide the participants with a thorough background in current research in these areas, as well as to promote greater awareness and interaction between multiple research groups within the university. The course material is well suited for students in computer science, computer engineering, electrical engineering and biomedical engineering.

Project Topics

Outline of Lectures

Week 1.	**Fri Jan 22: Introduction** Course Objectives and Administration (Slides)
Week 2.	**Fri Jan 29: Math Basics, Least Square and PCA (Slides)** M. Turk and A. Pentland, "Face recognition using eigenfaces", CVPR 1991. M. Brand, "Incremental singular value decomposition of uncertain data with missing values", ECCV 2002. D. Ross, J. Lim, R. Lin, M. Yang, "Incremental Learning for Robust Visual Tracking", International Journal of Computer Vision, 2007.
Week 3.	**Fri Feb 5: Optimization Basics and Gradient Methods (Slides)** A. Beck and M. Teboulle, "A Fast Iterative Shrinkage-Thresholding Algorithm for Linear Inverse Problems", SIAM Journal on Imaging Sciences, No. 1, pp. 183-202, 2009. A. Beck and M. Teboulle, "Fast Gradient-Based Algorithms for Constrained Total Variation Image Denoising and Deblurring Problems", IEEE Trans. Image Processing, Vol. 18, No. 11, pp. 2419-2434, 2009 Yurii Nesterov, "Gradient Methods for Minimizing Composite Objective Function", 2007.
Week 4.	**Fri Feb 12: Concentration Inequality** N.P. Slagle, "One Hundred Probability/Statistics Inequalities", 2012. K. Sridharan, "A Gentle Introduction to Concentration Inequalities", 2009 S. Boucheron, G. Lugosi, P. Massart, "Concentration Inequalities: A Nonasymptotic Theory of Independence", 2013.
Week 5.	**Fri Feb 19: Scalable Searching Via Hiearchical Kmean Tree (Slides)** D. Lowe, "Object recognition from local scale-invariant features", ICCV 1999. D. Nisťer and H. Stewenius, "Scalable Recognition with a Vocabulary Tree", CVPR 2006.
Week 6.	**Fri Feb 26: Scalable Searching Via Locality-sensitive Hashing (Slides)** A. Andoni and P. Indyk, "Near-Optimal Hashing Algorithms for Near Neighbor Problem in High Dimensions", FOCS 2006. Brian Kulis & Kristen Grauman , "Kernelized Locality-Sensitive Hashing for Scalable Image Search", ICCV 2009
	Fri Mar 4: Scalable Searching Via Unsupervised Hashing (Slides)

Week 7.	Y. Gong and S. Lazebnik, "Iterative Quantization: A Procrustean Approach to Learning Binary Codes", CVPR 2011. W. Liu, J. Wang, S. Kumar and S. Chang, "Hashing with Graphs", ICML 2011.
Week 8.	**Fri Mar 11:** **Scalable Searching Via Semi-supervised and Supervised Hashing (Slides)** J. Wang, S. Kumar and S.-F. Chang, "Semi-Supervised Hashing for Scalable Image Retrieval", CVPR 2010 W. Liu, J. Wang, R. Ji, Y. Jiang, and S. Chang, "Supervised Hashing with Kernels", CVPR 2012
Week 9.	**Fri Mar 18: Spring Break**
Week 10.	**Fri Mar 25: Sparse Optimization (Slides)** P.L. Combettes, and J.C. Pesquet, "Proximal Splitting Methods in Signal Processing", Fixed-Point Algorithms for Inverse Problems in Science and Engineering (2011), 185-212. S. Ma, D. Goldfarb, and L. Chen, "Fixed Point and Bregman Iterative Methods for Matrix Rank Minimization", Mathematical Programming, 128 (2011), 321-53. J. Liu, S. Ji, and J. Ye. SLEP: Sparse Learning with Efficient Projections. Arizona State University, 2009.
Week 11.	**Fri Apr 1: Online Learning** Introduction of Online Convex Optimization, Elad Hazan, November 22 2015 Online Learning and Online Convex Optimization. Shai Shalev-Shwartz.Foundations and Trends in Machine Learning Online Learning for Group Lasso, Haiqin Yang , Zenglin Xu , Irwin King , Michael R. Lyu, ICML 2010
Week 12.	**Fri Apr 8: Parallel Optimization** Hogwild: A Lock-Free Approach to Parallelizing Stochastic Gradient Descent Accelerated, Parallel and PROXimal coordinate descent, O. Fercoq and P. Richtárik, December 2013 Median Selection Subset Aggregation for Parallel Inference, .X Wang, P. Peng, D. Dunson, NIPS 2014
Week 13.	**Fri Apr 15: Distributed Optimization** Distributed Basis Pursuit, J. Mota, J. Xavier, P. Aguiar and M. Püschel, 2012 Z. Peng, M. Yan, and W. Yin. Parallel and Distributed Sparse Optimization,

	Asilomar'13, 2013
Week 14.	**Fri Apr 22: Distributed Optimization** Distributed block coordinate descent for minimizing partially separable functions, J. Mareček, P. Richtárik and M. Takáč, to appear in Recent Developments in Numerical Analysis and Optimization, Springer Proceedings in Mathematics and Statistics, 2015 Communication Efficient Distributed Optimization using an Approximate Newton-type Method
Week 15.	**Fri Apr 29: Final Project Presentations**
Week 16.	**Fri May 6: Final Project Presentations**

Other Information

Americans with Disabilities Act

The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 93112 -- The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans With Disabilities Act - (ADA), pursuant to section 504 of The Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens. As a faculty member, I am required by law to provide "reasonable accommodation" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels.

Academic Integrity

It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University. "Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts." (Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22)

Grade Appeal Policy

If you do not believe a grade on a particular assignment is correct, you may appeal the grade in writing (email) within 5 class days. Grade appeals must be ppealed to the appropriate GTA firstly, then to your instructor if necessary. Please refer to the UTA Catalog for the detailed guide of grade appeals.

Student Support Services Available

The University of Texas at Arlington provides a variety of resources and programs to help you develop academic skills, deal with personal situations, better understand concepts and information related to their courses, and achieve academic success. These programs include major-based learning centers, developmental education, advising and mentoring, personal couneling, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 or visit www.uta.edu/resources for more information and appropriate referrals.

Academic Integrity
