Workshop

PVAM-TSU Collaborative Research on Big Data Analytics

Data: Jan. 31, 2019 Location: SB144, TSU

Schedule

10-10:50am: Lei Huang - *Introduction to Data Science*

11-11:50am: Mei Yang - *Optimizing Krylov Subspace Methods for Linear Systems and Least Squares Problems*

Lunch and discussion

2-2:50pm: Rasoul Hekmati - *Machine Learning to Evaluate fMRI Recordings of Brain Activity Time Series*

3 – 3:50pm: Nishath Rajiv Ranasinghe - *Sedimentary Basin Characterization using Large-N Passive Seismic Arrays*

Discussion

Abstracts and bios can be found in the following pages.

Organizers: Daniel Vrinceanu and Yunjiao Wang

Lei Huang, PhD

Associate Professor

Department of Computer Science

Prairie View A&M

Title: Introduction to Data Science

Abstract:

Data science, as a fast-spreading interdisciplinary field, is based on the theories of probability and statistics to extract valuable knowledge and insights from structured and unstructured data directly. Data science has rapidly reshaped the methodology, workflow, algorithms, and systems used in the industry and scientific community. In my research lab at PVAMU, we are currently studying how to leverage the power of data science to facilitate the computational problems. In this presentation, I will first present the fundamentals of data science with focus on the deep learning technology. I will then show our ongoing research in applying deep learning to computational problems.

Presenter's Bio:

Dr. Lei Huang is an Associate Professor in the Department of Computer Science, Prairie View A&M University (PVAMU), a member of Texas A&M University System, where he is leading research at the Cloud Computing Research Lab. He also serves as the Associate Director of Research in the Center of Excellence in Research and Education for Big Military Data Intelligence at PVAMU sponsored by Department of Defense (DoD). He is currently the Principal Investigator of multiple research projects sponsored by National Science Foundation (NSF) in the Big Data Analytics, Cloud Computing, and High Performance Computing (HPC) areas. He joined PVMAU in 2011 with research experience in HPC at the University of Houston, and working experience in seismic software R&D. Huang has earned his Ph.D. from the Computer Science Department at the University of Houston in 2006.

Mei Yang, PhD

Research Associate

University of Texas at Arlington

Title: Optimizing Krylov Subspace Methods for Linear Systems and Least Squares Problems

Abstract:

In this talk, we focus on Krylov subspace methods for linear systems and least squares problems. For linear systems, in order to reduce orthogonalization cost, memory use and to accelerate convergence speed in flexible GMRES, we proposed the heavy ball flexible GMRES method by combining the heavy ball method and the restarted flexible GMRES. Two methods are proposed

for least squares problems. One is the heavy ball minimal residual method which utilizes the restarted Golub-Kahan bidiagonalization process to incorporate the heavy ball method and the least squares minimal residual method (LSMR). In each loop, the approximate solution is sought in an extended subspace which includes the information of previous loops. To implement this method, a stable algorithm is designed to solve a reduced problem in every loop. The other one is the flexible preconditioned iterative method which is designed to find effective preconditioners in LSMR by solving normal-type equations in each inner iteration. Numerical experiments show the advantages of these three methods.

Presenter's Bio:

Mei Yang finished her Ph.D in computational mathematics in August, 2018 under the supervision of Prof. Ren-Cang Li at University of Texas at Arlington. Her research interests are numerical linear algebra, machine learning, data mining and model order reduction. She currently is a postdoc research associate at UT Arlington.

Rasoul Hekmati

University of Houston

Title: Machine Learning to Evaluate fMRI Recordings of Brain Activity Time Series

Abstract:
I will first Introduce the data set (fMRI recordings of brain activity in epileptic infants) achieved by Texas Children's Hospital. These recordings provide roughly 1500 recorded large time series mapping the activity of 1500 very small cortex patches. Then I shortly list the defined projects .e.g. Automatic Clustering, Graph Mining, Focal Focus Classification and Data Compression. Then I explain the Focal Focus Classification in detail. The ultimate goal of this project is to facilitate noninvasive localization of the epileptic focus. We have implemented several Automated Classifiers of fMRI recordings into 5 classes of patients. Here I outline how one can use a Multi-Layer Perceptron (MLP) with highly restricted number of nodes to mitigate the currently small number of diagnosed patients. Drastic selection of pairs of regions with significant inter-connectivity provide efficient inputs for our Multi-Layer Perceptron (MLP) classifier. I explain a novel multiscale analysis to select Cortex Regions with high discriminating power between patients classes. Another key point is our systematic use of very large matrices of Mutual Information (MI) between pairs of recorded time series. We generalized the MI concept to evaluate the interactivity between pairs of cortex regions of arbitrary size. By imposing rigorous parameter parsimony to avoid over fitting we constructed a small size MLP with very good percentages of successful classification.

Presenter's Bio:

Rasoul Hekmati is a Ph.D candidate of Applied mathematics.

He collaborates with Texas Children's Hospital and work on large brain activity fMRI time series of epileptic patients. He developed new machine learning and deep learning algorithms to evaluate these big data and also to extract useful information based on advanced statistical and computational methods. The results are a published chapter book, 2 papers under the publication and 3 conference abstracts (Big Data conf in UTHealth, Q-bio in Rice and RSNA).

Nishath Rajiv Ranasinghe, Ph.D

Visiting Assistant Professor

Colorado State University-Pueblo

Title: Sedimentary Basin Characterization using Large-N Passive Seismic Arrays

Abstract:

Ambient seismic noise collected from large-N seismic deployments can be efficiently used to characterize the Earth's structure by retrieving the Green's function between pairs of seismic stations employing seismic interferometry. The Albuquerque-Belen and Socorro basins reside in the central Rio Grande rift and partially overlie the mid-crustal Socorro magma body, the inflation of which contributes to ongoing seismicity and localized uplift of the region. Ambient seismic noise data collected from ~800 seismic stations deployed in the Sevilleta wild life refuge in the southern part of the Albuquerque Basin for a period of two weeks is used to measure Rayleigh wave dispersion between the station pairs. The resulting measurements were inverted to obtain Rayleigh-wave phase velocity maps at 3 to 7 s periods and the tomography maps generated from the results indicate large degree (~6%) of lateral variations in Rayleigh-wave phase velocities at this period range. Subsequently, Rayleigh-wave velocity models were inverted utilizing a nonlinear Markov Chain Monte Carlo (MCMC) method to obtain a 3-D shear wave velocity model in the uppermost 10 km of the crust.

Presenter's Bio:

Dr. Nishath Ranasinghe is a visiting assistant professor of physics at the Colorado State University-Pueblo. He received his B.Sc. in physics from University of Perdeniya in 2007 and M.Sc. in physics from Old Dominion University in 2011. He received his PhD in physics and minor in electrical engineering from New Mexico State University in 2016. He studied regional seismic wave attenuation and site amplification in northeast China for his dissertation. As a postdoc at University of New Mexico, he studied shear wave velocity structure of the southern Albuquerque Basin using ambient seismic noise.