Dr. Jason Stumpff
University of Vermont

“Centering the Genome: how and why do chromosomes align within the mitotic spindle.”

Monday, November 13, 2017
12:00 pm
CBIS, Bruggeman Room

REFRESHMENTS SERVED AT 11:45
Fall 2017
Mathematical Sciences
Colloquium

“Three Applications of Randomized Numerical Linear Algebra in Data Analytics”

This talk presents recent results on the advantages and limitations of randomized numerical linear algebra in three data analysis applications. First we characterize the statistical and optimization tradeoffs in using randomized sketching to approximately solve the matrix ridge regression (MRR) problem; we show that in the distributed setting, model averaging combined with sketching obtains near-optimal solutions to the MRR problem while mitigating the statistical risk incurred by sketching. Second, we introduce a novel class of randomized low-rank approximations that can be used to obtain approximate non-linear k-means solutions with $(1+\varepsilon)$ approximation ratio. We argue that k-means clustering with these randomized approximations is a more theoretically sound—and in practice more effective—approach to non-linear clustering than randomized spectral clustering. Finally, we establish a rate of convergence for randomized Gauss-Siedel that captures the fact that randomized partitioning can outperform a fixed partition scheme when the submatrices are well-conditioned. We provide experimental evidence that randomized Gauss-Siedel outperforms (even accelerated) fixed-partition Gauss-Siedel on large-scale machine learning tasks.

Speaker: Alex Gittens

(Rensselaer Polytechnic Institute)

Monday, November 13, 2017

Time: 4:00 – 5:00 PM

Location: AE214

4:00-5:00pm

Host: Rongjie Lai
Finding Sources in Spreading Processes

The phenomenon of spreading is very broad: it can mean spreading of electromagnetic waves, wind-blown seeds, diseases or information. Spreading can also happen in various environments, from simple spatial (like waves on water) to complicated networks (like information in society). Quite often, it is evident there is a spread, but it is not directly known where it came from. In case of physical phenomena, that feature constant-velocity spreading in space, it may require simple triangulation to pinpoint the source. But if the process happens in a complex network and it also has nature so complex as to be only possible to describe in a stochastic manner (such as epidemics or information spreading) then finding a source becomes a more complicated problem.

Both epidemics and information spreading share a common property - there is no total mass, energy, count, or volume conserved, as is for example in spreading waves (energy) or diffusing substances (mass/volume). Because of that, both can be modeled in similar way, for example by a basic SI (Susceptible-Infected) model. The presentation will describe some existing methods to find sources of spread in such processes and focus on a method based on maximum likelihood introduced by Pinto et.al. as well as describe derivative methods that feature much better performance, as well as improvements in accuracy.

Assume we have a network, where information or epidemic has spread, and we only know when it arrived in some specific points in the network (which we call observers). Further assumptions are that spreading always happens along shortest paths from source to any node, and that the delays on links can be approximated by normal distribution. It is then possible for each potential source in the network (every node in general) to calculate expected arrival times as well as the variances and covariance of these times. For each node we therefore have a multivariate normal distribution of arrival times at all observers. Comparing the distributions with actual observation, we can find the source that has distribution best fitting observed arrival times.

One of drawbacks of such method is that for large number N of nodes in network, the computational costs gets prohibitive, with up to O(N^3) complexity. We have proposed a derivative method that limits the considered observers, as well as smart choice of suspected nodes. We only take into account √N observers that are closest to real source (have earliest observed time of infection), greatly decreasing computational complexity. Instead of calculating distribution for every node, we start with closest observer and follow a gradient of increasing likelihood. These changes not only greatly increase performance (complexity at worst O(N^{3/2}log(N))) but also increase accuracy in scale-free network topologies.

Bio:
Krzysztof Suchecki is an assistant professor at Warsaw University of Technology, Faculty of Physics. He has MSc and PhD degrees in physics. His research topics focus on dynamics of and on complex networks, such as Ising and voter model dynamics, including co-evolution of network structure and dynamical node states. His current research is focused on spreading of information in networks and methods to identify sources of information.

Tuesday, November 14, 2017
CII (LOW) 3051 – 4:00 p.m.
Refreshments served at 3:45 p.m.
Computational Studies of High Entropy Ceramics

Donald W. Brenner, PhD

Kobe Steel Distinguished Professor and Interim Department Head
Department of Materials Science and Engineering, North Carolina State University

ABSTRACT
The number of known materials that can be used for ultra-high temperature (UHT) applications is limited, even when just considering melting point. When considering other performance factors such as mechanical stability, thermal conductivity, thermal shock and oxidation resistance, the list of viable materials becomes even smaller. With this in mind, we have been working within a Multi-University Research Initiative (MURI) to develop a new material class, high entropy ceramics, to expand the palette of possible UHT candidates. These materials are unique within the broader classification of high entropy alloys in that they have an ordered crystal sublattice together with a second crystal sublattice containing four or more elements in roughly equi-molar concentrations. The entropic carbides, nitrides and oxides, for example, are in a rock salt structure containing an fcc sublattice of C, N or O atoms, respectively, with a second fcc sublattice containing a random population of cations. After a brief introduction to our MURI team, this talk will focus on first principles and molecular modeling studies we are using to characterize the atomic and electronic structure of these materials, their point defect energies, and their thermal transport properties.

BIO
Professor Brenner received his B.S. from the State University of New York in 1982, and his Ph.D. from Penn. State University in 1987, both in Chemistry. He then joined the research staff of the U.S. Naval Research Laboratory as a member of the Theoretical Chemistry Section. In 1994 Brenner joined the faculty at NC State, where he is currently a Kobe Steel Distinguished Professor and Interim Department Head in the Department of Materials Science and Engineering. His research focuses on the development and use of atomic, multi-scale and statistical modeling methods for the virtual design, development and characterization of advanced materials. His awards include the 2002 Feynman Prize for advances in nanotechnology, the 2013 Alcoa Foundation Distinguished Engineering Achievement Award, and the 2016 Alexander Quarles Holladay Medal for Excellence.
ABSTRACT:
This presentation is a historical talk about the early applications of electro-osmosis (EO) in the practice of Civil Engineering, specifically in the area of geotechnical engineering. It covers the time period from the mid 1930’s to about 1950, and includes a number of well-known geotechnical engineers such as Doctors Arthur Casagrande, Leo Casagrande, E.C.W. Geuze and Hugh Golder. There are a number of interesting and related aspects that took place during WWII: British Intelligence, Dutch partisans, U-boat pens and spy activities.

Leo Casagrande in 1939 was the first to use E-O for soil stabilization, a railway slope in Germany. WWII soon began, and this E-O application was little known at the time. In 1940 Germany had conquered most of Western Europe, and the British stood alone against the Germans, heavily reliant on supplies from the USA and Canada. The Germans felt if they could sink enough of the boats transporting supplies to the British, they could win the war or at least get the British to agree to a peaceful settlement. Thus they had to protect the valuable submarines (U-boats) in port, and decided to construct massive concrete U-boat pens which were resistant to any bombs existing at the time. One of these pens under construction on the southwest Norwegian coast was located in soft clay and was so unstable that construction was halted, until Leo Casagrande suggested and implemented the use of E-O. British Intelligence tried to find out about the construction methodology, and that involves some interesting vignettes.

British Intelligence had secured air photos of the Norwegian U-boat construction and contacted Hugh Golder, who was with the U.K. Building Research Station at the time. Golder initially concluded dewatering was being used to stabilize the soils, but quickly changed his mind realizing one cannot dewater tight clays, and the piping layout and associated hardware was not a dewatering operation. No one else could figure out the details, and Golder suggested contacting Dr Geuze, the head of the Delft Soil Mechanics Laboratory. That was not so simple, since Holland was under German occupation. However British Intelligence did contact Geuze, and the details of this contact would make a good movie. Basically Geuze’s logic was similar to that of Golder, and he also could not figure out the construction details. At the time the allies never did figure out that E-O was being used. The U-boat pens were constructed, the determination of the construction methodology became a low priority, and the war went on.

Immediately after the end of WWII the US, Britain and Russia were seeking out outstanding scientists and engineers in Germany. Leo Casagrande and his family left Berlin just before the Russians arrived. The British reached him first, and he joined the British Building Research Station, where he published several works on EO. In 1950 he joined his brother Arthur Casagrande and Karl Terzaghi at Harvard University, and published several classical papers dealing with electro-osmosis. Thus the geotechnical world became aware of the use of EO for civil engineering applications.

Refreshments will be served
"INNOVATORS IN ENGINEERING LECTURE"

Mukesh Chatter

Wednesday, November 15, 2017
2:00 PM — 3:00 PM
CBIS Auditorium

Abstract

Innovation is a key factor in finding optimized engineering solutions. While linear extrapolation often provides reasonable improvement from the prevailing answers, it may be sub-optimum. The key ingredients in finding/developing optimized answers include awareness of the challenge, in-depth learning of how it is solved today, the root causes of the resulting limitations, and thinking along a very different wavelength to leap frog! Sometimes we succeed when thinking outside the box and occasionally we grudgingly acknowledge that maybe linear growth is the right answer!

The purpose of this talk is to discuss this against the backdrop of key challenges, that at times are not apparent or well-advertised, but adversely impact the quality of life of billions of people around the globe. RPI grads bear a special responsibility as the institute was founded in 1824 by Stephen van Rensselaer and Amos Eaton for the "application of science to the common purposes of life" and that objective remains as relevant as ever.

BIO:

Mukesh Chatter is a successful high-tech entrepreneur and currently co-manages an investment firm NeoNet Capital LLC. In 1997, he co-founded Nexabit Networks, a highly successful terabit switch/router company which was acquired by Lucent Technologies in 1999. Mukesh holds 19 patents in Telecom, Data networking, Semiconductors, and Internet technologies. Mukesh was chosen as one of the top ten entrepreneurs in 1999 by the Red Herring magazine. He was also named Rensselaer Entrepreneur of the Year 2001. He has been widely covered by prestigious US and international media outlets over the years.

Mukesh and his wife Priti have funded and founded several research projects to develop ultra-low cost innovative products to improve the quality of life, especially in rural areas, globally. They have also endowed two chaired professorships at Rensselaer Polytechnic Institute.

He holds a master’s degree in Computer and Systems Engineering from Rensselaer Polytechnic Institute in Troy, New York.
ECSE SEMINAR

Can a computer improve your social skills?

Professor M. Ehsan Hoque

Department of Computer Science
Asaro-Biggar (’92) Family Fellow in Data Science
University of Rochester

WEDNESDAY, NOVEMBER 15 at 4:00 PM in DCC-324
REFRESHMENTS SERVED AT 3:30 PM

Many people fear automation. They may see it as a potential job killer. They may also be concerned about what can be automated. Could we train a computer to teach us human skills? Should we? Artificial intelligence, when designed properly, can help people improve important social and cognitive skills. My research group has shown how automated systems can develop skills that improve performance in job interviews, public speaking, negotiations, working as part of a team, producing vowels during music training, end-of-life communication between oncologists and cancer patients, and even routine social interactions for people with Asperger’s syndrome. In this talk, I will offer insights gained from our exploration of several questions: How are humans able to improve important social and cognitive skills with a computer? What aspect of the feedback helps the most? How to design experiments to ensure that the skills generalize?

M. Ehsan Hoque is an assistant professor of computer science and an Asaro-Biggar (’92) Family Fellow in Data Science at the University of Rochester, where he leads the Rochester Human-Computer Interaction (ROC HCI) Group. His group’s research focuses on understanding and modeling the unwritten rules of human communication, with applications in business communication, health, and educational assessment technology. Ehsan earned his Ph.D. in the MIT Media Lab in 2013. Ehsan and his group’s work has earned them a Best Paper Award at the ACM Conference on Pervasive and Ubiquitous Computing (UbiComp, 2013), as well as Best Paper Honorable Mentions at the Affective Computing and Intelligent Interaction (ACII, 2017), Automated Face and Gesture Recognition (FG, 2011) and Intelligent Virtual Agents (IVA, 2006). Ehsan has received an MIT TR35 (2016), a World Technology Award (2015), and two Google Faculty Research Awards (2014, 2016). In 2017, Science News recognized him as one of 10 early- to mid-career scientists to watch (the “SN 10”).

For additional information:
Contact: Laraine Michaelides 518-276-8525 michael@rpi.edu
OR VISIT: www.ecse.rpi.edu (See “Events”)
Nonlinear optical processes, such as second harmonic generation (SHG) are an important component of modern technology such as imaging and high speed data communication. However, traditional materials have a small response which limits the efficiency of devices. The inherently small size of two dimensional (2D) materials makes them attractive options to seamlessly interface with existing technology. In addition, 2D materials have been shown to exhibit extraordinary SHG response. In this talk we will characterize the SHG response of 2D materials using first principles density functional theory plus Bethe-Salpeter equation (BSE) calculations. We examine how strain, alloying, and excitons affect the response. In addition, theoretical structures are studied to gain insight into ways to enhance the SHG response.