ISTeC
The Information Science and Technology Center

Colorado State University

Distinguished Lectures

Fall 2015

Shashi Shekhar

McKnight Distinguished University Professor

Department of Computer Science

University of Minnesota

ISTeC Distinguished Lecture in conjunction with the Electrical and Computer Engineering Department and Computer Science Department

"From GPS and Google Maps to Spatial Computing"

Monday, October 19, 2015
Reception with refreshments: 10:30 am
Lecture: 11:00 am - 12:00 noon
Morgan Library Event Hall

Electrical and Computer Engineering Department and Computer Science Department Special Seminar Sponsored by ISTeC

"What is special about mining spatial and spatio-temporal datasets?"

Monday, October 19, 2015
Lecture: 3:00-4:00pm
Lory Student Center, Room 312

Abstracts

From GPS and Google Maps to Spatial Computing

From virtual globes (e.g., Google Maps) to global positioning system, spatial computing has transformed society via pervasive services (e.g., Uber and other location-based services), ubiquitous systems (e.g., geographical information system, spatial database management system), and pioneering scientific methods (e.g., spatial statistics). These accomplishments are just the tip of the iceberg and there is a strong potential for a compelling array of new breakthroughs such as spatial big data, localization indoors and underground, time-travel (and depth) in virtual globes, persistent monitoring of environmental hazards, accurate spatio-temporal predictive models, etc. For example, a McKinsey report projected an annual $600B saving from leveraging spatial big data (e.g., smart-phone trajectories) for novel eco-routing services to reduce wasted fuel, greenhouse gas emission and pollution exposure during unnecessary waits at traffic lights and in congestion.

However, many fundamental research questions need to be investigated to realize the transformative potential. For example, how can spatial big data (e.g., smart-phone trajectories) be mined without violating privacy? How can spatial statistical and machine learning algorithms be generalized to model geographic concepts (e.g., context, hot-spots, hot-features, doughnut-hole patterns), address spatio-temporal challenges (e.g., auto-correlation, non-stationarity, heterogeneity, multi-scale) and scale up to spatial big data? How can eco-routing address the new challenges, e.g., waits at traffic-signals violate the sub-path optimality assumption in popular A* and Dijktra's algorithms?
This presentation shares a perspective on the societal accomplishments, opportunities, and research needs in spatial computing based on a recent community report following the Computing Community Consortium workshop titled From GPS and Virtual Globes to Spatial Computing -- 2020 held at the National Academies.

What is special about mining spatial and spatio-temporal datasets?

The importance of spatial and spatio-temporal data mining is growing with the increasing incidence and importance of large datasets such as maps, virtual globes, repositories of remote-sensing images, the decennial census and collections of trajectories (e.g. gps-tracks). Applications include Environment and Climate (global change, land-use classification), Public Health (e.g. monitoring and predicting spread of disease), Public Safety (e.g. crime hot spots), Public Security (e.g. common operational picture), M(obile)-commerce (e.g. location-based services), etc.

Classical data mining techniques often perform poorly when applied to spatial and spatio-temporal data sets because of the many reasons. First, these dataset are embedded in continuous space, whereas classical datasets (e.g. transactions) are often discrete. Second, patterns are often local where as classical data mining techniques often focus on global patterns. Finally, one of the common assumptions in classical statistical analysis is that data samples are independently generated. When it comes to the analysis of spatial and spatio-temporal data, however, the assumption about the independence of samples is generally false because such data tends to be highly self correlated. For example, people with similar characteristics, occupation and background tend to cluster together in the same neighborhoods. In spatial statistics this tendency is called autocorrelation. Ignoring autocorrelation when analyzing data with spatial and spatio-temporal characteristics may produce hypotheses or models that are inaccurate or inconsistent with the data set.

Thus new methods are needed to analyze spatial and spatio-temporal data to interesting, useful and non-trivial patterns. This talk surveys some of the new methods including those for discovering interactions (e.g. co-locations , co-occurrences, tele-connections), detecting spatial outliers and location prediction along with emerging ideas on spatio-temporal pattern mining.

Speaker Biography:

Shashi Shekhar is a McKnight Distinguished University Professor at the University of Minnesota (Computer Science faculty). For contributions to Geographic Information Systems (GIS), spatial databases, and spatial data mining, he received the IEEE-CS Technical Achievement Award and the UCGIS Education Award. He was also elected an IEEE Fellow as well as an AAAS Fellow and named a key difference-maker for the field of GIS by the most popular GIS textbook. He has a distinguished academic record that includes 300+ refereed papers, a popular textbook on Spatial Databases (Prentice Hall, 2003) and an authoritative Encyclopedia of GIS (Springer, 2008). Shashi is serving as a co-Editor-in-Chief of Geo-Informatica: An International Journal on Advances in Computer Sciences for GIS (Springer), and a series editor for the Springer-Briefs on GIS. Earlier, he served on the Computing Community Consortium Council (2012-15), and multiple National Academies' committees including Geo-targeted Disaster Alerts and Warning (2013), Future Workforce for Geospatial Intelligence (2011) and Mapping Sciences (2004-2009). He also served as a general or program co-chair for the Intl. Conference on Geographic Information Science (2012) and the Intl. Symposium on Spatial and Temporal Databases (2011). He also served on the Board of Directors of the University Consortium on GIS (2003-4), as well as the editorial boards of IEEE Transactions on Knowledge and Data Eng. and IEEE-CS Computer Sc. & Eng. Practice Board. He received a Ph.D. degree in Computer Science from the University of California, Berkeley.

To arrange a meeting with the speaker, please contact Prof. Anura Jayasumana (Anura.Jayasumana@ColoState.edu, (970) 491-7855).

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