David Agogo is an Assistant Professor in the Information Systems and Business Analytics Department at the Florida International University College of Business. David earned his Ph.D. in Information Systems from the Isenberg School of Management, University of Massachusetts at Amherst. He also holds an MBA, a degree in Electrical and Computer Engineering, and some professional certifications. David is passionate about how technology can be used as a sustainable force for transforming individuals, organizations, and society. His research program centers on studying unintended consequences of technology use and applying data science methods to analyze new and interesting research questions for practice and policy. His professional experience is in project management and technology consulting.

Location Analytics in Business: A Position Statement

During an inspiring keynote at AMCIS 2016, Christopher Capelli of ESRI remarked that businesses which ignore location analytics cannot unlock the true potential of their organizational assets. This resonated strongly with me. I have always been excited by the potential for improving decision making using contextually aware and critically analyzed location data. During my professional life as a consultant and project manager, the value of GIS data was critical.

For instance, as a project manager responsible for planning the deployment of low-cost computing devices (the Intel Classmate PC) across 250 schools spread out across Nigeria, an understanding of the role of location was indispensable. At the time, the painstaking process of understanding the different terrains and road networks was done manually and using heuristics. Although the project plans were satisfactory, I couldn’t help wishing for a more data-driven approach. As a doctoral student at the Isenberg School of Management, while I did not have an opportunity to integrate GIS technology into my research, I consistently did so in my teaching using tools like Simplymap and BatchGeo. I exposed students to the principles of static and dynamic location analytics and developed exercises with which they could get hands-on practice with these basic GIS tools.

As an Assistant Professor at the College of Business at Florida International University, Miami, I hope to expand on my ability in this area and provide my students a more in-depth exposure to this area. FIU students are unique in the sense that many of them are first-generation college attendees, have strong and active roots internationally, and are very passionate about learning new and practical skills. Further, the unique geographical location of Miami and the city’s susceptibility to major
weather events translates to an above average interest in geography, location and the analysis of context-based information. Further, the College of Business at FIU considers programming and analytics to be a critical pillar of all business education. Given the critical importance of location-awareness in business today, and the support of my department for cutting-edge program directions, there is immense potential and support for me to develop both a research and teaching profile in this area.

It is also important to point out that FIU students are also passionate about social challenges. As one of only twelve institutions that are classified both as a Research One institution and an Ashoka U Changemaker Campus, there is also unique support for studying challenges faced by society, such as climate change and global humanitarian challenges. The role of location-awareness and location analytics technologies in addressing these challenges cannot be overemphasized. To equip my students to be the kind of changemakers that they want to be, teaching them about this area is essential. Ultimately, this knowledge will also increase their marketability to future employers.

Finally, this opportunity will be valuable for my research program also. Equipping myself to apply GIS will help me close the loop on one of my active research streams. I currently have projects that apply network analysis principles. Location is an important contextual variable that can be integrated as an additional dimension. I have some ideas for doing this based on the principle of brokerage (Gould & Fernandez, 1989) where both the presence of a tie and membership of a reference class can be a basis for understanding important patterns of influence in networks. I look forward to learning more at this workshop and also contributing insights from my current work in this area.

References
Camillo Archuleta is a recent MBA graduate from the Isenberg School of Management. He is currently working with the UMass Innovation Institute (UMII). In his role with UMII he is industry facing and is actively engaged in business development across many industries. Before enrolling in Isenberg, Archuleta held the position of Commercial Lines Underwriter for a large P&C carrier located in Worcester, MA. As an underwriter, he had the opportunity to review the operations and risk characteristics of many businesses across multiple industries. Most of his exposures were located in the Northeast but he also wrote business across the entire country. A fundamental business problem in the insurance industry is the management of risk and a key component of risk is the concentration and proximity of both property and people that are covered. As a company, the insurer has to think about how much value they are comfortable with covering within particular geographic area.

Archuleta quickly saw disconnect between the goals of management and the tools that underwriters had available to them in order to do the proper risk analysis. During his time as an underwriter, he continuously built maps and tools that would help people make better decisions. Archuleta never had any official training in the use of GIS systems. He learned everything that he could through ESRI MOOCS and other free courses. His ability to see problems from a spatial perspective gives him a unique filter and ability to understand complex situations.

While at Isenberg, Archuleta developed a passion for processes and the way that businesses operate. There is a clear benefit to incorporating spatial analysis when making business decisions. The greatest contribution that he can make at this time is from the business perspective. He does not have the strongest GIS skills but he does have a growth mind-set and an eagerness to move the field of spatial analysis further into how businesses think about problems and opportunities.

Position Statement

As a recent MBA graduate from the Isenberg School of Management, I believe that there are many ways in which I can help contribute to the workshop and program. In the past, I worked the property and casualty insurance industry. For three years, I worked as a commercial lines underwriter and I had the opportunity to review the operations of hundreds of businesses, primarily across the Northeast but also across the country. A fundamental business problem in the insurance industry is the management of risk. A key exposure is concentration of risk. As a company, we had to think about how much value we were comfortable with covering within a half-mile square.
I quickly saw a disconnect between the goals of management and the tools that underwriters had available to them in order to do the proper spatial and risk analysis. During my time as an underwriter, I continuously built maps and tools that would help people make better decisions. I have never had any official training in the use of GIS systems. I learned everything thing that I could through ESRI Moocs and other free courses. However, all of the things that I did learn helped me when I reentered the classroom as a Graduate Student. My ability see problems from a spatial perspective gave me a unique filter and ability to understand complex situations.

While at Isenberg, I have also developed a passion for processes and the way that businesses operate. In my time at Isenberg, I had the opportunity to learn core concepts of lean operations. I see an intersection between spatial analytics in business and how a business functions. The greatest contribution that I can make at this time is from the business perspective. I do not have the strongest GIS skills at this time but I do have a growth mindset and I am eager to move the field of spatial analysis further into how businesses operate and think about problems.
Jesus Chavez is an Esri technical consultant, assisting new and existing users in the adoption/expansion of location analytics best-practices at their respective organizations. Chavez supports Esri users in the Commercial sector, and focuses on both technical implementation and business application of Esri’s technology. Jesus also advises a team of Esri business consultants working across a number of verticals, and has developed location analytics industry expertise in retail, real estate, financial services, and healthcare.

Chavez is most interested in the computational and statistical models being used by location analytics practitioners. He appreciates opportunities to work with companies who have made an investment in their data science operations, and believes that organizations who do this have a leg up on their competitors at a time of rapid digital transformation.
Richard Church is a Professor of Geography and Associate Dean of the Sciences at the University of California, Santa Barbara. He received his Ph.D. in Environmental Engineering from The Johns Hopkins University. Before joining the faculty at UCSB, he was an Associate Professor of Civil Engineering at the University of Tennessee. He has taught courses in Geography, Business, Industrial Engineering, and Civil Engineering. Church’s research is concentrated on spatial optimization and Geographic Information Science applied to transportation systems, location and logistics, urban systems and environmental natural resource protection. He has published more than 250 papers in Regional Science, Geography, Transportation, Operations Research, Environmental Modeling, and Engineering. Church has served as a consultant to a number of companies and governmental agencies on a wide variety of problems (logistics, environmental management, site selection, and transportation) and is a co-inventor on a U.S. Patent on estimating manpower needs for emergency medical systems from computerized data systems. He is a Fellow of the Regional Science Association International and a Fellow of the American Association for the Advancement of Science (AAAS). He received the outstanding Graduate Mentor Award from the University of California, Santa Barbara in 2013, the Lifetime Achievement in Location Award (from the Section on Location Analysis of INFORMS) in 2012, and the University Consortium for Geographical Information Science Research Award in 2014. In 2015, he served as the President of the North American Regional Science Council and as President of the Section on Location Analysis of INFORMS from 2015–2017.
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Amit V. Deokar is an Assistant Professor of Management Information Systems in the Manning School of Business at the University of Massachusetts Lowell. Deokar received his PhD in Management Information Systems from the University of Arizona. He also earned a MS in Industrial Engineering from the University of Arizona and a BE in Mechanical Engineering from VJTI, University of Mumbai. His research interests include data analytics, enterprise data management, business intelligence, business process management, and collaboration processes. His work has been published in journals such as Journal of Management Information Systems, Decision Support Systems (DSS), The DATA BASE for Advances in Information Systems, Information Systems Frontiers, Business Process Management Journal (BPMJ) and IEEE Transactions. He is currently a member of the editorial board of DSS and BPMJ journals. Deokar was recognized with the 2014 IBM Faculty Award for his research and teaching in the areas of analytics and big data. He currently serves as the Chair of the AIS Special Interest Group on Decision Support and Analytics (SIGDSA).

Location Analytics in Business: A Position Statement

Location analytics has emerged as a distinct area of interest to scholars and practitioners in the area of decision support and analytics. Particularly, spatial decision support challenges that have traditionally relied on the joint foundations in decision support systems and geographical information systems are poised to leverage recent advances in big data and analytics. This interest is further fueled by external drivers such as mobile device adoption, proliferation of sensors and Internet of Things.

Spatial decision support, also referred to as location analytics, has found applications in many different domains. Applications such as crime prediction based on social media data with location content, optimal placement of wireless towers in rural areas, and so forth are some such examples in non-business domains. Location analytics, has now become more prominent in business applications, and is often referred to as a subset of business analytics, similar to text analytics and streaming data analytics.

Within business domains, different applications leveraging geospatial data are evolving and are presenting new research opportunities. For example, in marketing, enhancing in-store consumer experience through personalization and retargeting consumers outside stores is a pressing issue for
brick-and-mortar stores. A related issue is that of providing an omni-channel experience to avoid consumer messaging fatigue, and achieving consumer engagement—pestering delicate balance. In a different business area such as logistics and supply chain, autonomous drones working on spatial data are being deployed to do more efficient inventory recording and search in warehouse management. These are some examples of analytics applications where location data, in tandem with non-location data, can be integrated effectively. Further, sharing economy presents opportunities for leveraging location data to offer services. Applications like telematics that involve location data are being deployed by many auto insurance companies. In many of these applications, several socio-technical and socio-economic issues have emerged that deserve attention from the research community. In addressing these issues, applying methods from spatial analysis as well as data mining to detect patterns and test hypotheses is key.

As a co-editor of a recent special issue published in the premier *Decision Support Systems* (DSS) journal, the editorial article “Location analytics and decision support: Reflections on recent advancements, a research framework, and the path ahead” (Pick, Turetken, Deokar, & Sarkar, 2017) emphasizes opportunities in two broad aspects:

(a) **Data sources**: Harness newer spatial, i.e., georeferenced data sources, emerging as a byproduct of technological advances and dynamic global environment factors, among others.

(b) **Methods**: Integrate spatial analysis techniques and data analytics (descriptive, predictive, and prescriptive) techniques. This may include conceptual integration.

In terms of application areas, location analytics research needs to be expanded in business sectors that are under-researched, yet present a vital geospatial data platform. This includes real estate, utilities, banking, oil and gas, telecommunications, and insurance, among others. In many of these sectors, strategic, operational, and tactical decision support applications such as resource allocation, location-based marketing, preventative maintenance and planning of infrastructure are still relatively in early stages of maturity. Such applications provide opportunities for research into predictive modeling of geospatial phenomena.

From a methods perspective, analytic models, particularly predictive models that utilize spatial analysis methods such as local indicators of spatial association (LISA) techniques are required. Concerted development of algorithms with geospatial considerations can have considerable impact in the field of location analytics. These analytical methods broadly fall under the design science methodological paradigm within information systems field. Further, in studying research phenomena related to location analytics in business, it can be expected that multi-methodological approaches such as qualitative, quantitative, and design science will need to be harnessed in a synergistic manner to triangulate findings and address research questions of interest.

From a theory perspective, research questions in this area, like many interdisciplinary fields, can tremendously benefit from integration and development of theory that builds on theoretical models, instruments, and evaluation techniques in diverse fields such as information systems, geography, psychology, consumer behavior, and so forth.
In sum, location analytics for business presents strong potential for research opportunities in terms of novel applications, methods development, and theory development. Location analytics in business is poised to push the envelope in terms of how to meaningfully use geospatial data along with non-locational data, ultimately to gain deeper understanding of research phenomena. Leadership workshop on this topic, as being organized by UCSB and Esri, Inc. are indicative of the strong interest from research and practice communities to advance the field.

1 Algorithmic/software integration, and/or integration based on seamless experience to end-users.

Reference:

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Michael F. Goodchild (B.A., Physics, Cambridge University; Ph.D., Geography, McMaster University) is Professor Emeritus of Geography and former director of the Center for Spatial Studies (spatial@ucsb) at the University of California, Santa Barbara. After 19 years at the University of Western Ontario, including three years as Chair, he moved to Santa Barbara in 1988. Since then, he has served as Director of the National Center for Geographic Information and Analysis (NCGIA); Associate Director of the Alexandria Digital Library Project; and Director of the Center for Spatially Integrated Social Science. Goodchild retired from academia June 2012.

Goodchild’s research publications, including more than 400 scientific papers and a dozen authored and edited books, have laid a foundation for geographic information science and spatial analysis, extended the development of geo-libraries, contributed to understanding uncertainty in geographic data, and advanced capabilities in location-allocation modeling. He was Editor of Geographical Analysis for three years and of the “Methods, Models, and Geographic Information Sciences” section of the Annals of the Association of American Geographers for six years. Goodchild is an elected member of the National Academy of Sciences and the American Academy of Arts and Sciences, and is a Foreign Fellow of the Royal Society of Canada. He has received honorary doctorates from Laval University, Keele University, Ryerson University, and McMaster University. He is a recipient of the Canadian Association of Geographers’ Award for Scholarly Distinction, Association of American Geographers’ Award for Outstanding Scholarship, Canadian Cartographic Association’s Award of Distinction for Exceptional Contributions to Cartography, Educator of the Year Award from the University Consortium for Geographic Information Science, the Founder’s Medal of the Royal Geographical Society, a Lifetime Achievement Award from Environmental Systems Research Institute, Inc., the American Society of Photogrammetry and Remote Sensing Intergraph Award, and the Horwood Critique Prize (twice) of the Urban and Regional Information Systems Association (URISA). In 2007 Goodchild was inducted into the GIS Hall of Fame of URISA and received the prestigious international Prix Vautrin Lud, in St Dié-des-Vosges, France. More recently, Goodchild received the Peter A. Burrough Medal, International Spatial Accuracy Research Association, 2012.
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Michael Gould received a Ph.D. from the State University of New York at Buffalo, and has been teaching and researching in the field of GIS since 1991, when he moved to Spain. In 2008 he joined Esri (Redlands, CA) as director of education and now is back in Spain as Esri’s global education manager. In this capacity, he works on diverse educational projects in collaboration with Esri’s 84 international offices and with almost 11,000 universities.
**INDY HURT**
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Indy Hurt is a data scientist at Gap Inc. She leads all spatial analysis for the global real estate team. Her academic achievements include a Ph.D. in Geography from the University of California, Santa Barbara, a Masters of Science in GIS from the University of Redlands, and a Bachelors of Arts in Geography from the University of California, Los Angeles.

Prior to Gap Inc., Hurt was one of the coordinators for geospatial research at Apple and later provided spatial data analysis and outreach for open source mapping startup, Mapzen. Between graduate degrees, she was an instructor for Esri. When she’s not analyzing data, her hobbies include singing, sewing, hiking, and traveling.

**Position Statement**

I have had a lot of exposure to spatial analysis over the years, but never so tightly coupled with business. I see a profitable intersection between the domain of geographic information science and several big data methodologies advancing in computer science.

Retail is inherently spatial with the coupling of demographic analysis for customer profiling, site suitability analysis, optimized distribution channels, and so much more. While it all seems intuitive, one can find complexity in the sheer volume of data and the rapidly changing landscape of retail.

One or even several off-the-shelf solutions are rarely adequate. The ability to code solutions quickly and effectively is so valuable yet I find that most candidates strong in spatial analysis neglect their coding and communication skills. It may not be realistic to strengthen students in all areas at the same time, but collaborative projects at the undergrad and graduate level can bridge the gap.
Krzysztof Janowicz
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Krzysztof Janowicz is an Associate Professor for Geographic Information Science and Geoinformatics at the Geography Department of the University of California, Santa Barbara. He is the program chair of the Cognitive Science Program, one of two Editors-in-Chief of the Semantic Web journal, a Faculty Research Affiliate of the Center for Information Technology and Society, and the community leader of the 52° North semantics community. He currently runs the STKO Lab, which investigates the role of space and time for knowledge organization. Prior to coming to UCSB, Janowicz was an Assistant Professor at the GeoVISTA Center, Department of Geography at The Pennsylvania State University. Before moving to the United States, he worked as a postdoctoral researcher at the Institute for Geoinformatics (ifgi), University of Münster, Germany, for the international research-training group on Semantic Integration of Geospatial Information and the Münster Semantic Interoperability Lab (MUSIL). Methodologically, his niche is the combination of theory-driven (e.g., semantics) and data-driven (e.g., data mining) techniques.
Mehrdad Koohikamali is an Assistant Professor of IS/GIS in the School of Business, University of Redlands. Mehrdad received his Ph.D. in Information Systems at the University of North Texas. He holds an M.S. in Applied GIS from the University of North Texas and an M.S. in GIS from the University of Tehran. His research and professional interests include location intelligence for business, big data analytics, social media analytics, and information privacy. He is a member of the Association for Information Systems and the Decision Sciences Institute. His work appears in journals such as Decision Support Systems, Computers in Human Behavior, Informing Science, and Lecture Notes in Business Information Processing. He is currently working on several projects, including spatial big data analytics: spatial accuracy and privacy challenges, locational privacy issues in US cities and counties, sharing economy in mega cities, and location-based sentiment mining during social crises. His teaching interests include spatial big data analytics, global business spatial analytics, business intelligence and analytics, GIS for business, visual display of business information, and introduction to GIS. He has recently received an IT innovation award in teaching where he integrated location-based social media with teaching materials. Mehrdad has several years of working experience in the field of GIS, ranging from GIS consultant, analyst, and programmer, to GIS manager.

Location Analytics Themes:
Spatial-Temporal Tapestry, Location Privacy, and Spatial Accuracy

Location analytics is not only the intersection of GIS and data science. Location analytics is an emerging field of science where GIS is finally blooming to its full extent. At the root, location analytics is indeed still the application of traditional spatial analysis methods. The availability of new tools to work with spatial data upsurges the need for research and practice in specific areas of location intelligence. There are two main themes in location intelligence that businesses and researchers should put more time into:

- Validating the spatial accuracy of location information and its alignment with the business objective
- Development of real-time and privacy-preserving data collection and location analytics methods to benefit different decision-making processes for businesses and individuals

With some of the newest advancements in Internet of Things (IoT) including location-tracking devices, collection of information has gone too far into people’s [former] private lives. Availability of
spatial big data and the accessibility of tools to create fascinating graphics, has tremendously increased the importance of making true and useful interpretations for businesses and individuals. The goal of location analytics is not to create “beautiful graphics,” but valid and meaningful insights. The question is whether an outcome of location analytics is really going to benefit the specific business process/decision-making? The need for validation of big data and the resulting outcome signals a new form of business practices and responsibilities to monitor the quality of information throughout the location analytics process.

Today’s businesses target individuals to personalize services and products. Tapestry segmentation is a great data source to enhance the location intelligence and analytics capabilities [1]. Current tapestry segmentation does not take into account the spatial-temporal patterns of people’s behaviors. As a result, there is an opportunity to develop more detailed profiles of individuals at different locations and times to infuse neighborhood tapestry segmentation. With the availability of sensor data inside households (e.g., from smartphones, IoT devices, smart assistants) and valuable social media data [2], spatial-temporal segmentation can even go inside homes to see what people do (behavioral analysis) and how they feel (sentiment mining) at different locations within their private life. It may sound creepy and intimate, but people already give up some portion of their privacy in exchange for some benefits and incentives [3]. They even bring their smartphones to bed. Researchers and practitioners should find new ways to keep track of individuals’ data and maximize business benefits, while still preserving individuals’ privacy.

References
Werner Kuhn holds the Jack and Laura Dangermond Endowed Chair in Geography at the University of California, Santa Barbara, where he is professor of Geographic Information Science. He is also the director of the Center for Spatial Studies at UCSB. His main research and teaching goal is to make spatial information and computing accessible across domains and disciplines. Before joining UCSB in late 2013, Kuhn was a professor of Geoinformatics at the University of Munster, Germany, where he led MUSIL, an interdisciplinary semantic interoperability research lab. Kuhn is described as a leading expert in the area of geospatial semantics and especially known for his work on Semantic Reference Systems as well as his work on interaction metaphors for Geographic Information Systems. Recent research projects include the Linked Open Data University of Muenster (together with the university library), and a series of EU projects on geospatial services in the semantic web.

Kuhn holds a doctorate from ETH Zurich (1989) and was a post-doctoral researcher with the National Center for Geographic Information and Analysis (1989–1991) as well as with the Vienna University of Technology (1991–1996). He is a co-founder of the COSIT Conference Series (since 1993) and of the Vespucci Initiative for Advancing Science through Geographic Information. He has been a visiting scientist at UCSD’s Meaning and Computation Lab (2002/03), the UK eScience Center at Edinburgh (2007), and the Brazilian Institute for Space Research, INPE (2011). His publications range from GIScience and usability engineering through cognitive science to formal ontology.

Kuhn was an elected member of the Council of AGILE (Association of Geographic Information Laboratories in Europe, from 1998 to 2002), the international member of the Research Management Committee of the Canadian GEOIDE network (2001 to 2003), the Technical Director Europe of the Open GIS Consortium (1998 to 2001), and an Austrian delegate to CEN TC 287 on Geographic Information (1992 to 1995). He is a member of several editorial boards of peer-reviewed international journals, such as the International Journal of Geographical Information Science (IJGIS), the Semantic Web Journal (SWJ), Applied Ontology (AO), Spatial Cognition and Computation (SCC), the International Journal of Spatial Data Infrastructures Research (IJSDIR) and the Journal of Spatial Information Science (JoSIS).
Paul Longley is Professor of Geographic Information Science at University College London where he also directs the UK Economic and Social Research Council funded Consumer Data Research Centre. In addition to wide interests in GIScience, he has also worked in data sharing projects with the business sector since 2000. His research interests are developed around socioeconomic applications of GIScience, and have included projects based on topics such as: geo-temporal demographics and social media usage, fractal analysis of cities, geo-genealogy of family names, retail geography analytics and the effectiveness of public service delivery (specifically health, education and policing). His publications include 18 books and more than 150 contributions to refereed journal articles, edited collections, and book chapters. He is past Editor-in-Chief of the academic journal Computers, Environment and Urban Systems and a past co-editor of Environment and Planning B.

Longley is a co-author of the best-selling book, Geographic Information Science and Systems. He is a regular contributor to internationally conferences, he has held 11 externally funded visiting appointments, and has many extensive teaching commitments.
Karthik Babu Nattamai Kannan is a Ph.D. Candidate in IT Management at the Scheller College of Business, Georgia Institute of Technology. His research interests include business/location analytics, economic geography of internet, economics of information, Big Data, electronic/mobile commerce, and social media. In his research he uses empirical methods such as advanced econometrics, machine learning, field/natural experiments etc. and optimization models to study large-scale datasets. His teaching interests include business analytics, and applied statistics. Prior to academia he spent ten years in industry as a technology and process consultant for The Home Depot, Citigroup, Johnson & Johnson, and GE. In this role, he worked on every aspect of the Software Development Life Cycle (SDLC)—from requirements analysis, and coding, to production support for developing/managing enterprise applications. While working for GE, he was inspired by their six-sigma philosophy that motivated him to become a Six Sigma Black Belt certified by the American Society for Quality (ASQ).

Spatial Analytics Position Statement

Due to the strategic role of the Internet, the United Nations special rapporteur declared that access to the Internet is a basic human right as it “boosts economic, social and political development, and contributes to the progress of humankind as a whole”. However, a large section of our society still does not use internet (digital divide), or even if they have access they can’t use it well (digital inequality). Scholars attribute these inequalities to geographic divide (difficulty in serving isolated rural areas) and socioeconomic divide (lack of knowledge and resources to effectively use the internet).

Can mobile internet overcome some of the limitations of previous generations of internet to reduce digital inequality? Can it help those who are disadvantaged because of social background, location, or lack of resources? Can enterprises use the unique location from mobile phones to improve their operations? Can e-commerce markets help local businesses sell to national markets? I explore (Figure 1) these socially important questions by examining the mechanisms by which the internet benefits individuals, society and enterprises. In the first stream of research, I use location data gathered from mobile phones to study flow of people in geographic networks. I build a data-driven optimization models that leverage this location data to predict both the number and location of retail stores for a given market. In the second stream, I study the production and consumption of goods (both physical and information gods) in internet enabled markets. I explore how local
businesses can leverage social media to sell their products in national markets. I also study the geographic distribution of internet content creation and consumption. In the third stream, I study the last mile delivery of internet, namely mobile networks and Wi-Fi. I examine how subscribers use these channels in a complementary manner and how this usage is moderated by the location (home, office, restaurants, retail shops etc.). I also look at how mobile internet can reduce digital inequality.

**Figure 1. Research program**

<table>
<thead>
<tr>
<th>Location Analytics</th>
<th>Geography</th>
<th>Economic Context</th>
<th>Research Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markets</td>
<td>Flow of people</td>
<td>Optimization of retail networks, online vs. stores behavior of customers</td>
<td>Machine learning, optimization, natural experiment</td>
</tr>
<tr>
<td>Consumption</td>
<td>Geographic Networks</td>
<td>Marker Movement, social media</td>
<td>Econometrics, matching, quasi experiment</td>
</tr>
<tr>
<td>Last Mile Infrastructure</td>
<td>Online activities across geography</td>
<td>Content creation vs. consumption</td>
<td>Econometrics, field/quasi experiment</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Urban vs. Rural</td>
<td>Digital Inequality, Knowledge Gap, Complements or substitutes?</td>
<td></td>
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<tr>
<td></td>
<td>Coffee shops vs. home etc.</td>
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</tbody>
</table>

Geography plays a key element in all my of research questions. I am looking to understand how geography was studied in other disciplines so that I can use this knowledge in my research. Also, I want to develop my skills in the tools and techniques used in the analysis of geographic data. I hope to leverage my research in this area to develop courses on location analytics targeted for graduate and undergraduate students in business schools.
Selwyn Piramuthu is Professor of Information Systems at the University of Florida in Gainesville. He received his Ph.D. from the University of Illinois at Urbana-Champaign. His research interests include machine learning and cryptography as well as their applications in various domains that include manufacturing scheduling, sensor networks, supply chains, among others.

Position Statement

I am interested in studying location-awareness as a concept, and have briefly studied the use of location information generated through sensors (e.g., GPS) for RFID/IoT authentication purposes and multichannel retailing. I have read about the use of location information for routing in supply chains. I want to learn more about location-related information, its use, and the state-of-the-art from experts at this event.
John Preysner is a business consultant at Esri focused on introducing Location Analytics to new Esri users in the Commercial sector. This often takes the form of identifying and partnering with an analytics champion within each prospective user’s organization, and working with this champion to demonstrate to a larger department- or company-wide audience how location impacts business outcomes. While focused on the Commercial sector broadly, Preysner has a particular interest in introducing location analytics to mid-market companies and has worked with companies in the financial services, real estate, agriculture, professional services, and healthcare verticals.

Preysner is particularly interested in how companies understand and target customers, and enjoys working with new Esri users to show them how location analytics can help them reach these ends. He has found that companies that have a concrete strategy for deriving and applying location-based insights find the most success—whether they are working with simple demographic overlays of a given market or detailed customer loyalty program data.
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Kevin Scheibe is a Kingland Business Analytics Faculty Fellow and Associate Professor of Management Information Systems at Iowa State University. His research interests include business analytics, IT privacy and security, supply chain risk, spatial decision support systems, wireless telecommunications, and IT outsourcing. He is a member of the Association for Information Systems and the Decision Sciences Institute. Scheibe has published in journals such as Decision Sciences Journal, European Journal of Operations Research, Decision Support Systems, Journal of Information Privacy and Security, Communications of the ACM, and Computers in Human Behavior. He serves as an Associate Editor at Decision Sciences Journal. His teaching interests include machine learning and business analytics, computer-based decision support systems, and management information systems at both graduate and undergraduate levels. He received a Ph.D. from Virginia Polytechnic Institute and State University. Prior to academia he spent ten years in industry as a software engineer, IT consultant, and director of operations for a real estate investment company.

Spatial Analytics Position Statement

The call for participation in the leadership workshop on location analytics in business is directed to early-career researchers. While I am no longer an early-career researcher, my renewed interests in location analytics motivates me to request special consideration. My Ph.D. is from Virginia Polytechnic Institute and State University and was granted in 2003. My dissertation work was focused on spatial analytics using ESRI ArcView. The title of my dissertation is “A spatial decision support systems for planning fixed wireless telecommunications networks.” Out of my dissertation, I was able to publish three peer-reviewed journal articles that had location analytics components. The first was published in Decision Support Systems entitled “Going the last mile: A spatial decision support system for wireless broadband communications.” The second location analytics paper was published in Telecommunications Systems entitled “Addressing universal-broadband-service implications with wireless mesh networks.” The third paper was published in European Journal of Operational Research and was titled “A model for the capacitated, hop-constrained, per-packet wireless mesh network design problem.”

Each of these three papers applied spatial analytics and used optimization to solve a prescriptive analytics problem. Each used ArcView API to add a spatial level of depth to the constraints and objective functions of relevant problems.
Since that time, I have moved away from spatial components of research, but have had a strong desire to reacquaint myself in that area. As analytics have increased in prominence of research, my original training has also increased in relevance. I am still on the front side of midway through my career, and I see many opportunities to publish location analytics research, in addition to teaching opportunities. I have started a couple projects with our state department of transportation, where they have massive datasets at fine levels of spatial granularity, and would like to apply analytics to enable location sensitive decisions. I believe there are some interesting opportunities in this area. Additionally, I have been working with a manufacture of large-scale equipment that contains telematics data including GPS, and there are some interesting analytic questions involved.

My university has a strong relationship with ESRI, and I have access to the necessary tools. However, as it has been some time since I last worked with spatial data, and I found publishing my spatial decision support papers to be difficult in that it was not widely used in business journals, I think the time has changed for viability of location analytics paper in the business domain.

So, I would ask that you consider my application to participate in this workshop, even though I am not early-career. I do see a strong likelihood that I will be working in this area for many years to come, and would like to opportunity to engage with other likeminded scholars.
Position Paper

Location analytics and business-oriented research are all about optimization. Although my experience with geography and GIS is limited, I have expressed interest in the topic of optimization since my introduction to geographic information systems. For my final project during my introductory GIS course, I evaluated the efficiency of library placements in my county in terms of patronage and distance traveled by patrons. I later led a more extensive GIS project for the nutrition department at my university wherein I developed an interactive mapping tool of the food sources, public health indicators and demographic data in the 16 countries that make up East Tennessee for the use of any academician, policymaker or activist to study local trends in nutrition and health. This was to ensure that reliable methods are used to improve food access so that people are positively impacted and funds are not wasted.

This intersection between social issues and GIS/GIScience would serve as my focus and my intended contribution to this workshop and to this emerging field. Specifically, I would hope to apply these questions, topics and technologies for nonprofit businesses that address UN Sustainable Development Goals. SDGs are valuable in condensing and prioritizing the most vital needs of the population today. In terms of food security and nutrition, for instance, the Huff Model—which is used to calculate the probability that a person from any given location will visit a particular store and predict the sales potential of potential store locations—has been applied alongside a number of other models to determine spatial rates of high food insecurity in the Minneapolis area. It would be fascinating to explore this and similar models further through this workshop.

I am currently a first-year graduate (MA/PhD) student in the Department of Geography at UCSB in the STKO lab. I finished my undergrad in the spring, where I studied an interdisciplinary course
titled Computational Social Science, for which I took classes in GIS, data mining and analytics using R and NCSS, database management, more advanced HTML skills, and network analysis using Gephi, as well as courses in sociology, political science, information science and the non-profit model. I graduated with a minor in Business Analytics. I therefore supply both an interdisciplinary perspective and prior knowledge of business analytics themes and goals, as well as strong communication skills and adaptability to new material and perspectives.
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Shaohua Wang is Postdoctoral Fellow of Institute of Geographic Sciences and Natural Resources Research, CAS. He is Visiting Scholar of Department of Geography University of California, Santa Barbara. Wang received his PhD in Cartography and Geographical Information System from the University of Chinese Academy of Sciences, China. He also earned a BS in Mathematics from Beijing University of Chemical Technology. His research interests include spatial optimization, location analytics, logistics, spatial big data, machine learning and other critical geographic information technologies. His work has been published in journals such as ISPRS International Journal of Geo-Information, Bulletin of Surveying and Mapping, Journal of Resources and Ecology, Physica A: Statistical Mechanics and its Applications, Sensor Letters and Journal of Geo-Information Science. He was recognized with the 2015 Beijing science and technology award and 2014 scientific and technological progress award of Chinese Geographic information. He served as deputy director of SuperMap GIS Technology Institute in 2015. He obtained Beijing Training Funding for Excellent about location analytics in business. He got the international postdoctoral exchange fellowship program and Chinese government scholarship on location analytics as a visiting scholar of Department of Geography University of California, Santa Barbara.

Comparative analysis for p-median problems: A Position Statement

P-median problem is widely used for location analytics in business. The p-median problem has attracted more attentions[1]. There are hundreds of methods for solving p-median problems[2]. Heuristic methods can get approximate solution for p-median problems within short time. Integer linear programming and formulation method can be used for finding an optimal solution via linear programming solver over long time. It is important to analyze efficiency of different p-median problems. We explore a benchmark framework to comparative analysis for p-median problems.

There are four types of methods were implemented for benchmark of comparative analysis for p-median problems, including open source linear programming solvers, commercial linear programming solvers, heuristic methods and formulation methods. In this study, we used open source solver (Google Or-Tools, Soplex, Qsopt), commercial solvers (Gurobi, Cplex 12.7.1) for get an optimal solution. Teiz_bart, Simulation Annealing[3], Variable neighborhood search[4] and GRASP[5] are tested as heuristic methods for approximate solution. BEAMR[6] and Radius[7] are used as formulation methods. 40 files test data set came from Beasley files.
Flowchart shows how these steps interacting in the benchmark framework (Figure 1).

Figure 1. Flowchart of benchmark framework for p-median problem

Results show that Soplex works best from open source solvers, Gurobi performs much faster than Cplex, GRASP is the fastest algorithm among heuristic methods, BEAMR is better than Radius method. GRASP can be used for finding approximate solution for p-median problem. Gurobi is first choice to solve p-median problem as integer linear programming method. We can use BEAMR to solve a huge p-median problem. GRASP can be used for finding approximate solution in the first phrase, Gurobi can be used for integer linear programming.

In this research, the benchmark framework was able to provide comparative analysis of the efficiency for p-median problems. Further work in this area will implement methodology of BEAMR for solving huge p-median problem (over 10000 nodes). In addition, we can use hybrid parallel framework to improve performance for p-median problems. Pointer networks of machine learning framework for the p-median problem will be evaluated in the future work.

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