OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Shekhar, Shashi

eRA COMMONS USER NAME (credential, e.g., agency login): SSHEKHAR

POSITION TITLE: Distinguished McKnight University Professor

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)

| INSTITUTION AND LOCATION | DEGREE(if applicable) | Completion DateMM/YYYY | FIELD OF STUDY |
| --- | --- | --- | --- |
| Indian Institute of Technology, Kanpur, India | B.S | 05/1985 | Computer Science |
| University of California, Berkeley, CA, USA | M.S. | 12/1987 | Computer Science |
| University of California, Berkeley, CA, USA | M.S. | 12/1989 | Business Administration |
| University of California, Berkeley, CA, USA | Ph.D. | 12/1989 | Computer Science |

**A. Personal Statement**

I have a broad background in Computer Science, with specific training and expertise in spatial databases, spatial data mining and Geographic Information Science. My research includes geo-spatial approaches to cancer control including geo-spatial surveillance. As PI or co-Investigator on several university-, NSF-, USDOD- and NIH-funded grants, I laid the groundwork for the proposed research by developing effective measures and scalable algorithms to analyze spatial and spatio-temporal data for interesting, novel and non-trivial patterns such as statistically significant hotspots, colocations, spatial anomalies in context of societal applications such as public health, public safety, emergency evacuation and transportation. Many of my previous experiences are interdisciplinary and I am aware of the importance of communication among project members from different disciplines and I know how to construct a realistic research plan, timeline, and budget in a collaborative research project. In summary, I have the expertise, leadership, training, expertise and motivation necessary to successfully carry out the proposed research project.

**B. Positions and Honors**

## Positions and Employment

1989-1995 Assistant Professor, University of Minnesota, Minneapolis, MN

1995-2000 Associate Professor, University of Minnesota, Minneapolis, MN

2001-present Professor, University of Minnesota, Minneapolis, MN

2005 – 2007 Director, Army High Performance Computing Research Center, University of Minnesota

2005-present Distinguished McKnight Univ. Professor, University of Minnesota, Minneapolis, MN

2015-present Distinguished Teaching Professor, University of Minnesota, Minneapolis, MN

## Other Experience and Professional Memberships

## 2016 - present Member, Masonic Cancer Center, University of Minnesota.

## 2016 Presented a talk in the Conference on Geospatial Approaches to Cancer Control and Population Sciences, September 12-14, NIH National Cancer Institute, Bethesda, MD, 2016.

## 2013 Distinguished Colloquium on “From GPS and Virtual Earth to Spatial Computing 2020”, Division of Cancer Control and Population Sciences, NIH National Cancer Institute, Dec. 12th, 2013.

## 2012-2013 Invited speaker in three NIH-AAG workshops on Geospatial Frontiers in Health and Social Environment: Towards a Unified Vision, National Inst. of Health & Am. Asso. of Geographers.

2003-2009 Member, Mapping Sciences Committee, National Academy of Sciences.

2015-2016 Member, National Academies Committees on “From Maps to Models:

Augmenting Nation’s Geospatial-Intelligence Capabilities”

2012-2013 Member, National Academies Committee on Geo-targeted Alerts and Warning,

2011-2012 Member, National Academies’ Committee on Future Workforce for Geospatial Intelligence.

2004-2005 Member, National Academies) Committee to review basic and applied research at the

USDOD National Geo-spatial Intelligence Agency (NGA).

2016-2017 President Elect, University Consortium of Geographic Information Science.

2016-2019 Chair, Board of Directors, Symp. on Spatial and Temporal Databases (SSTD) Endowment.

2016-2019 Member, Board of Directors, Computing Research Association (CRA).

2012-2015 Member, Computing Community Consortium Council supervising a grant from the

National Science Foundation to the Computing Research Association.

## Honors

2015 Education Award, University Consortium on Geographic Information Science

2015 Post-baccalaureate, Graduate and Professional Teaching Award, University of Minnesota

2011 Elected a Fellow of the Institute on Environment, University of Minnesota

2006 Elected an AAAS Fellow for distinguished research, service and teaching contributions to the advancement of science in the fields of spatial databases, spatial data mining and GIS.

2006 Awarded the IEEE Computer Society Technical Achievement Award for distinguished contributions to research, teaching and service in spatial databases.

2005 McKnight Distinguished University Professorship, University of Minnesota

2003 Elected an IEEE Fellow for contributions to spatial database storage methods, data mining, and geographic information systems.

**C. Contributions to Science**

1. A major goal of my research is to understand the computational structure of very large geo-spatial computations (e.g., data analysis via spatial querying and mining) needed by social, biological and physical sciences as well as engineering disciplines. Since 1999, I have developed the research area of spatial computing, spatial database management and spatial data analytics via keynote speeches, survey papers and workshop organizations.
2. *Spatial Computing*, Communications of the ACM (Association for Computing Machinery), cover article, 59(1), Jan. 2016 (w/ S. Feiner, W. Aref).
3. *Spatiotemporal Data Mining: A Computational Perspective*, Special Issue on Advances in Spatio-Temporal Data Analysis and Mining, ISPRS International Journal of Geo-Information, 4(4), 2306-2338, 2015. (w/ Z Jiang, R. Ali, E. Eftelioglu, X. Tang, V. Gunturi, and X. Zhou)
4. *Identifying patterns in spatial information: A survey of methods*, Wiley Interdisciplinary Review: Data Mining and Knowledge Discovery 1(3), 2011. (w/ M. Evans, J. Kang, P. Mohan).
5. *Spatial Databases: A Tour*, Prentice Hall, 2003 (co-authored with S. Chawla).
6. Another part of my research investigated spatial data mining techniques since classical data mining techniques often perform poorly due to violation of underlying assumption that the data samples are drawn independently and from identical distribution. Other challenges include large data size, implicit spatial (e.g., neighbor) relationship in a continuous geographic space, high cost of false positives and spurious chance patterns. To address these, my papers provided an influential neighbor-graph representation and leveraged it to define new spatial pattern families (e.g., co-location, spatial outliers, hotspots) quantified by interest measures, providing not only scalable algorithms but also spatial-statistical interpretation. This transformed the field from a collection of ad-hoc techniques into a mathematically-rigorous scientific discipline.
7. *Ring-Shaped Hotspot Detection*, IEEE Transactions on Knowledge and Data Engineering, 28(12):3367-3381, 2016 (w/ E. Eftelioglu, J. Kang, C. Farah).
8. *A K-Main Routes Approach to Spatial Network Activity Summarization*, Transactions in Knowledge and Data Engineering , IEEE, 26(6), 2014 (with Dev Oliver, James M. Kang, Renee Laubscher, Veronica Carlan, and Abdussalam Bannur).
9. *Cascading spatio-temporal pattern discovery*, Transactions on Knowledge and Data Engineering, IEEE, 24(11), 2012. (with P. Mohan, J. Shine, and J. Rogers.)
10. *Discovering Colocation Patterns from Spatial Data Sets: A General Approach*, IEEE Transactions on Knowledge and Data Engineering, 16(12), 2004 (with Y. Huang et al.).
11. My research developed core technologies behind in-vehicle navigation devices as well as web-based routing services, which revolutionized outdoor navigation in urban environment in the last decade. My recent research results also played a critical role in evacuation route planning for homeland security and received multiple recognitions including the Cnter for Transportation Studies Partnership Award for significant impact on transportation. Traditional approaches evacuation route planning face severe scalability challenges. My approach introduced compact time-aggregated graph representation and the Capacity Constrained Route Planner, the most scalable evacuation route-planning algorithm today.
12. *Capacity-Constrained Network Voronoi Diagram*, IEEE Transactions on Knowledge and Data Engineering, 27(11), 2015. (w/ Kwangsoo Yang).
13. *Experiences with Evacuation Route Planning Algorithms*, International Journal of Geographical Information Science (IJGIS), Taylor and Francis, 26(12), 2012, (with KwangSoo Yang, Viswanath Gunturi, and Dev Oliver).
14. *Contraflow Transportation Network Reconfiguration for Evacuation Route Planning*, IEEE Transactions on Knowledge and Data Engineering, 20(8), 2008, (pp. 1115-1129). (w/ Sangho Kim, and Manki Min).
15. *CCAM: A Connectivity-Clustered Access Method for Networks and Network Computations*, Transactions on Knowledge and Data Engineering, IEEE, 9(1), Jan.-Feb. 1997 (with D. R. Liu.).

## Complete List of Published Work in My Bibliography:

<http://www.cs.umn.edu/~shekhar/bio/2016/fullreport.pdf>

**D. Additional Information: Research Support and/or Scholastic Performance**

## Ongoing Research Support

## NSF CISE/Expeditions 08/2010 – 08/2017

## Expedition: Understanding Climate Change: A Data Driven Approach: This project addresses key challenges in the science of climate change by developing methods that take advantage of the wealth of climate and ecosystem data available from satellite and ground-based sensors, the observational record for atmospheric, oceanic, and terrestrial processes, and physics-based climate model simulations.

## Role: Senior Personnel, Investigator

## NSF OCI/Datanet 10/2011 – 09/2017

## Datanet: Terra Populus: A Global Population Environment Data Network: Terra Populus will integrate the world’s population and environmental data, including population censuses and surveys; land cover information from remote sensing; climate records from weather stations; and land use records from statistical agencies.

## Data that are interoperable across time, space, and scientific domain will allow us to understand the dramatic transformation of the earth’s inhabitants and their environment. This infrastructure will make it easier for researchers to use data describing people along with data describing the places they inhabit.

## Role: Co-Principal Investigator

## NSF CISE/IIS/III 09/2012 – 08/2017

## III: Small: Towards Spatial Database Management Systems for Flash Memory Storage: The goal of this research project is to design and develop highly efficient spatial and spatio-temporal database systems on flash memory storage. Specific aims include investigation of efficient spatial indexing on flash memory, efficient spatial query processing and optimization, spatio-temporal indexing and querying, storage hierarchy of flash and magnetic disks to exploit the full potential of both storage media.

## Role: Co-Principal Investigator

## USDOD NGA (HM0210-13-1-0005) 05/2013 – 05/2017

## Identifying and Analyzing Patterns of Evasion: The goal of this project is to investigate novel and computationally efficient methods for quantifying and mining spatio-temporal patterns of evasion.

## Role: Principal Investigator

## NSF CISE/IIS/III (IIS-1320580) 08/2013 – 08/2017

## III: Small: Investigating Spatial Big Data for Next Generation Routing Services: The goal of this project is to study emerging spatial big datasets (e.g., GPS track, engine measurements, temporally detailed roadmaps) to rank alternative routes on greenhouse gas emissions and fuel consumption.

## Role: Principal Investigator

## NSF (1541876) 05/2015 – 05/2017

## FEW: A Workshop to Identify Interdisciplinary Data Science Approaches and Challenges to Enhance Understanding of Interactions of Food Systems and Water Systems: The goal of this project is exploring a research agenda intersecting data science and the nexus of food, energy and water security.

## Role: Principal Investigator.

## Completed Research Support

<http://www.cs.umn.edu/~shekhar/bio/2016/fullreport.pdf>