HANCHENG CAO

chc14@mails.tsinghua.edu.cn | http://hanchengcao.me | (+86) 18810996068

EDUCATION

Tsinghua University Beijing, China
B.Eng. in Electronic Engineering Aug 2014 – Jun 2018

- GPA: 92.2/100; Rank: 12/262
- Course Highlight: Calculus (100), Linear Algebra (98), Signal & Systems (92), Physics (95), Intro to Artificial Intelligence (100), Advanced Matlab Programming and Applications (95), Student Research Training (97)
- Awarded the China National Scholarship, the Comprehensive Scholarship, the Research Excellence Award, and the Academic Excellence Award
- Selected to Spark Scientific and Technological Innovation Fellowship (top 1.5% of 3560 Tsinghua students for outstanding research performance)

University of Maryland, College Park College Park, MD, USA
Exchange Student Aug 2016 – Dec 2016

- GPA: 3.83/4.0
- Course Highlight: Intro to Data Science (A+), Digital Signal Processing (A+)
- Contributed to collaboration between UMD Distinguished Professor Hanan Samet's lab and Tsinghua Future Communications & Internet Lab

Massachusetts Institute of Technology Cambridge, MA, USA
Visiting Student and Research Assistant in the Human Dynamics Group, MIT Media Lab Jun 2017 – Sep 2017

- Fostered collaboration between MIT Human Dynamics Group, BNU-MIT Intellectual Innovations City Lab and Tsinghua Future Communications & Internet Lab.

PUBLICATIONS

1. **H. Cao**, F. Xu, J. Sankaranarayanan, Y. Li, H. Samet. Habit2vec: Trajectory Semantic Embedding for Living Pattern Recognition in Population. Submitted to 2018 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2018). Under Review. [PDF]
2. **H. Cao**, J. Feng, Y. Li, V. Kostakos. Uniqueness in the City: Urban Morphology and Location Privacy. Submitted to 2018 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2018). Under Review. [PDF]
3. **H. Cao**, J. Sankaranarayanan, J. Feng, Y. Li, H. Samet. Understanding Metropolitan Crowd Mobility via Mobile Cellular Accessing Data. Submitted to IEEE Transactions on Visualization and Computer Graphics (TVCG). Under Review. [PDF]
4. M. Zeng, **H. Cao**, M. Chen, Y. Li. User Behavior Modeling, Recommendations, and Purchase Prediction During Online Shopping Festivals. To appear in Springer Electronic Markets (EM). [PDF]
5. H. Shi, **H. Cao**, X. Zhou, Y. Li, C. Zhang, V. Kostakos. Semantics-Aware HMM for Human Mobility Modelling. Submitted to the Web Conference 2018 (WWW'18). Under Review. [PDF]
6. F. Xu, T. Xia, **H. Cao**, Y. Li, F. Sun, F. Meng. Detecting Popular Temporal Modes in Population-scale Unlabelled Trajectory Data. Conditionally accepted under major revision in 2018 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2018). [PDF]

RESEARCH EXPERIENCE

Massachusetts Institute of Technology (Media Lab) Cambridge, MA, USA
Research Assistant to Prof. Alex 'Sandy' Pentland, Member of National Academies, World Economic Forum Councils, Advisory Board of United Nations, Director of MIT Media Lab Human Dynamics Group, and Prof. Xiaowen Dong Jun 2017 – Present

Purchasing Pattern Recognition in Metropolis

- Independent research work recognizing typical purchasing patterns in population from large-scale credit card transaction data via representation learning based method and Monte Carlo Simulation
- Proposed algorithms embedding people's purchasing behavior to numeric vectors that better preserved original semantics; studied demographic factors (gender, age, etc.) contributing to people's purchasing patterns and the role of social learning in shaping those purchasing patterns
- Described the study and presented results in a paper being prepared for submission as first author

University of Maryland (Department of Computer Science) College Park, MD, USA
Research Assistant to Prof. Hanan Samet, University Distinguished Professor May 2017 – Present
IEEE/ACM/AAAS/ICPR/UCGIS Fellow

Habit2vec: Trajectory Semantic Embedding for Living Pattern Recognition in Population

- Proposed a novel method to recognize and cluster metropolitan human living patterns through semantic-rich spatial temporal data breaking through geographic constraints; introduced neural network based representation

learning to represent user living habits embedded in individual trajectories through numeric vectors; evaluated the effectiveness of the proposed framework on a large-scale real-world trajectory dataset in Beijing
- Submitted a paper to 2018 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2018) as first author

University of Maryland (Department of Computer Science) College Park, MD, USA
Research Assistant to Prof. Hanan Samet, University Distinguished Professor Sep 2016 – Apr 2017
IEEE/ACM/AAAS/ICPR/UCGIS Fellow
Understanding Metropolitan Crowd Mobility via Mobile Cellular Accessing Data
- Took advantage of a large-scale fine-grained cellular tower access trace and analyzed crowd mobility on city block level recognized through road network data in Shanghai; proposed algorithms to recognize homes, workplaces and stay regions of users; validated the methodology via ground truth data collected from volunteers; developed a visual analytics procedure to discover hidden block-level correlation rules and neighborhood structures formed by crowd mobility via network analysis method
- Submitted a paper to IEEE Transactions on Visualization and Computer Graphics (TVCG, IF: 2.840) as first author

University of Melbourne (School of Computing and Information Systems) Melbourne, Australia
Research Assistant to Prof. Vassilis Kostakos and Prof. Yong Li (Tsinghua) Sep 2017 – Nov 2017
Uniqueness in the City: Urban Morphology and Location Privacy
- Studied location uniqueness in cities through Open Street Map (OSM) data to better understand city structure and location privacy
- Proposed an efficient algorithm to re-identify user geolocations supplied by provision of surrounding Point of Interest (POI); conducted experiments in New York, Melbourne, Vancouver, and Zurich to analyze factors including reporting radius, POI density, POI composition, and distance to city center, in shaping location privacy
- Submitted a paper to 2018 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2018) as first author

Tsinghua University (Department of Electronic Engineering) Beijing, China
Research Assistant to Prof. Yong Li, Future Communications & Internet Lab Jun 2017 – Oct 2017
User Behavior Modeling, Recommendations and Purchase Prediction
- Case study on user online browsing and purchasing behaviors during a large shopping festival in China via clickstream data and shopping logs collected from China's leading e-commerce site
- Conducted detailed analysis on user browsing and shopping patterns; proposed collaborative filtering based method to recommend items for different customers; constructed customer model to predict user shopping behavior
- Paper accepted at Springer Electronic Commerce (IF: 1.864) as second author

Tsinghua University (Department of Electronic Engineering) Beijing, China
Research Assistant to Prof. Yong Li, Future Communications & Internet Lab Jun 2017 – Oct 2017
Semantic-Aware HMM for Human Mobility Modeling
- Proposed a novel human mobility model, which jointly takes into account spatial and temporal activity, as well as user motivation in human mobility
- Introduced graph embedding in mobility model to capture complex semantics in mobility; proposed a von Mises-Fisher mixture clustering for grouping users of similar mobility patterns to tackle data sparsity; trained an ensemble of Hidden Markov Model in embedding space to represent group-level mobility patterns
- After conducting extensive experiments on two large-scale datasets, we found that our model outperformed baselines by a statistically significant margin in the task of next location/activity prediction; the resulting paper was submitted to the Web Conference 2018 (WWW'18) with me as second author

Tsinghua University (Department of Electronic Engineering) Beijing, China
Research Assistant to Prof. Yong Li, Future Communications & Internet Lab Jun 2017 – Oct 2017
Detecting Popular Temporal Modes in Population-scale Unlabelled Trajectory Data
- Presented the innovative idea of understanding human daily routines by detecting different popular temporal modes (i.e., how different people allocate their time)
- Proposed a novel distance metric to compare the similarity between temporal modes for clustering; using two large-scale spatial temporal datasets in Beijing and Shanghai, we successfully detected distinct and meaningful temporal modes
- Paper conditionally accepted under major revision in 2018 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2018) as third author

Tsinghua University (Department of Electronic Engineering) Beijing, China

Student Research Training Project with Prof. Depeng Jing, Oct 2015 – Aug 2016
Future Communications & Internet Lab
Linking Physical and Cyber Space via Big Data

- Independent research work exploring the correlation between webpage browsing behavior and the location of web connection using Wi-Fi big data in Shanghai, China through co-clustering

Tsinghua University (Department of Automation) Beijing, China
Student Research Training Project advised by Prof. Lihui Peng, Mar 2015 – Feb 2016
Director of Institute of Measurement and Electronic Technology
Music Performance Analysis—A Perspective from Signal Processing

- Collected music performance datasets; used signal processing and machine learning method to recognize chord usage, analyzed music genre, and performance style
- Research Group Leader

SELECTED AWARDS AND HONORS

- China National Scholarship, 2017 (Highest level of scholarship set by the government of China)
- Qualcomm Scholarship, 2017 (Awarded to top 33 of 2562 applicants with excellent scientific potential)
- The China Scholarship Council (CSC) Scholarship, 2016
- Zhang Mingwei Scholarship, 2016 (Awarded to students for outstanding academic performance)
- Changhong Scholarship, 2015 (Awarded to students for outstanding academic performance)
- Philobiblion Scholarship, 2016 (0.5% of 1000 applicants)
- Tsinghua Comprehensive Excellence Award, 2015–17 (Top 5% of 262 students)
- Tsinghua Research Excellence Award, 2015–17 (Top 5% of 262 students)
- Tsinghua Academic Excellence Award, 2015–17 (Top 5% of 262 students)
- 1st Prize for the 32rd National Undergraduate Physics Olympic, 2015 (Top 1%)

ADDITIONAL INFORMATION

- **Extracurricular activities:** Clavier Team of Tsinghua Student Art Troupe, (Member: 2014 – Present; Vice Captain 2015 – 2016), Tsinghua Science and Technology Association (Member: 2015 – 2016)
- **Computer skills and proficiencies:** C/C++, MATLAB, Python, R, SQL, D3.js, Data Structure and algorithms, Data Scraping, Machine Learning, LATEX
- **Language skills and proficiencies:** Mandarin Chinese (Native); English (Proficient: TOEFL 117/120; GRE Verbal 161, Quantitative 170, Analytical Writing 3.5); German (Elementary)