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Fangzhou Sun

Ph.D. in Computer Science

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EDUCATION

- **Ph.D., Computer Science,** Vanderbilt University, Nashville, TN, USA *May 2018*
  - **Dissertation:** Algorithms for context-sensitive prediction, optimization, and anomaly detection in urban mobility
- **M.S., Computer Science,** Vanderbilt University, Nashville, TN, USA *Aug. 2015*
- **B.S., Computer Science and Technology,** Nanjing University, Nanjing, Jiangsu, China *July 2013*

SUMMARY

Machine Learning

- Deep learning models for predicting bus delay using contextual information and identifying contextual anomalies in traffic data.
- Cyber-attack detection system for web applications that combines machine learning and unit tests.

Data Mining

- Multi-timescale data analytics mechanisms for predicting and optimizing the performance of transit systems.

RESEARCH EXPERIENCE

Transit Hub - Funded by the National Science Foundation (NSF) *Mar. 2015 – Apr. 2018*

(Predicting and Optimizing the Performance of Urban Mobility Using Machine Learning and Data Mining Techniques)

- Designed *deep neural networks* (*convolutional neural networks*) to identify non-recurring traffic congestion, achieving a 98.73% accuracy with low false positive and false negative rates [5]. *Keras Python* library with *TensorFlow* backend is used.
- Implemented a multi-task deep neural network that predicts the bus delay in short-term using contextual information [4].
- Developed a short-term bus delay prediction model that combines *unsupervised clustering* analysis and *Kalman filters*. The *root-mean-square-error* is only 60 seconds, which outperforms the state-of-the-art in accuracy [1,6].
- Applied long-term predictive analytics on historical *General Transit Feed Specification (GTFS)* and time-point bus data through *MongoDB* using *scikit-learn* and *Matplotlib* Python libraries [1,6].
- Developed *unsupervised* mechanisms for optimizing the on-time performance of fixed schedule transit vehicles [8].
- Designed and implemented the *T-HUB iOS* app which features route planning, delay estimation and real-time navigation, using *Objective-C, Core Data, Google Map SDK for iOS, GTFS, GPS* and *RESTful APIs*, and it's used by hundreds of bus riders in Nashville.
- Implemented a graph visualization web front-end dashboard using *HTML*, *JavaScript*, *Google Map JavaScript API*, *D3.js*, *Bootstrap*, *Socket.IO* with a *Python Flask RESTful* server for Nashville Metro Transportation Authority.

Robust Software Modeling Tool - Funded by the Office of Naval Research (ONR) *Oct. 2014 - Oct. 2015*

(Detecting Cyber-Attacks Using Machine Learning and Unit Tests)

- Developed a web service that applies various machine learning algorithms (*naive Bayes*, *Random Forests* and *SVM*) to detect the top cyber-attacks from the OWASP [7].

- Captured the data flows in the target application using *aspect-oriented programming* (*AOP*); employed *ElasticSearch*, *Logstash*, *Kibana* (*ELK*) for log parsing, analysis and storage, the *Weka* library for machine learning; used *Dockers* and *Containers* to wrap up and deploy the server and applications.
- Created *unit tests* to evaluate the performance of the machine learning classifiers.
- Detected *XSS*, *SQL injection* and *directory traversal* attacks of over 90% accuracy.

PRESENTATIONS

- DxNAT - Deep Neural Networks for Explaining Non-Recurring Traffic Congestion, IEEE BigData 2017 - 3rd Special Session on Intelligent Data Mining, December 2017
- Unsupervised Mechanisms for Optimizing On-Time Performance of Fixed Schedule Transit Vehicles, SMARTCOMP2017: Smart Computing Technologies and Applications, May 2017
- PhD Forum: Robust Sensing and Analytics in Urban Environment, SMARTCOMP2017: Smart Computing Technologies and Applications, May 2017
- Transit-Hub: An urban Transportation Systems with Multi-Timescale Analytics. Pizza Lecture at Institute for Software Integrated Systems - Vanderbilt University, May 2017
- DelayRadar: A Multivariate Predictive Model for Transit Systems, IEEE Big Data 2016 Conference Special Session on Intelligent Data Mining, December 2016
- Real-time and Predictive Analytics for Smart Public Transportation Decision Support System, 2016 IEEE International Conference on Smart Computing, May 2016

PUBLICATIONS

Journal Papers

[1] **Fangzhou Sun**, Abhishek Dubey, Jules White, Aniruddha Gokhale, Transit-Hub: A Smart Public Transportation Decision Support System with Multi-Timescale Analytical Services, Journal of Cluster Computing, Special Issue on Dynamic Data Driven Applications Systems (DDDAS)

[2] Chinmaya Samal, Liyuan Zheng, **Fangzhou Sun**, Lillian J. Ratliff, Abhishek Dubey, Towards a Socially Optimal Multi-Modal Routing Platform, ACM Transactions on Cyber-Physical Systems (TCPS) (Under Review)

[3] Yao Pan, **Fangzhou Sun**, Jules White, Douglas Schmidt, Jacob Staples, Lee Krause, Detecting Web Attacks with End-to-End Deep Learning, IEEE Transactions on Dependable and Secure Computing (Under Review)

Conference Papers

[4] **Fangzhou Sun**, Abhishek Dubey, Hiba Baroud, Chetan S. Kulkarni, Chinmaya Samal, Short-term Transit Decision Support System Using Multi-task Deep Neural Networks, The 4th IEEE International Conference on Smart Computing (SMARTCOMP 2018)

[5] **Fangzhou Sun**, Abhishek Dubey, Jules White, DxNAT - Deep Neural Networks for Explaining Non-Recurring Traffic Congestion, IEEE BigData 2017 - 3rd Special Session on Intelligent Data Mining, December 11-14, 2017, Boston, MA, USA

[6] **Fangzhou Sun**, Yao Pan, Jules White, and Abhishek Dubey, Real-time and Predictive Analytics for Smart Public Transportation Decision Support System, 2016 IEEE International Conference on Smart Computing, May 18-20, 2016, St. Louis, Missouri, USA (34% acceptance rate)

[7] **Fangzhou Sun**, Peng Zhang, Jules White, Douglas C. Schmidt, Jacob Staples, and Lee Krause. A Feasibility Study of Autonomically Detecting In-process Cyber-Attacks. 3rd IEEE International Conference on Cybernetics (CYBCONF-2017), Special Session on Cyber Security, June 21-23, 2017, Exeter, UK (35% acceptance rate)

[8] **Fangzhou Sun**, Chinmaya Samal, Jules White and Abhishek Dubey, Unsupervised Mechanisms for Optimizing On-Time Performance of Fixed Schedule Transit Vehicles, SMARTCOMP2017: Smart

Computing Technologies and Applications, May 29-31, 2017, Hong Kong, China (37% acceptance rate)

[9] Aparna Oruganti, **Fangzhou Sun**, Hiba Baroud, Abhishek Dubey, DelayRadar: A Multivariate Predictive Model for Transit Systems, IEEE Big Data 2016 Conference Special Session on Intelligent Data Mining, December 5-8, 2016, Washington D.C. USA

Workshop Papers

[10] Abhishek Dubey, Ali Guarneros, **Fangzhou Sun**, Distributed and Stacked Neural Network for Anomaly Detection in Small Satellites, 15th Annual CubeSat Developers Workshop, April 30-May 2, 2018, San Luis Obispo, CA, USA

[11] Chinmaya Samal, **Fangzhou Sun**, Abhishek Dubey, SpeedPro: A Cluster-Based Predictive Model for Urban Traffic Speed Estimation, SmartSys2017: Second International Workshop on Smart Service Systems, May 29-31, 2017, Hong Kong, China

[12] Shashank Shekhar, Subhav Pradhan, **Fangzhou Sun**, Abhishek Dubey, and Annirudha Gokhale, Empowering the Next Generation City-Scale Smart Systems, In Proceedings of the 2015 IEEE 22nd International Conference on High Performance Computing Workshops (HiPCW), December 19-22, Hyderabad, India

Book Chapter

[13] Shashank Shekhar, **Fangzhou Sun**, Abhishek Dubey, Aniruddha Gokhale, Himanshu Neema, Martin Lehofer, Dan Freudberg, Transit Hub: A Smart Decision Support System for Public Transit Operations, Internet of Things and Data Analytics Handbook, John Wiley & Sons, 2016

POSTERS AND DEMOS

Posters

[1] Abhishek Dubey, **Fangzhou Sun**, Chinmaya Samal, Anne Zou, Baosen Zhang, Lillian Ratliff, Liyuan Zheng, Tanner Fiez, Socially Optimal Multi-modal Routing Platform, US Ignite Application Summit 2017

[2] **Fangzhou Sun**, Abhishek Dubey, PhD Forum: Robust Sensing and Analytics in Urban Environment, SMARTCOMP2017: Smart Computing Technologies and Applications, 2017

[3] Abhishek Dubey, Jules White, **Fangzhou Sun**, Hiba Baroud, Martin Lehofer, Public Transportation Decision System with Multi-Timescale Analytical Services, 2016 CPS PI Meeting

[4] **Fangzhou Sun**, Abhishek Dubey, PhD Forum: Heterogeneous and Multi-Domain Data Analytics Platforms for Smart Cities, 2016 IEEE International Conference on Smart Computing, May 18-20, 2016, St. Louis, Missouri, USA

[5] Abhishek Dubey, Subhav Pradhan, **Fangzhou Sun**, Aniruddha Gokhale, Resilient Platform for Heterogeneous Big Data Driven CPS, NSF Workshop

[6] Abhishek Dubey, Subhav Pradhan, **Fangzhou Sun**, Aniruddha Gokhale, Gautam Biswas, Martin Lehofer, Dan Freudberg, Platform for Enabling Optimal Multi-Modal Transportation Planning Service, The 2016 Global City Teams Challenge (GCTC) Expo

[7] **Fangzhou Sun**, Shashank Shekhar, Abhishek Dubey, Himanshu Neema, Aniruddha Gokhale, Sandeep Neema, Jules White, Transit Hub Smart Decision Support System for Public Transportation, The 2015 Global City Teams Challenge (GCTC) Expo

Demos

[8] Cyber Security for Smart Manufacturing, 2017 CSD R&D Showcase Tech Demo

[9] Socially Optimal Multi-modal Routing Platform, US Ignite Application Summit 2017

[10] Transit Hub and City Hub Demo, 2016 CPS PI Meeting

HONOR AND AWARD

- **9th Annual NTC Awards - Technology Student of the Year (Top 3 Finalist)**

- Nashville Technology Council (*http://ntcawards.com/awards/*)

TECHNICAL SKILLS

- **Languages:** Python, Java, Objective-C, SQL, JavaScript
- **Mobile and Web Development:** iOS Development, AngularJS, Django, Flask, Kibana, Logstash, ElasticSearch
- **Databases:** MySQL, MongoDB
- **Operating Systems:** macOS, Linux