Bingbing Rao (He/Him/His)

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Education

University of Central Florida
Ph.D. in Computer Science (Advisor: Dr. Liqiang Wang) — June 2016 - May 2022 (Expected)

University of Central Florida
M.S. in Computer Science — Aug. 2015 - May 2017

Wuhan University of Science and Technology
B.S. in Electrical and Information Engineering — Sept. 2008 - June 2012

Huazhong University of Science and Technology
B.A. in Public Administration (Minor) — Sept. 2008 - June 2012

Skills

Deep Learning: Transformer, RNN, ResNet, Attention, Pytorch

Software Engineering: Apache Spark, Hadoop, HDFS, Amazon EC2

Programming Languages: Proficient in Python and Scala; Project Experience in C, Java, R, and Shell

Work and Research Experience

Unknot.id — **Orlando, Florida, USA**
Software Engineer Intern, AI Research — *July 2020 - July 2021*
Investigated Transformer-based and GAN-based neural models for inertial navigation using IMU measurements and synthesizing tabular data without leaking any sensitive information, respectively

University of Central Florida — **Orlando, Florida, USA**
System Engineer, Cyber Intelligence Lab (CiLab) — *May 2019 - Aug. 2019*
Deployed and maintained big data (e.g., Apache Spark) and deep learning infrastructures for researchers; provided systematic technical support in developing efficient algorithms of big data and deep learning to perform social media analytics tasks

Graduate Research Assistant, Big Data Lab — *May 2016 - Present*
Innovating techniques of program analysis and deep learning (e.g., Transformer, RNN, ResNet) towards efficient and intelligent big data systems (e.g., Apache Spark) as well as neural repair models for big code

Elivebuy Co., Ltd. — **Shenzhen, GuangDong, China**
Director, IT Department — *Mar. 2014 - Aug. 2015*
Analyzed requirements of all departments to improve their business processes and determine the technology needs; Received the outstanding staff award in 2014 for coordinating IT resources to increase employee efficiency

MacroSAN Technologies Co., Ltd. — **Shenzhen, GuangDong, China**
Linux kernel developer, R & D Department — *Feb. 2012 - Mar. 2014*
Awarded 22^{nd} R & D Honor due to developing a new and faster direct memory access (DMA) model and collaborating with Linux kernel upstream on providing efficient solutions to the Linux kernel issues

Wuhan University of Science and Technology — **Wuhan, Hubei, China**
Undergraduate Research Assistant, Control Theory Laboratory — *Sept. 2010 - June 2012*
Designed embedding algorithms of microcontroller and FPGA to generate arbitrary waveform and measure precise frequencies of input signals; Won the provincial third prize at 2011 National Undergraduate Electronics Design Contest

Selected Projects

CTIN: A robust contextual Transformer network for Inertial Navigation — Jan. - July 2021
Mentor: Devu M Shila, Liqiang Wang — Unknot.id

- Innovated a robust Transformer-based model for inertial navigation using IMU measurements only
- Designed a ResNet-based encoder to exploit spatial knowledge of IMU observations by applying attention mechanism
- Extended Transformer decoder to capture temporal information within IMU observations
- Leveraged multi-task learning techniques to improve learning efficiency and to reduce the model's uncertainty

Key achievement: Paper accepted to AAAI Conference on Artificial Intelligence 2022

GTable: Generating synthetic tabular data by an improved GAN-based model June - Dec. 2020
Mentor: Devu M Shila, Liqiang Wang Unknot.id

- Designed a model-specific encoder to transform category and continuous data into meaningful feature representations
- Developed a GAN-based algorithm enhanced with information loss to learn data distribution
- Generated synthetic data for downstream tasks from the learned distribution without leaking any sensitive information
- Built a comprehensive evaluation tool to assess the performance in terms of data, utility, and privacy qualities

Key achievement: The developed GAN-based synthesizer has been adopted by multiple projects at Unknot.id

Bug2Fix: An enhanced Transformer model for automated program repair Oct. 2020 - June 2021
Mentor: Liqiang Wang University Of Central Florida

- Designed a novel abstraction approach to extract contextual features and reduce vocabulary size
- Developed a Transformer-based network to learn neural translations from buggy to fixed code
- Established context-aware alignments by exploiting attention to contextual path information of each token
- Achieved optimal weights of code translation and context-aware alignment tasks by performing multi-task learning
- Investigated the applicability of NLM techniques comprehensively for repairing bugs automatically

Key achievement: Paper submitted to IEEE International Conference on Software Testing, Verification and Validation 2022

SODA: Semantics-aware Optimizations for Data-Intensive Applications Jan. - Dec. 2020
Mentor: Liqiang Wang University Of Central Florida

- Analyzed code using offline Scala-Refactor tool to construct the skeleton of an application
- Designed an online ASM tool to profile the execution of an application
- Established multiple optimizations atop of offline and online acquiring data to scrutinize performance bugs

Key achievement: Paper accepted to IEEE International Conference on Cloud Computing (CLOUD) 2021

Detecting Trends in Dynamic Social Media Networks May 2016 - Dec. 2018
Mentor: Winyan Chung, Liqiang Wang University Of Central Florida

- Proposed three novelty and robustness theory-based models for temporal social network activity detection
- Designed and validated their performance atop of Apache Spark in large-scale social networks (e.g., Twitter)
- Developed a new metric to evaluate social network trend detection for researchers and practitioners

Key achievement: Papers accepted to I/ITSEC 2016 and TMIS 2019

Selected Publications

[1] **Bingbing Rao**, Jie Yao, Weiwei Xing, and Liqiang Wang. Bug2Fix: An enhanced transformer model with context-aware alignment for automated program repair. In *IEEE International Conference on Software Testing, Verification and Validation (ICST)*, 2022 (Under Review).

[2] **Bingbing Rao**, Ehsan Kazemi, Yifan Ding, Devu M Shila, Frank M. Tucker, and Liqiang Wang. CTIN: Robust contextual transformer network for inertial navigation. In *Proceedings of the AAAI Conference on Artificial Intelligence*, 2022.

[3] **Bingbing Rao**, Zixia Liu, Hong Zhang, Siyang Lu, and Liqiang Wang. SODA: A semantics-aware optimization framework for data-intensive applications using hybrid program analysis. In *IEEE 14th International Conference on Cloud Computing (CLOUD)*, pages 433–444, 2021.

[4] **Bingbing Rao** and Liqang Wang. A survey of semantics-aware performance optimization for data-intensive computing. In *IEEE Cyber Science and Technology Congress (CyberSciTech)*, pages 81–88, 2017.

[5] Wingyan Chung, **Bingbing Rao**, and Liqiang Wang. Interaction models for detecting nodal activities in temporal social media networks. *ACM Transactions on Management Information Systems (TMIS)*, 10(4):1–30, 2019.

[6] Siyang Lu, Xiang Wei, **Bingbing Rao**, Byungchul Tak, Long Wang, and Liqiang Wang. LADRA: Log-based abnormal task detection and root-cause analysis in big data processing with spark. *Future Generation Computer Systems*, 95:392–403, 2019.

[7] Zixia Liu, Hong Zhang, **Bingbing Rao**, and Liqiang Wang. A reinforcement learning based resource management approach for time-critical workloads in distributed computing environment. In *IEEE International Conference on Big Data (Big Data)*, pages 252–261, 2018.

Leadership Experience

University of Central Florida **Orlando, FL, USA**
Graduate Teaching Assistant, COP4020: Functional Programming Languages Aug. 2017 - Dec. 2018