Bingbing Rao (He/Him/His)

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Skills

Deep Learning: Transformer, Attention, MLP, GNN, NLP, Pytorch, Tensorflow

Software Engineering: Apache Spark, Hadoop & HDFS, MapReduce, Program & Performance Analysis, AWS

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

Proven Record Of Research: Published nine papers in AAAI, ACM TMIS, IEEE BigData & Cloud etc

Experience

Citibank, N.A. **New York, NY, USA**

VP, Risk Analytics, Modeling, and Validation, Quant Risk Libraries (QRL) *May 2022 - Present*

- Design and implement a framework for model driven computations using knowledge of graph and grid computing
- Optimize and improve performance of data model and platform to handle the sheer size of data
- Leverage knowledge in compilers and optimization to help QRL team craft efficient numerical pipelines
- Work on the translation logic to convert symbolic model representation into implementations

Unknot.id **Orlando, Florida, USA**

Software Engineer Intern, AI Research *July 2020 - July 2021*

- Investigated a Transformer-based model to exploit spatial and temporal features of IMU measurements for inertial navigation, being accepted as a research paper by AAAI-22 due to its novelty and the performance improvement of over 30%
- Developed a GAN-based data pipeline to synthesize tabular data, reducing risks of leaking sensitive information from 33% to 4% while keeping most properties of the real data

University of Central Florida **Orlando, Florida, USA**

Graduate Research Assistant, Big Data Lab *May 2016 - May 2022*

- Innovating Transformer/GNN models to learn contextual and structural code representations for automated program repair
- Optimized performance and scalability of big data systems by leveraging program analysis and machine learning techniques
- Proposed two theory-based dynamic graph models using GraphX to characterize temporal trends in a large social-media (Twitter) community consisting of 790,462 users and 3,055,797 links
- Published nine related research papers in AAAI, ACM TMIS, IEEE Bigdata & Cloud etc, submitted one for peer review

System Engineer, Cyber Intelligence Lab (CiLab) *May 2019 - Aug. 2019*

- Singlehandedly designed and developed a data analysis pipeline to analyze Twitter datasets efficiently
- Deployed and maintained big data (e.g., Apache Spark) and deep learning infrastructures for researchers
- Trained 5 individuals in developing efficient algorithms of big data and deep learning to perform social media analytics tasks

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
- Coordinated IT technicians to develop warehouse and finance management systems, a stock-keeping unit encoder, etc
- Designed and provided training programs about IT resources and development support to all staffs
- 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*

- Developed and maintained Linux kernel modules: direct memory access (DMA) and general-purpose input/output (GPIO)
- Collaborated with Linux kernel upstream on providing efficient solutions to the Linux kernel issues
- Awarded 22^{nd} R & D Honor due to developing a new DMA model and strong problem-solving skills

Education

University of Central Florida **Orlando, Florida, USA**
Ph.D. in Computer Science (Advisor: Dr. Liqiang Wang) August 2022
Research area: Towards Efficient Graph-based Computing and Analytics using program analysis and deep learning
M.S. in Computer Science May 2017

Wuhan University of Science and Technology **Wuhan, Hubei, China**
B.S. in Electrical and Information Engineering June 2012

Huazhong University of Science and Technology **Wuhan, Hubei, China**
B.A. in Public Administration (Minor) June 2012

Selected Projects

CTIN: A robust contextual Transformer network for Inertial Navigation Jan. - July 2021
Mentor: Devu M Shila, Liqiang Wang Unknot.id
- Extended ResNet-18 to encode spatial knowledge of an IMU measurement by applying a novel attention mechanism
- Leveraged Transformer decoder to capture temporal information among IMU observations
- Fused spatial and temporal information for inertial navigation by using encoder-decoder attention mechanism
- Leveraged multi-task learning techniques to improve learning efficiency and to reduce the model's uncertainty
- Code (written in **Python**): `https://github.com/bingrao/ctin`

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

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 with information loss to learn real data distribution and then generate synthetic data
- Built a comprehensive evaluation tool to assess the performance in terms of data, utility, and privacy qualities
- Code (written in **Python**): `https://github.com/bingrao/gtable`

Key achievement: This work is received high appreciation and facilitated Unknot.id to pursue further funding

An Enhanced Graph Transformer model for automated program repair Oct. 2020 - June 2021
Mentor: Liqiang Wang University Of Central Florida
- Designed a novel abstraction approach atop of AST to extract structural features and reduce vocabulary size
- Developed a Transformer-based network to learn neural code translations from buggy to fixed code
- Established context-aware alignments by exploiting attention to contextual path information of each token in an AST
- Achieved optimal weights of code translation and context-aware alignment tasks by performing multi-task learning
- Abstraction Code (written in **Scala**): `https://github.com/bingrao/code2abs`
- Translation Code (written in **Python**): `https://github.com/bingrao/Bug-Transformer`

Key achievement: Paper accepted to JCSC 2022 (Journal); Paper submitted to IEEE TAC 2022 (Journal)

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 a graph-based representation of an application
- Integrated metrics and log components in Spark with a dedicated 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: Papers accepted to IEEE CyberSciTech 2017 and Cloud 2021

Dynamic Graph Model to Detect Trends in Dynamic Social Media Networks May 2016 - Dec. 2018
Mentor: Winyan Chung, Liqiang Wang University Of Central Florida
- Proposed two novelty and robustness theory-based models for temporal social network activity detection
- Designed and validated their performance atop of Apache Spark GraphX 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 ACM TMIS 2019 (Journal)

Selected Publications

[1] **Rao Bingbing**, Yao J., Xing W., and Wang L. Bug2Fix: An enhanced transformer model with context-aware alignment for automated program repair. *IEEE Transactions on Affective Computing*, 2022 (Submitted).

[2] **Rao Bingbing**, Yao J., Xing W., and Wang L. Bug-transformer: Automated program repair using attention-based deep neural network. *Journal of Circuits, Systems and Computers*, 2022 (Accepted).

[3] **Rao Bingbing**, Kazemi E., Ding Y., Devu S., Frank T., and Wang L. CTIN: Robust contextual transformer network for inertial navigation. In *Proceedings of the AAAI Conference on Artificial Intelligence (**Oral**)*, 2022.

[4] **Rao Bingbing**, Liu Z., Zhang H., Lu S., and Wang L. 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.

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

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

Leadership Experience

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