

Tao Zhang

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Contact Information

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Education

- Doctor of Philosophy (09/2008-02/2013)
Department of Computer Science and Engineering, University of Seoul, Seoul, South Korea
Advisor: Prof. Byungjeong Lee
Dissertation: A Bug Triage and Localization Technique Based on Bug Reports Classification
- Master of Engineering (09/2005-03/2008)
College of Software, Northeastern University, Shenyang, China
Advisor: Prof. Chaowan Yin
Thesis: Research and Implementation of Globus Sandglass Model Based Steel Transportation Service System
- Bachelor of Science in Engineering (09/2000-07/2005)
Department of Automation, Northeastern University, Shenyang, China

Teaching and Research Experience

- Professor (07/2025-Present), School of Computer Science and Engineering, Macau University of Science and Technology, Macao SAR
- Associate Professor (09/2019-06/2025), School of Computer Science and Engineering, Macau University of Science and Technology, Macao SAR
- Associate Professor (12/2016-08/2019), College of Computer Science and Technology, Harbin Engineering University, Harbin, China
- Lecturer (02/2016-12/2016), School of Computer Science, Nanjing University of Posts and Telecommunications, Nanjing, China
- Postdoctoral Fellow (11/2014-11/2015), Department of Computing, The Hong Kong Polytechnic University, Hong Kong SAR
- Postdoctoral Fellow (03/2014-08/2014), Faculty of Computer Science and Information Technology, University of Malaya, Kuala Lumpur, Malaysia
- Research Professor (03/2013-02/2014), Department of Computer Science and Engineering, University of Seoul, Seoul, South Korea

Industrial Experience

- Software Engineer (03/2008-07/2008), Division of Network Security, Neusoft, China

- Intern (07/2007-11/2007), Division of Network Security, Neusoft, China

Honors and Awards

- Distinguished Member, China Computer Federation (CCF), September 2025
- Top Reviewer Award 2023, Journal of Systems and Software (JSS), April 2024
- Distinguished Reviewer in 2023, ACM Transactions on Software Engineering and Methodology (TOSEM), February 2024
- Top Reviewer Award 2020, Information and Software Technology (IST), May 2021
- Senior Member, ACM, October 2020
- Senior Member, IEEE, February 2020
- Senior Member, China Computer Federation (CCF), January 2019
- Best Paper Award, 16th Korea Conference on Software Engineering (KCSE), February 2014
- Honor Prize, 18th Samsung HumanTech Paper Award, February 2012
- Bronze Prize, IEEE Seoul Section Student Paper Contest, December 2011
- Second Place Award, National Senior High School Mathematics Tournament, October 1999

Research Area

- AI for Software Engineering
- Software Security
- Mining Software Repositories

Publications

(* indicates that I am a corresponding/co-corresponding author)

Representative Papers

- Jie Cai, Jiachi Chen, **Tao Zhang***, Xiapu Luo, Xiaobing Sun, and Bin Li, “Detecting Reentrancy Vulnerabilities for Solidity Smart Contracts with Contract Standards-Based Rules”, *IEEE Transactions on Information Forensics and Security (TIFS)*, Vol. 20, pp. 3662-3676, 2025.
- Yao Li, Sen Fang, **Tao Zhang***, and Haipeng Cai, “Enhancing Android Malware Detection: The Influence of ChatGPT on Decision-centric Task”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Vol. 34, No. 8, Article No. 226, pp. 1-30, November 2025.
- Yao Li, Dawei Yuan, **Tao Zhang***, Haipeng Cai, David Lo, Cuiyun Gao, Xiapu Luo, and He Jiang, “Meta-Learning for Multi-Family Android Malware Classification”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Vol. 33, No. 7, Article No. 174, pp. 1-27, September 2024.
- Yao Li, **Tao Zhang***, Xiapu Luo, Haipeng Cai, Sen Fang, and Dawei Yuan, “Do Pretrained Language Models Indeed Understand Software Engineering Tasks?”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 49, No. 10, pp. 4639-4655, October 2023.
- Youshuai Tan, Jinfu Chen, Weiyi Shang, **Tao Zhang***, Sen Fang, Xiapu Luo, Zijie Chen, and Shuhao Qi, “STRE: An Automated Approach to Suggesting App Developers When to Stop Reading Reviews”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 49, No. 8, pp. 4135-4151, August 2023.
- Sen Fang, **Tao Zhang***, Youshuai Tan, He Jiang, Xin Xia, and Xiaobing Sun, “RepresentThemAll: A Universal Learning Representation of Bug Reports”, in *Proc. of the 45th International Conference on Software Engineering (ICSE'23)*, May 14-20, 2023, pp.

602-614.

- **Tao Zhang**, Jiachi Chen, Xian Zhan, Xiapu Luo, David Lo, and He Jiang, “Where2Change: Change Request Localization for App Reviews”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 47, No. 11, pp. 2590-2616, November 2021.

Full Paper List

International Journal Papers

- Guocang Yang, Dawei Yuan, **Tao Zhang***, and Zhenghan Chen, “A Sign Language to SQL Query Translation System for Enhancing Database Accessibility”, *Automated Software Engineering*, Vol. 33, No. 1, Article 15, June 2026.
- Jican Zhang, Jianeng Zhang, Xin Shen, Lei Xue, Liming Nie, Fengwei Lin, Kefeng Wu, **Tao Zhang**, and Pingxin Du, “Rethinking Code Similarity: A Logic-Based Framework for Cross-Language Analysis beyond Functional Equivalence”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Accepted, 2025.
- Jiawei Guo, Xiaoqin Fu, Li Li, **Tao Zhang**, Mattia Fazzini, and Haipeng Cai, “Characterizing Installation- and Run-Time Compatibility Issues in Android Benign Apps and Malware”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Accepted, 2025.
- Jie Cai, Jiachi Chen, **Tao Zhang***, Xiapu Luo, Xiaobing Sun, and Bin Li, “Detecting Reentrancy Vulnerabilities for Solidity Smart Contracts with Contract Standards-Based Rules”, *IEEE Transactions on Information Forensics and Security (TIFS)*, Vol. 20, pp. 3662-3676, 2025.
- Yao Li, Sen Fang, **Tao Zhang***, and Haipeng Cai, “Enhancing Android Malware Detection: The Influence of ChatGPT on Decision-centric Task”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Vol. 34, No. 8, Article No. 226, pp. 1-30, November 2025.
- Dawei Yuan, Guocang Yang, and **Tao Zhang***, “UI2HTML: Utilizing LLM Agents with Chain of Thought to Convert UI into HTML Code”, *Automated Software Engineering*, Vol. 32, No. 2, Article 41, November 2025.
- Shuo Yang, Jiachi Chen, Lei Xiao, Jinyuan Hu, Dan Lin, Jiajing Wu, **Tao Zhang**, and Zibin Zheng, “Who is Pulling the Strings: Unveiling Smart Contract State Manipulation Attacks Through State-Aware Dataflow Analysis”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 51, No. 10, pp. 2942-2956, October 2025.
- Dawei Yuan, **Tao Zhang***, and He Jiang, “UNA: Improving Automated PL-NL System by A Unified Neural Architecture”, *IEEE Transactions on Reliability (TRel)*, Vol. 74, No. 3, pp. 3585-3599, September 2025.
- Manqing Zhang, Yunwei Dong, **Tao Zhang**, Kang Su, and Zeshan Li, “Modeling and Verifying Resources and Capabilities of Ubiquitous Scenarios for Unmanned Aerial Vehicle Swarm”, *Journal of Systems and Software (JSS)*, Vol. 226, Article 112416, August 2025.
- Jiashuo Zhang, Jiachi Chen, Yiming Shen, **Tao Zhang**, Yanlin Wang, Ting Chen, Jianbo Gao, and Zhong Chen, “When Crypto Fails: Demystifying Cryptographic Defects in Ethereum Smart Contracts”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 51, No. 5, pp. 1381-1398, May 2025.
- Dawei Yuan, Xiao Peng, Zijie Chen, **Tao Zhang***, and Ruijia Lei, “Code Context-Based Reviewer Recommendation”, *Frontiers of Computer Science (FCS)*, Vol. 19, No. 1, Article 191202, January 2025.
- Yao Li, Dawei Yuan, **Tao Zhang***, Haipeng Cai, David Lo, Cuiyun Gao, Xiapu Luo, and He Jiang, “Meta-Learning for Multi-Family Android Malware Classification”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Vol. 33, No. 7, Article

- No. 174, pp. 1-27, September 2024.
- Xiaohui Wang, **Tao Zhang***, Youshuai Tan, Weiyi Shang, and Yao Li, “How to Effectively Mine App Reviews Concerning Software Ecosystem? A Survey of Review Characteristics”, *Journal of Systems and Software (JSS)*, Vol. 213, Article 112040, July 2024.
 - Guodong Fan, Shizhan Chen, Cuiyun Gao, Jianmao Xiao, **Tao Zhang**, and Zhiyong Feng, “Rapid: Zero-shot Domain Adaptation for Code Search with Pre-trained Models”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Vol. 33, No. 5, Article No. 128, pp. 1-35, June 2024.
 - He Jiang, Zun Wang, Zhide Zhou, Xiaochen Li, Shikai Guo, Weifeng Sun, and **Tao Zhang**, “A Testing Program and Pragma Combination Selection Based Framework for High-Level Synthesis Tool Pragma-Related Bug Detection”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 50, No. 4, pp. 937-955, April 2024.
 - Jie Cai, Bin Li, **Tao Zhang**, Jiale Zhang, and Xiaobing Sun, “Fine-Grained Smart Contract Vulnerability Detection by Heterogeneous Code Feature Learning and Automated Dataset Construction”, *Journal of Systems and Software (JSS)*, Vol. 209, Article 111919, March 2024.
 - Sicong Cao, Xiaobing Sun, Lili Bo, Rongxin Wu, Bin Li, Xiaoxue Wu, Chuanqi Tao, **Tao Zhang**, and Wei Liu, “Learning to Detect Memory-Related Vulnerabilities”, *ACM Transactions on Software Engineering and Methodology (TOSEM)*, Vol. 33, No. 2, Article No. 43, pp. 1-35, February 2024.
 - Yao Li, Zhi Xiong, **Tao Zhang***, Qinkun Zhang, Ming Fan, and Lei Xue, “Ensemble Framework Combining Family Information for Android Malware Detection”, *The Computer Journal*, Vol. 66, No. 11, pp. 2721-2740, November 2023.
 - Yao Li, **Tao Zhang***, Xiapu Luo, Haipeng Cai, Sen Fang, and Dawei Yuan, “Do Pretrained Language Models Indeed Understand Software Engineering Tasks?”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 49, No. 10, pp. 4639-4655, October 2023.
 - Xiaobing Sun, Zhenlei Ye, Lili Bo, Xiaoxue Wu, Ying Wei, **Tao Zhang**, and Bin Li, “Automatic Software Vulnerability Assessment by Extracting Vulnerability Elements”, *Journal of Systems and Software (JSS)*, Vol. 204, Article 111790, October 2023.
 - Youshuai Tan, Jinfu Chen, Weiyi Shang, **Tao Zhang***, Sen Fang, Xiapu Luo, Zijie Chen, and Shuhao Qi, “STRE: An Automated Approach to Suggesting App Developers When to Stop Reading Reviews”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 49, No. 8, pp. 4135-4151, August 2023.
 - Dawei Yuan, Xiaohui Wang, Yao Li, and **Tao Zhang***, “Optimizing Smart Contract Vulnerability Detection via Multi-Modality Code and Entropy Embedding”, *Journal of Systems and Software (JSS)*, Vol. 202, Article 111699, August 2023.
 - Dawei Yuan, Sen Fang, **Tao Zhang***, Zhou Xu, and Xiapu Luo, “Java Code Clone Detection by Exploiting Semantic and Syntax Information from Intermediate Code-Based Graph”, *IEEE Transactions on Reliability (TRel)*, Vol. 72, No. 2, pp. 511-526, June 2023.
 - Ying Wei, Lili Bo, Xiaobing Sun, Bin Li, **Tao Zhang**, and Chuanqi Tao, “Automated Event Extraction of CVE Descriptions”, *Information and Software Technology (IST)*, Vol. 158, Article 107178, June 2023.
 - He Jiang, Yulong Li, Shikai Guo, Xiaochen Li, **Tao Zhang**, Hui Li, and Rong Chen, “DupHunter: Detecting Duplicate Pull Requests in Fork-Based Development”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 49, No. 4, pp. 2920-2940, April 2023.
 - Le Yu, Haoyu Wang, Xiapu Luo, **Tao Zhang**, Kang Liu, Jiachi Chen, Hao Zhou, Yutian Tang, and Xusheng Xiao, “Towards Automatically Localizing Function Errors in Mobile Apps with User Reviews”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 49, No. 4, pp. 1464-1486, April 2023.

- Jianwei Zeng, Yutong He, **Tao Zhang***, Zhou Xu, and Qiang Han, “CLG-Trans: Contrastive Learning for Code Summarization via Graph Attention-Based Transformer”, *Science of Computer Programming (SCP)*, Vol. 226, Article 102925, March 2023.
- Kunsong Zhao, Zhou Xu, Meng Yan, **Tao Zhang**, Lei Xue, Ming Fan, and Jacky Keung, “The Impact of Class Imbalance Techniques on Crashing Fault Residence Prediction models”, *Empirical Software Engineering (EMSE)*, Vol. 28, No. 2, Article 49, March 2023.
- Zhou Liao, Shuwei Song, Hang Zhu, Xiapu Luo, Zheyuan He, Renkai Jiang, Ting Chen, Jiachi Chen, **Tao Zhang**, and Xiaosong Zhang, “Large-Scale Empirical Study of Inline Assembly on 7.6 Million Ethereum Smart Contracts”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 49, No. 2, pp. 777-801, February 2023.
- Zhou Zhou, Lili Bo, Xiaoxue Wu, Xiaobing Sun, **Tao Zhang**, Bin Li, Jiale Zhang, and Sicong Cao, “SPVF: Security Property Assisted Vulnerability Fixing via Attention-Based Models”, *Empirical Software Engineering (EMSE)*, Vol. 27, No. 7, Article 171, December 2022.
- Sen Fang, **Tao Zhang***, Youshuai Tan, Zhou Xu, Zhixin Yuan, and Lingze Meng, “PRHAN: Automated Pull Request Description Generation Based on Hybrid Attention Network”, *Journal of Systems and Software (JSS)*, Vol. 185, Article 111160, March 2022.
- Yan Lei, Huan Xie, **Tao Zhang**, Meng Yan, Zhou Xu, and Chengnian Sun, “Feature-FL: Feature-Based Fault Localization”, *IEEE Transactions on Reliability (TRel)*, Vol. 71, No. 1, pp. 264-283, March 2022.
- Zhou Xu, Kunsong Zhao, **Tao Zhang**, Chunlei Fu, Meng Yan, Zhiwen Xie, Xiaohong Zhang, and Gemma Catolino, “Effort-Aware Just-in-Time Bug Prediction for Mobile Apps via Cross-Triplet Deep Feature Embedding”, *IEEE Transactions on Reliability (TRel)*, Vol. 71, No. 1, pp. 204-220, March 2022.
- **Tao Zhang**, Jiachi Chen, Xian Zhan, Xiapu Luo, David Lo, and He Jiang, “Where2Change: Change Request Localization for App Reviews”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 47, No. 11, pp. 2590-2616, November 2021.
- Kunsong Zhao, Zhou Xu, Meng Yan, **Tao Zhang**, Dan Yang, and Wei Li, “A Comprehensive Investigation of the Impact of Feature Selection Techniques on Crashing Fault Residence Prediction Models”, *Information and Software Technology (IST)*, Vol. 139, Article 106652, November 2021.
- Muhammad Ashfaq, Rubing Huang, Dave Towey, Michael Omari, Dmitry Yashunin, Patrick Kwaku Kudjo, and **Tao Zhang**, “SWFC-ART: A Cost-Effective Approach for Fixed-Size-Candidate-Set Adaptive Random Testing through Small World Graphs”, *Journal of Systems and Software (JSS)*, Vol. 180, Article 111008, October 2021.
- Jinting Lu, Xiaobing Sun, Bin Li, Lili Bo, and **Tao Zhang**, “BEAT: Considering Question Types for Bug Question Answering via Templates”, *Knowledge-Based Systems (KBS)*, Vol. 225, Article 107098, August 2021.
- Kunsong Zhao, Zhou Xu, **Tao Zhang***, Yutian Tang, and Meng Yan, “Simplified Deep Forest Model Based Just-in-Time Defect Prediction for Android Mobile Apps”, *IEEE Transactions on Reliability (TRel)*, Vol. 70, No. 2, pp. 848-859, June 2021.
- Sen Fang, Youshuai Tan, **Tao Zhang***, Zhou Xu, and Hui Liu, “Effective Prediction of Bug-Fixing Priority via Weighted Graph Convolutional Networks”, *IEEE Transactions on Reliability (TRel)*, Vol. 70, No. 2, pp. 563-574, June 2021.
- Sen Fang, Youshuai Tan, **Tao Zhang***, and Yepang Liu, “Self-Attention Networks for Code Search”, *Information and Software Technology (IST)*, Vol. 134, Article 106542, June 2021.
- Jingxuan Zhang, He Jiang, Zhilei Ren, **Tao Zhang**, and Zhiqiu Huang, “Enriching API Documentation with Code Samples and Usage Scenarios from Crowd Knowledge”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 47, No. 6, pp. 1299-1314, June 2021.

- Zhou Xu, **Tao Zhang**, Jacky Keung, Meng Yan, Xiapu Luo, Xiaohong Zhang, Ling Xu, Yutian Tang, “Feature Selection and Embedding Based Cross Project Framework for Identifying Crashing Fault Residence”, *Information and Software Technology (IST)*, Vol. 131, Article 106452, March 2021.
- Le Yu, Xiapu Luo, Jiachi Chen, Hao Zhou, **Tao Zhang**, Henry Chang, and Hareton. K. N. Leung, “PPChecker: Towards Accessing the Trustworthiness of Android Apps’ Privacy Policies”, *IEEE Transactions on Software Engineering (TSE)*, Vol. 47, No. 2, pp. 221-242, February 2021.
- Youshuai Tan, Sijie Xu, Zhaowei Wang, **Tao Zhang***, Zhou Xu, and Xiapu Luo, “Bug Severity Prediction Using Question-and-Answer Pairs from Stack Overflow”, *Journal of Systems and Software (JSS)*, Vol. 165, Article 110567, July 2020.
- **Tao Zhang**, Haoming Li, Zhou Xu, Jian Liu, Rubing Huang, and Yiran Shen, “Labeling Issue Reports in Mobile Apps”, *IET Software*, Vol. 13, No. 6, pp. 528-542, December 2019.
- Zhou Xu, Shuai Li, Jun Xu, Jin Liu, Xiapu Luo, Yifeng Zhang, **Tao Zhang**, Jacky Keung, and Yutian Tang, “LDFR: Learning Deep Feature Representation for Software Defect Prediction”, *Journal of Systems and Software (JSS)*, Vol. 158, Article 110402, December 2019.
- Zhou Xu, Shuai Pang, **Tao Zhang***, Xiapu Luo, Jin Liu, Yutian Tang, Xiao Yu, and Lei Xue, “Cross Project Defect Prediction via Balanced Distribution Adaptation Based Transfer Learning”, *Journal of Computer Science and Technology (JCST)*, Vol. 34, No. 5, pp. 1039-1062, August 2019.
- Zhou Xu, Shuai Li, Xiapu Luo, Jin Liu, **Tao Zhang**, Yutian Tang, Jun Xu, Peipei Yuan, and Jacky Keung, “TSTS: A Two-Stage Training Subset Selection Framework for Cross Version Defect Prediction”, *Journal of Systems and Software (JSS)*, Vol. 154, pp. 59-78, August 2019.
- Yiran Shen, Chengwen Luo, Hongkai Wen, **Tao Zhang**, Wen Hu, and Daniela Rus, “GaitLock: Protect Virtual and Augmented Reality Headsets Using Gait”, *IEEE Transactions on Dependable and Secure Computing (TDSC)*, Vol. 16, No. 3, pp. 484-497, May 2019.
- **Tao Zhang**, Wenjun Hu, Xiapu Luo, and Xiaobo Ma, “A Commit Message-Based Bug Localization for Android Applications”, *International Journal of Software Engineering and Knowledge Engineering (IJSEKE)*, Vol. 29, No. 4, pp. 457-487, April 2019.
- Zhou Xu, Jin Liu, Xiapu Luo, Zijiang Yang, Yifeng Zhang, Peipei Yuan, Yutian Tang, and **Tao Zhang**, “Software Defect Prediction Based on Kernel PCA and Weighted Extreme Learning Machine”, *Information and Software Technology (IST)*, Vol. 106, pp. 182-200, February 2019.
- He Jiang, Liming Nie, Zeyi Sun, Zhilei Ren, Weiqiang Kong, **Tao Zhang**, and Xiapu Luo, “ROSF: Leveraging Information Retrieval and Supervised Learning for Recommending Code Snippets”, *IEEE Transactions on Services Computing (TSC)*, Vol. 12, No. 1, pp. 34-46, January 2019.
- **Tao Zhang**, Jiachi Chen, Xiapu Luo, and Tao Li, “Bug Reports for Desktop Software and Mobile Apps in GitHub: What’s the Difference?”, *IEEE Software*, Vol. 36, No. 1, pp. 63-71, January 2019.
- Zhou Xu, Peipei Yuan, **Tao Zhang***, Yutian Tang, Shuai Li, and Zhen Xia, “HDA: Cross-Project Defect Prediction via Heterogeneous Domain Adaptation with Dictionary Learning”, *IEEE Access*, Vol. 6, pp. 57597-57613, October 2018.
- Geunseok Yang, **Tao Zhang**, and Byungjeong Lee, “An Emotion Similarity Based Severity Prediction of Software Bugs: A Case Study of Open Source Projects”, *IEICE*

Transactions on Information and Systems, Vol. E101-D, No. 8, pp. 2015-2026, August 2018.

- He Jiang, Najam Nazar, Jingxuan Zhang, **Tao Zhang**, and Zhilei Ren, “PRST: A PageRank-Based Summarization Technique for Summarizing Bug Reports with Duplicates”, *International Journal of Software Engineering and Knowledge Engineering (IJSEKE)*, Vol. 27, No. 6, pp. 869-896, August 2017.
- Le Yu, **Tao Zhang**, Xiapu Luo, Lei Xue, and Henry Chang, “Toward Automatically Generating Privacy Policy for Android Apps”, *IEEE Transactions on Information Forensics and Security (TIFS)*, Vol. 12, No. 4, pp. 865-880, April 2017.
- **Tao Zhang**, Jiachi Chen, Geunseok Yang, Byungjeong Lee, and Xiapu Luo, “Towards More Accurate Severity Prediction and Fixer Recommendation of Software Bugs”, *Journal of Systems and Software (JSS)*, Vol. 117, pp. 166-184, July 2016.
- Najam Nazar, He Jiang, Guojun Gao, **Tao Zhang**, Xiaochen Li, and Zhilei Ren, “Source Code Fragment Summarization with Small-Scale Crowdsourcing Based Features”, *Frontiers of Computer Science (FCS)*, Vol. 10, No. 3, pp. 504-517, June 2016.
- **Tao Zhang**, He Jiang, Xiapu Luo, and Alvin T.S. Chan, “A Literature Review of Research in Bug Resolution: Tasks, Challenges, and Future Directions”, *The Computer Journal*, Vol. 59, No. 5, pp. 741-773, May 2016.
- **Tao Zhang**, Geunseok Yang, Byungjeong Lee, and Alvin T.S. Chan, “Guiding Bug Triage through Developer Analysis in Bug Reports”, *International Journal of Software Engineering and Knowledge Engineering (IJSEKE)*, Vol. 26, No. 3, pp. 405-431, April 2016.
- **Tao Zhang** and Byungjeong Lee, “A Novel Technique for Duplicate Detection and Classification of Bug Reports”, *IEICE Transactions on Information and Systems*, Vol. E97-D, No. 7, pp. 1756-1768, July 2014.
- **Tao Zhang**, Byungjeong Lee, Hanjoon Kim, and Sooyong Kang, “Folksonomy Reasoning Based Personalized Tagging and Tag Recommendation for Web Page Search”, *INFORMATION-An International Interdisciplinary Journal*, Vol. 15, No. 4, pp. 1727-1743, April 2012.

International Conference Papers

- Zexu Wang, Jiachi Chen, **Tao Zhang**, Yu Zhang, Weizhe Zhang, Yuming Feng, and Zibin Zheng, “Copy-and-Paste? Identifying EVM-Inequivalent Code Smells in Multi-chain Reuse Contracts”, in *Proc. of the ACM on Software Engineering (PACMSE-ISSTA'25)*, June 25-28, 2025, Vol. 2, No. ISSTA, Article ISSTA046, pp. 1031-1053.
- He Ye, Aidan Z.H. Yang, Chang Hu, Yanlin Wang, **Tao Zhang**, and Claire Le Goues, “AdverIntent-Agent: Adversarial Reasoning for Repair Based on Inferred Program Intent”, in *Proc. of the ACM on Software Engineering (PACMSE-ISSTA'25)*, June 25-28, 2025, Vol. 2, No. ISSTA, Article ISSTA062, pp. 1398-1420.
- Youwei Huang, Sen Fang, Jianwen Li, Bin Hu, Jiachun Tao, and **Tao Zhang***, “Deep Smart Contract Intent Detection”, in *Proc. of the 32nd IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER'25)*, March 4-7, 2025, pp. 124-135.
- Liu Wang, Haoyu Wang, **Tao Zhang**, Haitao Xu, Guozhu Meng, Peiming Gao, Chen Wei, and Yi Wang, “Android Malware Family Labeling: Perspectives from the Industry”, in *Proc. of the 39th IEEE/ACM International Conference on Automated Software Engineering (ASE'24)*, Industry Showcase Track, October 27-November 1, 2024, pp. 2176-2186.

- Haoran Yang, Yu Nong, **Tao Zhang**, Xiapu Luo, and Haipeng Cai, “Learning to Detect and Localize Multilingual Bugs”, in *Proc. of the ACM on Software Engineering (PACMSE-FSE'24)*, July 15-19, 2024, Vol. 1, No. FSE, Article 97, pp. 2190-2213.
- Manqing Zhang, Renliang Wu, Kang Su, Yunwei Dong, and **Tao Zhang**, “Application Scenario Modeling and Verification for Unmanned Aerial Vehicle Swarm”, in *Proc. of the 24th International Conference on Software Quality, Reliability, and Security (QRS'24)*, July 1-5, 2024, pp. 364-375.
- Wei Luo, Yemao Luo, Yao Li, and **Tao Zhang***, “StructureTester: Automatic Machine Translation Testing Based on Variation Feature Vector”, in *Proc. of the 23rd International Conference on Software Quality, Reliability, and Security (QRS'23)*, October 22-26, 2023, pp. 301-312.
- Sen Fang, **Tao Zhang***, Youshuai Tan, He Jiang, Xin Xia, and Xiaobing Sun, “RepresentThemAll: A Universal Learning Representation of Bug Reports”, in *Proc. of the 45th International Conference on Software Engineering (ICSE'23)*, May 14-20, 2023, pp. 602-614.
- Cong Li, Qiang Han, **Tao Zhang**, Bingbing Lei, and Yu He, “Quantity-Simulation-Analysis Method Based Novel RSA Timing Attack Algorithm for Single-Chip Microcomputer Platform”, in *Proc. of the 22nd International Conference on Software Quality, Reliability, and Security (QRS'22)*, December 5-9, 2022, pp. 1026-1035.
- Yucen Shi, Ying Yin, Zhengkui Wang, David Lo, **Tao Zhang**, Xin Xia, Yuhai Zhao, and Bowen Xu, “How to Better Utilize Code Graphs in Semantic Code Search?”, in *Proc. of the 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE'22)*, November 14-18, 2022, pp. 722-733.
- Liu Wang, Haoyu Wang, Xiapu Luo, **Tao Zhang**, Shangguang Wang, and Xuanzhe Liu, “Demystifying “Removed Reviews” in iOS App Store”, in *Proc. of the 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE'22)*, Industry Track, November 14-18, 2022, pp. 1489-1499.
- He Ye, Matias Martinez, Xiapu Luo, **Tao Zhang**, and Martin Monperrus, “SelfAPR: Self-supervised Program Repair with Test Execution Diagnostics”, in *Proc. of the 37th IEEE/ACM International Conference on Automated Software Engineering (ASE'22)*, October 10-14, 2022, Article 92, pp. 1-13.
- Zijie Chen, **Tao Zhang***, and Xiao Peng, “A Novel API Recommendation Approach by Using Graph Attention Network”, in *Proc. of the 21st International Conference on Software Quality, Reliability, and Security (QRS'21)*, December 6-10, 2021, pp. 726-737.
- Jianwei Zeng, **Tao Zhang***, and Zhou Xu, “DG-Trans: Automatic Code Summarization via Dynamic Graph Attention-Based Transformer”, in *Proc. of the 21st International Conference on Software Quality, Reliability, and Security (QRS'21)*, December 6-10, 2021, pp. 786-795.
- Xiaoqi Li, Ting Chen, Xiapu Luo, **Tao Zhang**, Le Yu, and Zhou Xu, “STAN: Towards Describing Bytecodes of Smart Contract”, in *Proc. of the 20th International Conference on Software Quality, Reliability, and Security (QRS'20)*, December 11-14, 2020, pp. 273-284.
- Xiaoyun Cheng, Naming Liu, Lin Guo, Zhou Xu, and **Tao Zhang***, “Blocking Bug Prediction Based on XGBoost with Enhanced Features”, in *Proc. of the 44th IEEE Annual International Computers, Software, and Applications Conference (COMPSAC'20)*, July 13-17, 2020, pp. 902-911.

- Zhou Xu, **Tao Zhang**, Yifeng Zhang, Yutian Tang, Jin Liu, Xiapu Luo, Jacky Keung, and Xiaohui Cui, “Identifying Crashing Fault Residence Based on Cross Project Model”, in *Proc. of the 30th International Symposium on Software Reliability Engineering (ISSRE'19)*, October 28-November 1, 2019, pp. 183-194.
- Zhou Xu, Sizhe Ye, **Tao Zhang***, Zhen Xia, Shuai Pang, Yong Wang, and Yutian Tang, “MVSE: Effort-Aware Heterogeneous Defect Prediction via Multiple-View Spectral Embedding”, in *Proc. of the 19th International Conference on Software Quality, Reliability, and Security (QRS'19)*, July 22-26, 2019, pp. 10-17.
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- **Tao Zhang**, Jiachi Chen, He Jiang, Xiapu Luo, and Xin Xia, “Bug Report Enrichment with Application of Automated Fixer Recommendation”, in *Proc. of the 25th IEEE International Conference on Program Comprehension (ICPC'17)*, May 22-23, 2017, pp. 230-240.
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- **Tao Zhang**, Geunseok Yang, Byungjeong Lee, and Eng Keong Lua, “A Novel Developer Ranking Algorithm for Automatic Bug Triage Using Topic Model and Developer Relations”, in *Proc. of the 21st Asia-Pacific Software Engineering Conference (APSEC'14)*, December 1-4, 2014, pp. 223- 230.
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- **Tao Zhang** and Byungjeong Lee, “A Hybrid Bug Triage Algorithm for Developer Recommendation”, in *Proc. of the 28th ACM Symposium on Applied Computing (SAC'13)*, March 18-22, 2013, pp. 1088-1094.
- **Tao Zhang** and Byungjeong Lee, “An Automated Bug Triage Approach: A Concept Profile and Social Network Based Developer Recommendation”, in *Proc. of the 8th International Conference on Intelligence Computing (ICIC'12)*, July 25-29, 2012, LNCS 7389, pp. 505-512.
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- **Tao Zhang** and Byungjeong Lee, “A Bug Rule Based Technique with Feedback for Classifying Bug Reports”, in *Proc. of the 11th IEEE International Conference on Computer and Information Technology (CIT'11)*, August 31-September 2, 2011, pp. 336-343.
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- **Tao Zhang**, Byungjeong Lee, Sooyong Kang, Hanjoon Kim, and Jinseog Kim, “Collective Intelligence-Based Web Page Search: Combining Folksonomy and Link-Based Ranking Strategy”, in *Proc. of the 9th IEEE International Conference on Computer and Information Technology (CIT'09)*, October 11-14, 2009, pp. 166-171.

Patents

- **Tao Zhang** and Zi-ang Zhang, “A Semantic Concept-Based Software Bug Search and Analysis System and Method”, *Chinese Patent*, No. ZL-2018-1-1285850.5, 2020.
- **Tao Zhang** and Naming Liu, “A User Feedback-Based Software Requirement Search System”, *Chinese Patent*, No. ZL-2018-1-1172938.6, 2020.
- **Tao Zhang**, “A Commit Message-Based Fault Localization Method for Mobile Apps”, *Chinese Patent*, No. ZL-2018-1-0392611.3, 2020.
- **Tao Zhang**, Sijie Xu, and Youshuai Tan, “A Bug Rule and Classification Feedback-Based Bug Detection Method”, *Chinese Patent*, No. ZL-2018-1-1209067.0, 2019.
- **Tao Zhang** and Haoming Li, “An Automated Label Recommendation Method for Issue Reports in Mobile Apps”, *Chinese Patent*, No. ZL-2018-1-1087855.7, 2019.
- **Tao Zhang**, Jiachi Chen, and Xiapu Luo, “A Bug Localization Method for Mobile Apps Based on User Reviews”, *Chinese Patent*, No. ZL-2018-1-0509592.8, 2019.
- Byungjeong Lee, **Tao Zhang**, and Geunseok Yang, “Bug Severity Prediction System and Method Using the Concept Profile”, *Korean Patent*, No. 10-1775006, 2017.

- Byungjeong Lee, **Tao Zhang**, and Geunseok Yang, “System and Method for Recommending Bug Fixing Developers Based on Multi-Developer Network”, *Korean Patent*, No. 10-1697992, 2017.
- Byungjeong Lee, **Tao Zhang**, and Geunseok Yang, “System and Method for Bug Fixing Developers Recommendation and Bug Severity Prediction Based on Topic Model and Multi- Feature”, *Korean Patent*, No. 10-1691083, 2016.
- Byungjeong Lee and **Tao Zhang**, “A Hybrid Bug Triage System and Method for Recommending Bug Fixing Developers”, *Korean Patent*, No. 10-1538131, 2015.
- Byungjeong Lee and **Tao Zhang**, “Method for Recommending Appropriate Developers for Software Bug Fixing and Apparatus Thereof”, *Korean Patent*, No. 10-1390220, 2014.
- Byungjeong Lee, **Tao Zhang**, and Hanjoon Kim, “System and Method for Utilizing Personalized Tag Recommendation Model in Web Page Search”, *Korean Patent*, No. 10-1137491, 2012.
- Byungjeong Lee, **Tao Zhang**, and Hanjoon Kim, “Method of Searching Web Pages Based on a Collective Intelligence Using Folksonomy and Linked-Based Ranking Strategy, and System for Performing the Method”, *Korean Patent*, No. 10-1132393, 2012.

Competitive Research Grants

- PI, “Large Language Model Unlearning in Conical Subspaces for Rapid Mitigation of Book Copyright Risks”, supported by the CCF-Huawei Populus Grove Fund, CNY 500,000, 11/2025-10/2026.
- PI, “A Privacy Leakage Detection System for Mobile Applications Based on Large Language Model”, supported by the Macao Science and Technology Development Fund (FDCT), MOP 785,400, 05/2024-05/2026.
- PI, “Ensemble Detection System Combining Family Information for Android Malware Detection”, supported by the Macao Science and Technology Development Fund (FDCT), MOP 739,700, 09/2022-09/2024.
- PI, “Security Vulnerabilities Localization and Report Generation Method for Closed Source Mobile Apps”, supported by the Macao Science and Technology Development Fund (FDCT), MOP 1,123,000, 09/2020-09/2023.
- PI, “Bug Localization for Mobile Apps”, supported by the National Natural Science Foundation (NSFC), CNY 200,000, 01/2017-12/2019.

Industrial Projects

- PI, “Implementation of an Intelligent Debt Collection System Based on Deep Learning”, Shenzhen Jiayutai Technology Co., Ltd., CNY 300,000, 06/2022-05/2023.

Academic Service

- **Associate Editor**
IEEE Transactions on Reliability (TRel), 2025-Present
IEEE Transactions on Software Engineering (TSE), 2024-Present
Journal of Systems and Software (JSS), 2024-Present
IEEE Access, 2018-2019
- **Editorial Board Member**
Empirical Software Engineering (EMSE), 2024-Present
Science of Computer Programming (SCP), 2024-Present
Journal of Systems and Software (JSS), 2022-2024
- **Board Member of Distinguished Reviewers**
ACM Transactions on Software Engineering and Methodology (TOSEM), 2022-Present

- **Guest Editor**
Journal of Software: Evolution and Process (JSEP)
Journal of Systems and Software (JSS)
Science of Computer Programming (SCP)
Frontiers of Information Technology and Electronic Engineering (FITEE)
- **Steering Committee Member**
IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER), 2023-Now
- **General Chair/Co-Chair**
Asia-Pacific Software Engineering Conference (APSEC 2025)
IEEE Services Workshop on Emerging Services in the Greater Bay Area (ES-GBA 2024)
IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER 2023)
- **Program Co-Chair**
International Conference on Advanced Security on Software and Systems (ASSS 2025)
Asia-Pacific Symposium on Internetware (Internetware 2024)
International Conference on Dependable Systems and Their Applications (DSA 2021)
- **Local Organizing Co-Chair**
IEEE International Conference on Software Quality, Reliability, and Security (QRS 2020)
- **Organizing Committee Co-Chair**
IEEE International Workshop on Bug Fixing (IBF 2019-2021)
- **Track Co-Chair**
ACM Symposium on Applied Computing (SAC 2017-2022): *Software Engineering Track*
- **Publicity Chair/Co-Chair**
International Joint Conference on Artificial Intelligence (IJCAI 2023)
International Conference on Blockchain and Trustworthy Systems (BlockSys 2023)
IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER 2019)
IEEE International Conference on Software Quality, Reliability, and Security (QRS 2019)
- **Financial Chair**
International Conference on Internetware (Internetware 2025)
- **Proceedings Co-Chair**
IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER 2025)
- **Registration Chair**
IEEE World Congress on Services (SERVICES 2024)
- **TPC Member**
ACM SIGSOFT International Symposium on Software Testing and Analysis (ISSTA 2025-2026)
International Conference on Software Engineering (ICSE 2025-2026)
ACM Symposium on the Foundations of Software Engineering (FSE 2023-2024, 2026)
International Conference on Mining Software Repositories (MSR 2022-2023, 2026)
IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER 2020, 2026)
IEEE/ACM International Conference on Automated Software Engineering (ASE 2025): *Industry Showcase Track*
International Symposium on Software Fault Prevention, Verification, and Validation (SFPVV 2025)
International Conference on AI Foundation Models and Software Engineering (FORGE

- 2024)
- International Conference on Software Engineering for Adaptive and Self-Managing Systems (SEAMS 2024): *Artifact Track*
 - IEEE/ACM International Conference on Automated Software Engineering (ASE 2023-2024)
 - Asia-Pacific Software Engineering Conference (APSEC 2023-2024)
 - International Symposium on Software Reliability Engineering (ISSRE 2021-2024)
 - IEEE International Conference on Software Quality, Reliability, and Security (QRS 2020-2024)
 - IEEE/ACM International Conference on Software Engineering (ICSE 2023): *Demonstrations Track*
 - Asia-Pacific Symposium on Internetware (Internetware 2023)
 - IEEE/ACM International Conference on Automated Software Engineering (ASE 2019, 2023): *Tool Demonstrations Track*
 - IEEE Pacific Rim International Symposium on Dependable Computing (PRDC 2022)
 - IEEE International Conference on Software Maintenance and Evolution (ICSME 2020-2022)
 - International Conference on Network and System Security (NSS 2018, 2020-2022)
 - Innovations in Software Engineering Conference (ISEC 2020-2021)
 - ACM Symposium on Applied Computing (SAC 2015-2016): *Software Engineering Track*
- **Journal Reviewer**
 - ACM Computing Surveys (CSUR)
 - ACM Transactions on Software Engineering and Methodology (TOSEM)
 - IEEE Transactions on Software Engineering (TSE)
 - IEEE Transactions on Dependable and Secure Computing (TDSC)
 - Empirical Software Engineering (EMSE)
 - IEEE Software
 - Automated Software Engineering
 - Journal of Software: Evolution and Process (JSEP)
 - Journal of Systems and Software (JSS)
 - IET Software
 - Software: Practice and Experience (SPE)
 - Information and Software Technology (IST)
 - Computers & Security
 - Software Quality Journal (SQJ)
 - International Journal of Software Engineering and Knowledge Engineering (IJSEKE)
 - IEEE Transactions on Reliability (TRel)
 - IEEE Transactions on Haptics (TH)
 - SCIENCE CHINA Information Sciences
 - Journal of Software (in Chinese)
 - Journal of Computer Science and Technology (JCST)
 - Frontiers of Computer Science (FCS)
 - Neural Networks
 - Knowledge-Based Systems (KBS)
 - SN Computer Science
 - Innovations in Systems and Software Engineering: A NASA Journal (ISSE)
 - Sustainable Computing: Informatics and Systems (SUSCOM)
 - Journal of Ambient Intelligence and Humanized Computing (JAIHC)
 - Journal of KING SAUD University-Computer and Information Sciences

- IEEE Access
- Journal of Supercomputing
- Connection Science
- Cluster Computing
- Security and Communication Networks (SCN)
- IEEE Signal Processing Letters
- Applied Intelligence (APIN)
- Tsinghua Science and Technology
- **Professional Organization Service**
 - Conferences Co-Chair (Paper Awards) of IEEE Computer Society Technical Community on Software Engineering (TCSE), 2025-Present
 - Chair of IEEE Macau Computer Society Chapter, 2025-Present
 - Member of CCF Technical Committee on Software Engineering, 2017-Present
 - Board Member of Supervisors, IEEE Macau, 2022-Present
- **University-Level Service**
 - Member of Teaching Excellence Award Committee, Macau University of Science and Technology, 2021-Present
- **Faculty/School-Level Service**
 - Chair of Research Committee, School of Computer Science and Engineering, Macau University of Science and Technology, 2024-Present

Talks

- Keynote Speaker, “AI-Powered Software Data Analysis for Automated Software Engineering”, *The 10th International Conference on Computer Science and Application Engineering (CSAE 2026)*, Shanghai, October 17, 2026.
- Keynote Speaker, “AI and Automated Software Engineering: How Far Can We Go?”, *The 16th International Conference on Software Engineering and Service Science (ICSESS 2025)*, Macau, December 16, 2025.
- Invited Speaker, Advanced Explorations in Intelligent Software Data Analytics, *The 27th GOPS Global Operations Conference*, Shanghai, October 18, 2025.
- Keynote Speaker, “How AI is Changing the World of Software Engineering”, *IEEE Services Workshop on Emerging Services in the Greater Bay Area (ES-GBA 2024)*, Shenzhen, July 7, 2024.

Dissertations and Theses Supervised

Dissertations

- Supervisor, “Cognizant Detection of Android Malware: Intuitive Classification and Explication of Harmful Effects”, Dissertation by Yao Li, Ph.D. in Artificial Intelligence, Macau University of Science and Technology, 2024.
- Supervisor, “Detecting Smart Contract Vulnerabilities through Analysis of Control and Data Flow in Code Call Graphs”, Dissertation by Dawei Yuan, Ph.D. in Artificial Intelligence, Macau University of Science and Technology, 2023.

Theses

- Supervisor, “Automatic Smart Contract Vulnerability Detection Based on Large Language Model”, Thesis by Ruixiong Yang, Master of Science in Information Technology, Macau University of Science and Technology, 2025.
- Supervisor, “Automatic Patch Backporting”, Thesis by Yiming Sun, Master of Science in Information Technology, Macau University of Science and Technology, 2025.
- Supervisor, “A New Framework for Intelligent Log Analysis and Detection”, Thesis by

Xinyue Li, Master of Science in Information Technology, Macau University of Science and Technology, 2025.

- Supervisor, “An Innovative Framework for Enhancing Bug Report Information”, Thesis by Hongrong Yin, Master of Science in Information Technology, Macau University of Science and Technology, 2025.
- Supervisor, “Bug Discovery from App User Reviews Using Sentiment Analysis”, Thesis by Junhao Chen, Master of Science in Information Technology, Macau University of Science and Technology, 2024.
- Supervisor, “Automatic Program Repair Based on Large Language Model”, Thesis by Chang Hu, Master of Science in Information Technology, Macau University of Science and Technology, 2024.
- Supervisor, “Guiding User on How to Effectively Use Apps by Automated Responses”, Thesis by Zhengquan Li, Master of Science in Information Technology, Macau University of Science and Technology, 2024.
- Supervisor, “A New Framework for Security Bug Report Identification”, Thesis by Yansheng Liao, Master of Applied Mathematics and Data Science, Macau University of Science and Technology, 2024.
- Supervisor, “Analyzing User Reviews for App Release Strategy”, Thesis by Xiaohui Wang, Master of Applied Mathematics and Data Science, Macau University of Science and Technology, 2023.
- Supervisor, “STRE: An Automated Approach to Suggesting App Developers When to Stop Reading Reviews”, Thesis by Youshuai Tan, Master of Applied Mathematics and Data Science, Macau University of Science and Technology, 2023.
- Supervisor, “Towards Context-Aware Based Bug Localization”, Thesis by Xiao Peng, Master of Applied Mathematics and Data Science, Macau University of Science and Technology, 2022.
- Supervisor, “Q2Q: A Query-to-Query Neural Code Search Approach”, Thesis by Yutong He, Master of Applied Mathematics and Data Science, Macau University of Science and Technology, 2022.
- Supervisor, “API Usage Pattern Recommendation Considering Human Intentions”, Thesis by Zijie Chen, Master of Applied Mathematics and Data Science, Macau University of Science and Technology, 2022.
- Supervisor, “Automatic Code Summarization Research Based on Graph Attention Mechanism”, Thesis by Jianwei Zeng, Master of Science in Information Technology, Macau University of Science and Technology, 2022.
- Supervisor, “Bug Report Enrichment Based on BERT Model”, Thesis by Lingze Meng, Master of Science in Information Technology, Macau University of Science and Technology, 2021.
- Supervisor, “The Research on Automatic Labeling Method for Mobile Application Issue Reports”, Thesis by Haoming Li, Master of Engineering in Software Engineering, Harbin Engineering University, 2020.

Teaching Courses

Macau University of Science and Technology

- SE252 Software Project Management
- SE251 Software Engineering
- SE250 Software Engineering Practices
- SE480 Topics in Software Engineering
- CS240 Database Systems

- SE111 Object-Oriented Programming for Java
- ST001 Special Topic in New Computer Technology
- CS190 Professional Ethics and Communication Skills

Harbin Engineering University

- 201406323 Software Quality Assurance and Testing
- 201406415 Software Testing Comprehensive Experiment
- 201406421 Advanced Labs in Software Engineering

Nanjing University of Posts and Telecommunications

- B0301340S Algorithm Analysis and Design

Language and Technical Ability

- **Chinese:** Native Language
- **English:** High Level of Proficiency in Listening, Speaking, Reading, and Writing
- **Korean:** Elementary Proficiency in Listening, Speaking, Reading, and Writing
- **Programming Language:** High Level of Proficiency in Python, Java, C, C++, and C#
- **Development Tool:** High Level of Proficiency with VS, NetBeans, Eclipse, and MATLAB

Hobby

- Reading, Skating, Mountaineering, and Piano Performance