



南京大學

研究生畢業論文
(申請碩士專業學位)

論文題目 一種使用Hammer砸碎Nut的方法

作者姓名 張三

學科、專業 軟件工程

研究方向 某某研究主題

指導教師 李四 职称

20xx 年 x 月 xx 日

学 号 : MFxxxxxxx
论文答辩日期 : 20xx 年 x 月 xx 日
指 导 教 师 : (签字)



Using a Hammer to Crack a Nut

By

San Zhang

Supervised by

Advisor Title **Si Li**

A Thesis

Submitted to the Software Institute

and the Graduate School

of Nanjing University

in Partial Fulfillment of the Requirements

for the Degree of

Master of Engineering

Software Institute

May 20xx

南京大学研究生毕业论文中文摘要首页用纸

毕业论文题目： 一种使用Hammer砸碎Nut的方法
软件工程 专业 20xx 级硕士生姓名： 张三
指导教师（姓名、职称）： 李四 职称

摘 要

这部分是中文摘要。

以下展示列举（无编号）：

1. 结合代码依赖紧密度分析和用户反馈的软件追踪线索生成方法。我们提出了一种结合了代码依赖紧密度分析和用户反馈的软件追踪线索生成方法。一方面通过设置代码依赖紧密度阈值划分代码域，使得功能紧密的代码元素位于同一个代码域中；另一方面，对于给定需求，将各代码域中有代表性的代码元素交由用户判断与该需求相关性，根据用户反馈结果调整相关代码元素对应候选线索的相似度值。
2. 实验数据组织及方法验证。我们用一个被领域内广泛用于软件追踪线索生成方法验证的高质量数据集和三个被广泛应用于日常实践的开源系统可追踪数据集验证了我们方法的有效性和实用性。并且，我们通过对开源软件在issue-tracking工具上的软件行为信息进行分析整理，组织了其需求到代码的追踪关系。此外，我们通过运行开源系统自带的用于验证系统功能的测试用例得到了我们方法所需的代码依赖。
3. 基于代码依赖和用户反馈的软件追踪线索生成工具的设计与实现。为了将我们的方法应用于日常实践，我们设计并实现软件追踪线索生成工具，并集成了我们结合代码依赖紧密度分析和用户反馈的软件追踪线索生成方法。

关键词： 这里是关键字

南京大学研究生毕业论文英文摘要首页用纸

THESIS: Using a Hammer to Crack a Nut

SPECIALIZATION: Software Engineering

POSTGRADUATE: San Zhang

MENTOR: Advisor Title Si Li

Abstract

This is English abstract.

In summary, the contribution of this paper is summarized as follows:

1. Contribution 1.
2. Contribution 2.
3. Contribution 3.

The evaluation also showed that our approach statistically outperforms other baseline approaches through a small amount of user feedback. And we can use this approach in daily practice through the assistant tool for traceability recovery.

Keywords: traceability recovery, code dependencies, information retrieval, closeness analysis, user feedback

目 录

目录	v
参考文献	1
简历与科研成果	7
致谢	9

表 格

插图

第一章 这是章节标题

1.1 这是节标题

1.1.1 这是小节标题

参考文献

- [1] Xiaofan Chen and John C. Grundy. Improving automated documentation to code traceability by combining retrieval techniques. In *26th IEEE/ACM International Conference on Automated Software Engineering (ASE 2011)*, Lawrence, KS, USA, pages 223–232, 2011.
- [2] Giuliano Antoniol, Gerardo Canfora, Gerardo Casazza, Andrea De Lucia, and Ettore Merlo. Recovering traceability links between code and documentation. *IEEE transactions on software engineering*, 28(10):970–983, 2002.
- [3] Giuliano Antoniol, Gerardo Casazza, and Aniello Cimitile. Traceability recovery by modeling programmer behavior. In *Proceedings of the Seventh Working Conference on Reverse Engineering (WCRE 2000)*, Brisbane, Australia, pages 240–247, 2000.
- [4] Patrick Rempel and Patrick Mäder. Preventing defects: The impact of requirements traceability completeness on software quality. *IEEE Transactions on Software Engineering*, 43(8):777–797, 2017.
- [5] Jane Cleland-Huang. Are requirements alive and kicking? *IEEE Software*, 30(3):13–15, 2013.
- [6] Patrick Mäder and Alexander Egyed. Assessing the effect of requirements traceability for software maintenance. In *28th IEEE International Conference on Software Maintenance (ICSM 2012)*, Trento, Italy, pages 171–180, 2012.
- [7] Jane Cleland-Huang, Orlena Gotel, Jane Huffman Hayes, Patrick Mäder, and Andrea Zisman. Software traceability: trends and future directions. In *Proceedings of the on Future of Software Engineering (FOSE 2014)*, Hyderabad, India, pages 55–69, 2014.
- [8] Giuliano Antoniol, Jane Cleland-Huang, Jane Huffman Hayes, and Michael Vierhauser. Grand challenges of traceability: The next ten years. *arXiv preprint arXiv:1710.03129*, 2017.

- [9] Balasubramaniam Ramesh and Matthias Jarke. Toward reference models for requirements traceability. *IEEE Transactions on Software Engineering*, 27(1):58–93, 2001.
- [10] O. C. Z. Gotel and Anthony Finkelstein. An analysis of the requirements traceability problem. In *Proceedings of the First IEEE International Conference on Requirements Engineering (ICRE 1994), Colorado Springs, Colorado, USA*, pages 94–101, 1994.
- [11] Jane Huffman Hayes, Alex Dekhtyar, and Senthil Karthikeyan Sundaram. Advancing candidate link generation for requirements tracing: The study of methods. *IEEE Transactions on Software Engineering*, 32(1):4–19, 2006.
- [12] Andrian Marcus and Jonathan I. Maletic. Recovering documentation-to-source-code traceability links using latent semantic indexing. In *Proceedings of the 25th International Conference on Software Engineering (ICSE 2003), Portland, Oregon, USA*, pages 125–137, 2003.
- [13] Jane Cleland-Huang, Raffaella Settini, Chuan Duan, and Xuchang Zou. Utilizing supporting evidence to improve dynamic requirements traceability. In *13th IEEE International Conference on Requirements Engineering (RE 2005), Paris, France*, pages 135–144, 2005.
- [14] Collin McMillan, Denys Poshyvanyk, and Meghan Revelle. Combining textual and structural analysis of software artifacts for traceability link recovery. In *ICSE Workshop on Traceability in Emerging Forms of Software Engineering (TEFSE@ICSE 2009), Vancouver, BC, Canada*, pages 41–48, 2009.
- [15] Hongyu Kuang, Jia Nie, Hao Hu, Patrick Rempel, Jian Lu, Alexander Egyed, and Patrick Mäder. Analyzing closeness of code dependencies for improving ir-based traceability recovery. In *IEEE 24th International Conference on Software Analysis, Evolution and Reengineering (SANER 2017), Klagenfurt, Austria*, pages 68–78, 2017.
- [16] Annibale Panichella, Collin McMillan, Evan Moritz, Davide Palmieri, Rocco Oliveto, Denys Poshyvanyk, and Andrea De Lucia. When and how using structural information to improve ir-based traceability recovery. In *17th European Confer-*

- ence on Software Maintenance and Reengineering (CSMR 2013), Genova, Italy, pages 199–208, 2013.
- [17] Jane Cleland-Huang, Adam Czauderna, Marek Gibiec, and John Emenecker. A machine learning approach for tracing regulatory codes to product specific requirements. In *Proceedings of the 32nd ACM/IEEE International Conference on Software Engineering (ICSE 2010)*, Cape Town, South Africa, pages 155–164, 2010.
- [18] Jin Guo, Jinghui Cheng, and Jane Cleland-Huang. Semantically enhanced software traceability using deep learning techniques. In *Proceedings of the 39th International Conference on Software Engineering (ICSE 2017)*, Buenos Aires, Argentina, pages 3–14, 2017.
- [19] Aaron K. Massey, Paul N. Otto, and Annie I. Antón. Aligning requirements with HIPAA in the itrust system. In *16th IEEE International Requirements Engineering Conference (RE 2008)*, Barcelona, Catalunya, Spain, pages 335–336, 2008.
- [20] Claes Wohlin, Aybüke Aurum, Lefteris Angelis, Laura Phillips, Yvonne Dittrich, Tony Gorschek, Håkan Grahm, Kennet Henningsson, Simon Kågström, Graham Low, Per Rovegard, Piotr Tomaszewski, Christine Van Toorn, and Jeff Winter. The success factors powering industry-academia collaboration. *IEEE Software*, 29(2):67–73, 2012.
- [21] Jane Cleland-Huang. Toward meaningful industrial-academic partnerships. *IEEE Software*, 32(1):18–21, 2015.
- [22] Benedikt Burgstaller and Alexander Egyed. Understanding where requirements are implemented. In *26th IEEE International Conference on Software Maintenance (ICSM 2010)*, Timisoara, Romania, pages 1–5, 2010.
- [23] Ahron Abadi, Mordechai Nisenson, and Yahalomit Simionovici. A traceability technique for specifications. In *The 16th IEEE International Conference on Program Comprehension (ICPC 2008)*, Amsterdam, The Netherlands, pages 103–112, 2008.
- [24] Scott C. Deerwester, Susan T. Dumais, Thomas K. Landauer, George W. Furnas, and Richard A. Harshman. Indexing by latent semantic analysis. *JASIS*, 41(6):391–407, 1990.

- [25] Susan T. Dumais. Improving the retrieval of information from external sources. *Behavior Research Methods, Instruments, Computers*, 23(2):229–236, 1991.
- [26] Gerard Salton and Michael McGill. *Introduction to Modern Information Retrieval*. McGraw-Hill Book Company, 1984.
- [27] Scott C. Deerwester, Susan T. Dumais, Thomas K. Landauer, George W. Furnas, and Richard A. Harshman. Indexing by latent semantic analysis. *Journal of the American society for information science*, 41(6):391–407, 1990.
- [28] Michael Gutman. Asymptotically optimal classification for multiple tests with empirically observed statistics. *IEEE Transactions on Information Theory*, 35(2):401–408, 1989.
- [29] Hongyu Kuang, Patrick Mäder, Hao Hu, Achraf Ghabi, LiGuo Huang, Jian Lü, and Alexander Egyed. Can method data dependencies support the assessment of traceability between requirements and source code? *Journal of Software: Evolution and Process*, 27(11):838–866, 2015.
- [30] Andrea De Lucia, Rocco Oliveto, and Paola Sgueglia. Incremental approach and user feedbacks: a silver bullet for traceability recovery. In *22nd IEEE International Conference on Software Maintenance (ICSM 2006)*, Philadelphia, Pennsylvania, USA, pages 299–309, 2006.
- [31] Annibale Panichella, Andrea De Lucia, and Andy Zaidman. Adaptive user feedback for ir-based traceability recovery. In *8th IEEE/ACM International Symposium on Software and Systems Traceability (SST 2015)*, Florence, Italy, pages 15–21, 2015.
- [32] Wenjing Zhang and Junyi Wang. The study of methods for language model based positive and negative relevance feedback in information retrieval. In *Fourth International Symposium on Information Science and Engineering (ISISE 2012)*, Shanghai, China, pages 39–43, 2012.
- [33] Ricardo A. Baeza-Yates and Berthier A. Ribeiro-Neto. *Modern Information Retrieval*. ACM Press / Addison-Wesley, 1999.
- [34] Lingjun Kong, Juan Li, Yin Li, Ye Yang, and Qing Wang. A requirement traceability refinement method based on relevance feedback. In *Proceedings of the*

- 21st International Conference on Software Engineering Knowledge Engineering (SEKE 2009)*, Boston, Massachusetts, USA, pages 37–42, 2009.
- [35] Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze. *Introduction to information retrieval*. Cambridge University Press, 2008.
- [36] Dawn J. Lawrie, David W. Binkley, and Christopher Morrell. Normalizing source code vocabulary. In *17th Working Conference on Reverse Engineering (WCRE 2010)*, Beverly, MA, USA, pages 3–12, 2010.
- [37] Dawn J. Lawrie and David W. Binkley. Expanding identifiers to normalize source code vocabulary. In *IEEE 27th International Conference on Software Maintenance (ICSM 2011)*, Williamsburg, VA, USA, pages 113–122, 2011.
- [38] Wentao Wang, Arushi Gupta, Nan Niu, Li Da Xu, Jing-Ru C. Cheng, and Zhen-dong Niu. Automatically tracing dependability requirements via term-based relevance feedback. *IEEE Transactions on Industrial Informatics*, 14(1):342–349, 2018.
- [39] Massimiliano Di Penta, Sara Gradara, and Giuliano Antoniol. Traceability recovery in RAD software systems. In *10th International Workshop on Program Comprehension (IWPC 2002)*, Paris, France, pages 207–216, 2002.
- [40] Jane Cleland-Huang, Adam Czauderna, Alex Dekhtyar, Olly Gotel, Jane Huffman Hayes, Ed Keenan, Greg Leach, Jonathan I. Maletic, Denys Poshyvanyk, Yonghee Shin, Andrea Zisman, Giuliano Antoniol, Brian Berenbach, Alexander Egyed, and Patrick Mäder. Grand challenges, benchmarks, and tracelab: developing infrastructure for the software traceability research community. In *Proceedings of the 6th International Workshop on Traceability in Emerging Forms of Software Engineering (TEFSE 2011)*, Waikiki, Honolulu, HI, USA, pages 17–23, 2011.
- [41] Eya Ben Charrada, David Caspar, Cédric Jeanneret, and Martin Glinz. Towards a benchmark for traceability. In *Proceedings of the 12th International Workshop on Principles of Software Evolution and the 7th annual ERCIM Workshop on Software Evolution, (EVOL/IWPSE 2011)*, Szeged, Hungary, pages 21–30, 2011.
- [42] Xiaofan Chen, John G. Hosking, John Grundy, and Robert Amor. Development of robust traceability benchmarks. In *22nd Australian Conference on Software Engineering (ASWEC 2013)*, Melbourne, Victoria, Australia, pages 145–154, 2013.

- [43] Michael Rath, Patrick Rempel, and Patrick Mäder. The ilmseven dataset. In *25th IEEE International Requirements Engineering Conference (RE 2017), Lisbon, Portugal*, pages 516–519, 2017.
- [44] Lin Shi, Celia Chen, Qing Wang, Shoubin Li, and Barry W. Boehm. Understanding feature requests by leveraging fuzzy method and linguistic analysis. In *Proceedings of the 32nd IEEE/ACM International Conference on Automated Software Engineering (ASE 2017), Urbana, IL, USA*, pages 440–450, 2017.
- [45] Klaus Pohl. *Requirements Engineering - Fundamentals, Principles, and Techniques*. Springer, 2010.
- [46] Michael Fischer, Martin Pinzger, and Harald C. Gall. Populating a release history database from version control and bug tracking systems. In *19th International Conference on Software Maintenance (ICSM 2003), The Architecture of Existing Systems, Amsterdam, The Netherlands*, page 23, 2003.
- [47] Petra Heck and Andy Zaidman. An analysis of requirements evolution in open source projects: recommendations for issue trackers. In *13th International Workshop on Principles of Software Evolution (IWPSE 2013), Proceedings, Saint Petersburg, Russia*, pages 43–52, 2013.
- [48] Nasir Ali, Zohreh Sharafi, Yann-Gaël Guéhéneuc, and Giuliano Antoniol. An empirical study on the importance of source code entities for requirements traceability. *Empirical Software Engineering*, 20(2):442–478, 2015.
- [49] David J. Groggel. Practical nonparametric statistics. *Technometrics*, 42(3):317–318, 2000.
- [50] Fabio Palomba, Pasquale Salza, Adelina Ciurumelea, Sebastiano Panichella, Harald C. Gall, Filomena Ferrucci, and Andrea De Lucia. Recommending and localizing change requests for mobile apps based on user reviews. In *Proceedings of the 39th International Conference on Software Engineering (ICSE 2017), Buenos Aires, Argentina*, pages 106–117, 2017.

简历与科研成果

基本情况 张三，男，汉族，1993 年 1 月出生，江苏省南京市人。

教育背景

2015.9～2018.6 南京大学软件学院 硕士

2001.9～2015.7 南京大学软件学院 本科

这里是读研期间的成果（实例为受理的专利）

1. 李四，张三，“一种使用Hammer砸碎Nut的方法”，申请号：20xx1018xywz.a，已受理。

致 谢

这里是致谢