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Danksagung

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Acknowledgements

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Kurzfassung

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Abstract

200-250 words Enter your text here.

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Introduction

1.1 Motivation

- OK software, due to its(steady growing) complexity [LB85](need to read) maybe better than the lehman85 cus available [LR03]
structured programming <http://dl.acm.org/citation.cfm?id=1243380>
- OK software evolution
Evelyn Barry , Sandra Slaughter , Chris F. Kemerer, An empirical analysis of software evolution profiles and outcomes, Proceedings of the 20th international conference on Information Systems, p.453-458, December 12-15, 1999, Charlotte, North Carolina, USA
- OK maintenance [LS80] [ISO06]
T. H. Ng , S. C. Cheung , W. K. Chan , Y. T. Yu, Do Maintainers Utilize Deployed Design Patterns Effectively?, Proceedings of the 29th international conference on Software Engineering, p.168-177, May 20-26, 2007
code has to be understood [Boe76] in order to make changes or add features [SLea97]
integrate somewhere here: software -> bug -> understand(up to 60% [Bas97](is this really related? thorough reading may be better) [Pig96]) to fix

Software under lies a continuous changes, throughout its live cycle. The evolution process from the beginning of development until its release and maintenance. Large software¹ and most of all software classified as type E [CHLW06] gets more complex over time. If there are more than a few developers/development teams are involved or the developers/development teams are spread allover the world, there exists more foreign code than self written.

¹"The term large is, generally, used to describe software whose size in number of lines of code is greater than some arbitrary value. For reasons indicated in [leh79], it is more appropriate to define a large program as one developed by processes involving groups with two or more management levels." [LR03]

- program comprehension

Since changes, enhancements or fixes of existing code demand the developers involved to gain a high level of understanding for the software at hand. This task is referred to by the scientific community as "program understanding" or "program comprehension". This thesis addresses the task of improving program comprehension of the concatenative programming language forth on several level.

- proper reading as of [Bas97](?) [RCM04]
systematic approach, strategy may depend on various attributes
- mental model(LaToza et al., 2006)
read: @inproceedingsLieberman:1995:BGC:223904.223969, author = Lieberman, Henry and Fry, Christopher, title = Bridging the Gulf Between Code and Behavior in Programming, booktitle = Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, series = CHI '95, year = 1995, isbn = 0-201-84705-1, location = Denver, Colorado, USA, pages = 480–486, numpages = 7, url = <http://dx.doi.org/10.1145/223904.223969>, doi = 10.1145/223904.223969, acmid = 223969, publisher = ACM Press/Addison-Wesley Publishing Co., address = New York, NY, USA,
- strategies as stated by [SFM99]
- dynamic analysis as defined by [Bal99] [CZvD⁺09]
- static analysis as defined by [Bal99]

Namely the the reading of source code, static analysis, dynamic analysis and the assistance of writing readable and easy to understand source code.

- concatenative languages -> forth, postscript, factor -> implications from the concatenative nature... ie potential to be more natural to read cause of reverse polish notation
David Shepherd , Lori Pollock , K. Vijay-Shanker, Case study: supplementing program analysis with natural language analysis to improve a reverse engineering task, Proceedings of the 7th ACM SIGPLAN-SIGSOFT workshop on Program analysis for software tools and engineering, p.49-54, June 13-14, 2007, San Diego, California, USA
- comparison to oo langs
- higher abstraction, hard structure boundaries

Due to the nature of concatenative languages, it is possible to write source code which ready very similar to natural language. There are no hard boundaries to the structure of the source code(custom defined loops and control structures) as in object oriented languages.

- paradigm promotes a single shared data structure of high importance and thus may simplify the task of putting all the necessary run-time information visually together(cite someone who says that its important to have all information visible at every point in time). Although there are several stacks, features like arbitrary memory allocation, the focus on stacks is clearly stated.

Darren C. Atkinson , William G. Griswold, The design of whole-program analysis tools, Proceedings of the 18th international conference on Software engineering, p.16-27, March 25-29, 1996, Berlin, Germany

1.2 problem statement (which problem should be solved?)

hypothesis here

- much work and tools on oo- or procedural languages [CZvD⁺09]
- not so much on concatenative ~~stack-oriented~~ languages... nothing in fact, although maybe similarities to procedural
- applicability of oo- and procedural methods for concatenative ~~stack-oriented~~ languages at the example of forth
- applicability of oo-visualization methods
- suggestions of (new) methods(lineout style wordlists/words)

1.3 aim of the work

This work aims to better understand how program comprehension is performed in concatenative languages and how it can be made more efficient. The secondary goal is analyse the applicability of existing analysis- and visualization methods and provide modifications to existing visualization methods(and maybe suggestion of new methods). The forth programming language is used as a representative of concatenative languages.

~~demonstration by enhancing the gforth stepping debugger(trace recording, trace visualization, goal-based approach possible)~~

1.4 methodological approach

- qualitative approach(?)
- proposal
- Preliminary evaluations as defined by [CZvD⁺09]

- outcome is a subjectiv view of the available methods, and proposed enhancements which have been implementet
- case study of the implemented enhancement
- suggestions of further enhancements

1.5 structure of the work

At first, the available information of a forth program is identified. The next step is to characterize the information and its necessity for program comprehension is investigated. The differences of forth and object oriented languages are summarized and then the applicability of existing analysis and visualization methods is presented. The last part of this thesis investigates probable enhancements and modifications to existing methods and proposes new approaches. After the conclusion, the thesis presents further suggestions to support program comprehension and further topics of research in this direction.

State of the art / analysis of existing approaches

This section presents an overview of the work relevant to program comprehension regarding the aim of the work.

2.1 literature studies

software evolution software maintenance program comprehension structured approach and thorough reading is the most efficient[cite]

2.2 analysis

selected work

2.2.1 program comprehension strategies

about the mental model building

- top down
- bottom up
- knowledgebased
- systematic and as-needed
- integrated approaches

2.2.2 analysis to support program understanding

Several analysis types

dynamic analysis

- about realtime/interactive vs post mortem
- actual behavior
- incomplete view [Bal99]
- observer effect
Andrews, J. (1997). Testing using log file analysis: tools, methods, and issues. In Proc. International Conference on Automated Software Engineering (ASE), pages 157–166. IEEE Computer Society Press
- scalability
Zaidman, A. (2006). Scalability Solutions for Program Comprehension through Dynamic Analysis. PhD thesis, University of Antwerp
- debugging -> different kind of paradigms and languages and tools
see @incollectionreiss1993trace, title=Trace-based debugging, author=Reiss, Steven P, booktitle=Automated and Algorithmic Debugging, pages=305–314, year=1993, publisher=Springer
- about debugging
- dataflow analysis(Backward Analysis)(not sufficient in demo)
Darren C. Atkinson , William G. Griswold, Implementation Techniques for Efficient Data-Flow Analysis of Large Programs, Proceedings of the IEEE International Conference on Software Maintenance (ICSM'01), p.52, November 07-09, 2001

static analysis

complete view no actual data present

2.2.3 applicability to concatenative languages

existing methods abstract(abstract like print debugging and stepping and so on) furthermore the abstraction of all those methods mentioned above applicability for concatenative languages

2.3 visualization to support program understanding maybe some examples(and tools)

- sequence diagram

- circular diagram and interactive interaction sequence diagram [Cor09]
- interaction diagrams (Jacobson, 1992)/ scenario diagrams (Koskimies and MÄssenbÄck 1996)
- information murals (Jerding and Stasko, 1998)
- polymetric views (Ducasse et al., 2004)
- fisheye views (suggested by George W. Furnas, 1986, and formulated by [SM96] and [SB94])
- hierarchical edge bundling (Holten, 2006)
- structural and behavioral views of object-oriented program (Kleyn and Gingrich, 1988)
- matrix visualization and ÄÄJexecution patternÄÄ notations [PLVW98] to visualize traces in a scalable manner(De Pauw et al. 1993, 1994, 1998)
- architecture oriented visualization (Sefika et al. 1996)
- a continuous sequence diagram, and the ÄÄJinformation muralÄÄ (Jerding and Stasko, 1998)
- architecture with dynamic information (Walker et al. 1998)
- frequency spectrum analysis (Ball 1999)

2.4 comparison and summary of existing approaches

existing approaches for gforth/forth

- kgforth <http://sourceforge.net/projects/kgforth/>
- existing methods(actual methods)
 - factoring (http://en.wikipedia.org/wiki/Modular_programming <https://www.complang.tuwien.ac.at/html/Factoring-Tutorial.html> <http://www.ultratechnology.com/Forth-factors.htm>)
has to be considered during initial development
 - dump
 - . / type
 - dbg
 - see/ code-see
 - ~

CHAPTER 3

Methodology

- case study(maybe exploratory)
- prototype
- sketches
- trying to understand programs developed withing stackbased languages vl?

3.1 used concepts

- prototyping
- reading codes
- print-debugging
- step-debugging

3.2 methods and/or models

- prototyping

3.3 languages

- postscript
- forth
- shell script

- c
- m2

3.4 design methods

?

3.5 data models

?

3.6 analysis methods

- reading code
- tail and error

3.7 formalisms

?

Suggested solution/implementation

kind of an ide development environment

light table ide(js) continuous reverse engineering idea of [MJS⁺00] to provide immediate response of the systems output... although probably not applicable or very time consuming in setup(or not more than integration testing...) for most industrial scale software

eclipse ide(java)

4.1 suggested solution

- emphasis on on comprehension code while writing. factoring suggestion, documentation, aliases(same code with multiple aliases to read more natural at different points in programs), expressive naming, hard to generalize cause of the flexibility the language provides
- adequate search and cross reference facilities to support systematical investigation to benefit from effective program understanding as stated by [RCM04]
- display of the 'vocabulary' [cite moore: remember all the words]
- other data structures and variables should be displayed
 - memory maybe like [Rei95] or [AKG⁺10] but since there is no underlying object orientation and no standardized oo system this would be hard to accomplish
 - fisheye or word cloud like display(tree or sugiyama as of [SWFM97])

- interactive program manipulation: state of the system before a word, after a word and by clicking on the word jumping to its definition or inserting it and there also providing those features
- stepping debugger mode: simply stepping through the whole code word by word
- goal-oriented strategy: the definition of an execution scenario such that only the parts of interest of the software system are analyzed (Koenemann and Robertson, 1991; Zaidman, 2006).
- code analysis and visualization facilities see chapter 2 TODO

4.2 implementation

proof of concept by enhancement of stepping debugger on forth code level(cause it has turned out to be the fastest and simplest approach) by showing additional data: the other stacks

Critical reflection

5.1 comparison with related work

? is there any? maybe the modifications to oo methods? or listing of the methods which did work and those which did not

kgforth in some way

5.2 discussion of open issues

- not scaling well cause of limited screen real estate and thus the need to scroll
- not scalign well cause of unpredictable stack height(maybe show only depth according to stack effect comment)
- nature of gforth
 - interpretation/compilation mix(how to integrate the adhook changes between modes '[]')
 - implementation within the executing system
 - lack of dynamic information(return stack add -> wordname heuristic)
- not suitable for performance meassuring cause debugger...
- quantitative data on the effects the enhancement needed

Summary and future work

summary of what has been done and the subjective conclusion

- how does software maintenance work in those
- ide
- using a standard data type to store traces
- display of variable content
- display of allocated memory areas
- display of color diff with tooltip of previous values for stacks and memory areas
- (better visualization of loops and control structures) is this even possible?
- (display of the full program as a graph) is this even possible?
- (customizable inspection depth) ?
- static code analysis
 - stack depth per word
 - type system for forth
 - ...

conclusion like what i contributed to the community!!

work on program comprehension of concatenative languages good overview of the field [CDPC11] and [Cor09]

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