Term-Indexing for the Beagle Theorem Prover

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Except where otherwise indicated, this thesis is my own original work.

Timothy Clarence Richard Cosgrove
14 July 2013

For Dana.

Acknowledgements

Thank you to my Supervisor and all…

Abstract

This should be the abstract to your thesis...

Contents

Chapter 1

An Introduction to My Thesis

1.1 The Basis for this Work

1.1.1 A Theoretical Framework

Chapter 2

Background

2.1 First-Order Logic Terms and Notation

This thesis focuses around the extension of *beagle* , a *first-order logic* (FOL) theorem prover. In order to understand beagle's purpose and functions a basic understanding of the FOL logical system is required. This section provides a rudimentary overview of FOL syntax and uses; but also includes an explanation of any specialised terms and notation used throughout the paper.

2.1.1 FOL basics

2.1.2 Calculi and FOL problems

2.1.3 The Superposition Calculus

Should contain

- Variables
- Symbols
- Predicates
- Quantifiers
- Notion of soundness and completeness
- Description of a 'calculus'
- Positions

2.2 Automated Reasoning and Theorem Proving

Automated Reasoning is a rapidly growing field of research where computer programs are used to solve problems stated in first order logic statments or other formal logics.

Some existing theorem provers include:

SPASS

[Weidenbach et al. 1999]

Vampire

[Riazanov and Voronkov 1999]

E

[Schulz 2002]
Should contain

- Theorem prover examples

2.3 Term Indexing

Term indexing is a technique used to better locate logical terms which match rules in a prover's calculus.

Top Symbol Hashing

Discriminant Trees

2.4 Fingerprint Indexing

Fingerprint Indexing is a recent technique developed by Schulz [2012], the creator of the E prover.

2.5 The Beagle Theorem Prover

The core implementation of Beagle was developed by Peter Baumgartner et al. of NICTA. Its purpose was to demonstrate the capabilities of the *Weak Abstraction with Heirachic Superposition Calculus*; which allows the incorporation of prior knowledge via a 'background reasoning' modules.

2.5.1 The Weak Abstraction with Heirachic Superposition Calculus

2.5.2 Beagle's Shortcomings

2.6 Scala

As mentioned above *beagle* is written in *Scala*, the Scalable Language. Scala is a functional language and may be confusing to those who are not familiar with the functional programming paradigm. This thesis will contain occasional snippets of

Scala code; but note that any snippets used will be accompanied by an explanation and in general an understanding of Scala/funcitonal programming is not required.

Chapter 3

Implementing Fingerprint Indexing

3.1 Initial Implementation

```
/** Check two Fingerprint features for compatibility based
  * on the unification table (See page 6 of [Shulz 2012]).
  * This table is reduced to 4 cases:
  *   True if Features are equal,
  *   True if at least one Feature is B,
  *   True if at least one Feature is A; but no Ns,
  *   False otherwise  */
 def compareFeaturesForUnification
         (a:FPFeature, b:FPFeature) : Boolean =
  (a==b) ||
  (Set(a,b) match {
    case x if (x contains FPB) => true
    case x if (x contains FPA) => !(x contains FPN)
    case _ => false})
```

Listing 1: Scala implementation of the Fingerprint unification table. [Schulz 2012, p6]

3.1.1 Refactoring Current Implementation

3.1.2 Initial Problems

3.2 Tailoring to Beagle

Chapter 4

Results

4.1 Why I Did It

4.2 What I Did

Chapter 5

Conclusion

5.1 Why this is a Very Clever Thesis

Appendix A

Some Other Stuff

A.1 Why I Did It

Appendix B

More Stuff

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