Complete Contracts for EiffelBase

PROJECT PLAN

Semester project

Project period: SS 2007

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9th Semester

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1. PROJECT DESCRIPTION

Overview

The contracts currently used in Eiffel are strong underspecifications. There are always some properties when invoking Eiffel features that are not expressed though the contracts. This is specially true when it comes to express what does not change through a feature invocation. This makes the formal verification of Eiffel impossible, as in the case of verification we have to assume the worst possible implementation that still satisfies the contract.

To overcome these lacks, two approaches will be used to add full functional specifications to Eiffel:

- Models are mathematical structures which describe the abstract state of an object. These mathematical structures are built out of sets, relations, functions and sequences. The currently available library called MML [8] provides this functionality. This model library is based on a typed set theory of finite sets.
- Dynamic Frame Contracts (DFC) [3] enable us to talk about infinite sets of objects. They are contractual expressions describing the read effect and the write effect of a feature. With the DFC we can solve the "frame problem" and exclude unwanted side effects.

Scope of the work

This semester thesis is an effort to redevelop a major part of the EiffelBase Library to support Dynamic Frame Contracts and Models. The goal is to redesign and implement as much as possible in the given time-frame, with a focus is on the implementation of the linked list class in the EiffelBase Library and all supporting classes. The purpose of using Dynamic Frame Contracts and Models is to allow full functional specifications and therefore formal verification.

Intended results

The redesign and reimplementation using Dynamic Frame Contracts and Models should allow full functional specifications and therefore formal verification primarily of the linked list. And the redesign of the EiffelBase Library structure should lead to a cleaner and smoother Base Library.

2. BACKGROUND MATERIAL

Reading list

- Dynamic Frame Contract, see [3]
- OOSC, see [2]
- Dynamic Frames: Support for Framing, Dependencies and Sharing Without Restrictions, see [4]
- Making specifications complete through models, see [5]

- Strengthening Eiffel Contracts using Models, see [6]
- Eiffel0: An Object-Oriented Language with Dynamic Frame Contracts, see [7]

3. PROJECT MANAGEMENT

Objectives and priorities

- Develop a structure for the EiffelBase Library.
- Develop a model using MML for every class used in this structure.
- Check if the usage of models influences the structure.
- Compare the new structure with the original EiffelBase Library structure.
- Implement the new Base Library.

Criteria for success

The redesigned and reimplemented EiffelBase Library should be cleaner and smoother than the original EiffelBase Library. The new Library should use Dynamic Frame Contracts and Models to allow full functional specifications. At least the linked list class and its parents should be redesigned and reimplemented using Dynamic Frame Contracts and Models.

Method of work

All important decisions will be made together with the supervisor. Because this semester thesis is part of the Ballet project, there will be weekly meetings with the Ballet team. In this meetings, the current state of the work and possible problems can be discussed and the next steps are determined.

Quality management

Documentation

A documentation describing the changes made to the structure of the original EiffelBase Library is part of this semester project. Also in this documentation the use and the impact of Dynamic Frame Contracts and Models will be described.

Validation steps

To ensure good quality, there will be testing phases during the project. For testing, AutoTest [10] which is a fully automatic testing tool based on Design by Contracts, will be used. Also, periodical feedbacks form the supervisor Bernd Schoeller will be emphasized.

4. PLAN WITH MILESTONES

Project steps

- Plan the project
- Read background material (see reading list)
- Install Eiffel Studio 5.7 Branch with Frame Contract support
- Analyze the basic structure of the EiffelBase Library
- Design a new class hierarchy and class structures
- Design models for every class using MML
- Check if the usage of models influences the new class structures
- Compare new and old Base Library structures
- Implement the new Base Library using Dynamic Frame Contracts and Models
- Write documentation

Deadline

End of semester: June 22th 2007

Tentative schedule

Topic	March				April				Mai				June			
Plan		🟦	🟦													
Read papers		🟦	🟦	🟦												
Installation of ES			🟦													
Analyze EiffelBase Library			🟦	🟦												
Design new structures				🟦	🟦											
Design models				🟦	🟦											
Implementation					🟦	🟦	🟦		🟦	🟦	🟦		🟦	🟦		
Test and Verification							🟦	🟦			🟦	🟦		🟦	🟦	
Documentation					🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
Milestones (see below)					x			x						x		x

Milestones

- Presentation of the new designed structures and models after the design phase (1. week of April)
- Presentation of the first implemented part for short review after the first implementation phase (end of April)
- End of implementation (1. week of June)
- Final version of Documentation ready (end of June)

REFERENCES

[1] Chair of Software Engineering: *Semester-/Diplomarbeiten*; Online at: http://se.inf.ethz.ch/projects/index.html.

[2] Bertrand Meyer: *Object-Oriented Software Construction, 2nd edition*, Prentice Hall, 1997.

[3] Bernd Schoeller, Jonathan Ostroff: *Dynamic Frame Contracts*, to be published.

[4] Ioannis T. Kassios, *Dynamic Frames: Support for Framing, Dependencies and Sharing Without Restrictions*, Formal Methods 2006, Springer Verlag Berlin Heidelberg 2006.

[5] Bernd Schoeller, Tobias Widmer, and Bertrand Meyer: *Making specifications complete through models*, to appear in "Architecting Systems with Trustworthy Components", eds Ralf Reussner, Judith Stafford and Clemens Szyperski, Springer-Verlag Lecture Notes in Computer Science, vol. 3938, 2006.

[6] Bernd Schoeller: *Strengthening Eiffel Contracts using Models*, 2003.

[7] Bernd Schoeller: *Eiffel0: An Object-Oriented Language with Dynamic Frame Contracts*, Technical Report 2006

[8] MML. Online at: http://se.inf.ethz.ch/people/schoeller/mml.html.

[9] EiffelBase Library. Online at: http://www.eiffel.com.

[10]AutoTest. Online at: http://se.inf.ethz.ch/people/leitner/auto_test/.