ANNUAL
REPORT
2000

Contact
office@swc.rwth-aachen.de
www.swc.rwth-aachen.de
+49-241-80-21331
Ahornstr. 55
52074 Aachen, Germany

Software Construction

Staff

- Faculty:

    Univ.-Prof. Dr. rer. nat. Horst Lichter

- Secretary:

    Frau Bärbel Kronewetter

- Research Assistants:

    Dipl.-Inform. Thomas von der Maßen

    Dipl.-Inform. Moritz Schnizler

    Dipl.-Inform. Axel Uhl
    (50% third-party funds position until 01.05.2000,
    now external at Interactive Objects, Freiburg)

    Dipl.-Inform. Thomas Weiler
    (third-party funds position since 02.11.2000)

Overview

Software development is a complex, difficult, and challenging task. Although a lot of research has been done to improve our ability to develop high quality software, the state of practice concerning development methods, tools and languages is still insufficient.

The research group is doing basic research in the following areas

- **Object-Oriented Software Construction**

  Object technology has proven to be well suited for application development. Especially when building so called program families, object and component based development lead to a high degree of reusability. We are engaged in architectural issues for designing product families.

- **Software Quality Assurance**

  Quality assurance measures play an important role in delivering high quality software. Expierence shows that object-oriented and component based development needs new testing and validation techniques. We focus on a testing method for framework based developement by means of role modeling.

Currently we are running three research projects. The first aims in developing a method for testing applications implemented by means of an object- oriented framework. The goal of the second project is to define a technique and a tool set to improve Internet searchability based on object-oriented information modeling. The third project that was recently started focuses on requirements engineering and design issues of software product lines. Since we work in close cooperation with industrial partners our research projects have a strong practical orientation. We offer lectures and courses on object and component technology as well as on software quality assurance. Further information concerning our research and teaching activities can be found at:

<div align="center">

http://www-lufgi3.informatik.rwth-aachen.de

</div>

Research Projects

<div style="border:1px solid black; padding:1em; text-align:center">

Software Test Bench

H. Lichter, M. Schnizler

</div>

The goal of this project is a more efficient testing approach for the members of a program family. Today programs for related application areas are often developed as a family, in which different variants share a common kernel that implements their

basic functionality. This way common parts are reused across different programs saving considerable development effort. Actually, a family approach may also improve the overall quality of its members, since the reused parts have already been tested in previous variants. However, the adaptations and extensions required for different program variants make it imperative to thoroughly test each of them individually, since they may cause new defects that will also affect the reused parts. Unfortunately in practice, testing program family members remains laborious, because it often requires new tests for each variant. Our objective is the development of a test bench that can be reused without modification for every program family member. Since in particular the concepts of object-orientation promote reuse and therefore the construction of program families, we decided early to focus our work on testing framework-based programs. In this case a test bench is based on the framework that all program family members have in common, and it can be used to check, if every program variant correctly provides the common functionality.

It turned out early that the main obstacles on the way to a framework test bench are tightly linked with those of testing object-oriented software in general. A close inspection of current testing techniques showed that in particular the poor reusability of test cases across different implementations and the insufficient consideration of object interaction make it difficult to use them as starting point for our approach. While testing object-oriented software today means testing individual classes, we concentrate instead on testing the interaction of objects. So called object collaborations embody the main complexity in an object-oriented program and characterise its fundamental behaviour. Actually, they are also a framework's essential contribution. From our experience, collaborations once implemented are more stable than individual classes, which are clamped between conflicting collaborations. They are ideally suited as starting point for reusable tests.

Role modelling has shown to be an effective means for describing object collaborations. Roles allow separating the different concerns that are set up by the different collaborations, in which an object is involved. So a particular collaboration's role model can be reused for any implementation of the same collaboration. Consequently, test cases that are derived from a specific role model can be reused for each program family member that contains an identical collaboration. The project studies in particular, how collaborations can be modelled effectively with roles, and how test cases can be derived from such a role model. In the end, those test cases - once implemented - constitute the test bench, for which we set out in the beginning.

Objectbased Internet Search

H. Lichter, A. Uhl

External cooperation: Interactive Objects, Freiburg

Today's Internet search engines compute their centralized index by crawling web contents. This approach implies two major problems: large and relevant parts of the Internet content are not reachable by crawling and thus remain inaccessible for search engines ("deep web"), bandwidth and its growth impose harsh limits on central index currency and indexable share of vastly growing available information

The obvious solution is a distributed approach to information retrieval that better leverages the available bandwidth in order to achieve higher index currency and improved coverage, including deep web contents. A formal model regarding the bandwidth comsumption of distributed search can be established which can then be used to optimize logical network topologies like trader distributions for efficient bandwidth use.

The solution lies in reversing the paradigm of Internet search. Content providers will have to contribute to the searchability of their information space, thus making search more bandwidth-efficient and making deep web contents accessible to search.

Internet content increasingly tends to be generated by online applications rather than by static documents. In order to integrate this content with a distributed search infrastructure, searchability has to be incorporated into modern, holistic application architectures like is already done for other items like persistence, transactions, or distribution. The benefits of model-driven development (see also OMG's Model Driven Architecture - MDA) can be leveraged for this purpose.

A prototype showing how this can be done has been brought online at

<div align="center">

http://www.NewWaveSearchables.com

</div>

together with a white paper explaining the most important concepts. It combines best-of-breed techniques from the field of information retrieval with an architectural approach to designing searchable online applications.

<div style="border:1px solid black; padding:10px;">

Software Product Lines

H. Lichter, T. von der Maßen, T. Weiler

</div>

External cooperation: ABB Corporate Research, Ladenburg

A product line is a set of related products which serve a specific market segment. Within the scope of software engineering the product-line based approach provides the possibility to maximize the reuse of techniques, processes and organisations and to reduce time to market.

In order to develop a successful product line, the common and variable features among all products of a product line must be identified and summarized into a Domain Model.

Based on this Domain Model an Application Model for every single product of the product line is developed, which describes the variable parts of the specific product.

Thereby new tasks and problems in all areas of the software development process arise. To describe Software Product Lines adequately new methods must be developed respectively existing methods must be adapted. Furthermore it must be ensured that evolution of the Domain Model entails evolution of the thereon based applications.

In the context of this project methods for the systematic description of requirements and architectures for product lines should be analysed and advanced. Thereby particularly existing modelling languages like the UML should be analysed to what extend they fulfill the needs for modelling Software Product Lines.

Other Activities

Teaching

In 2001 the following courses were held:

- Lecture "Software Quality Assurance" (3V+2Ü)

- Lecture "Component Technology" (2V)

- Lecture "Object-Oriented Software Construction" (3V+2Ü)

- Seminar "Quality Assurance" in cooperation with sd&m AG Köln

- Seminar "Product Lines" (2Ü)

- Proseminar "GUI Development" (2Ü)

- Practical Course Java Application Development (3Ü)

Other activities

Speaker of the *GI-Fachgruppe 2.1.6. Requirements Engineering*, *H. Lichter*

Member of the *GI-Fachausschuss 2.1 Software Engineering and Programming Languages*, *H. Lichter*

Member of the GI-Arbeitsgruppe *Requirements Engineering für Produktfamilien* of the GI-Fachgruppe 2.1.6 Requirements Engineering, *T. von der Maßen*

Member of the program comittee, GI-Conference *Modellierung 2001*, Universtity of Paderborn, 28.-30.3.2001, *H. Lichter*

Program chair of GI-Conference *SEUH 2001*, Universtity of Zuerich, 22.-23.2.2001, *H. Lichter*

Organization of the anual workshop of *GI-Fachgruppe 2.1.6 Requirements Engineering*, Hamburg, 29.-30.11.2001, *H. Lichter*

Assessor for *Fonds zur Förderung der wissenschaftlichen Forschung*, Wien, *H. Lichter*

Reviewer for dpunkt-Verlag Heidelberg and Cluver Academic Publishers, *H. Lichter*

Representative of the Computer Science Department in the RWTH's quality of teaching program, *H. Lichter*

Organization of the Computer Science Department's mentors program, *H. Lichter*

Organization of the Beginner's Course in Computer Science 2001, *H. Lichter, T. Weiler*

Computer and Network infrastructure

The intranet of the *software construction* research group consists of 5 SUN Workstations running Solaris and 10 PCs running Windows 2000 resp. Linux which are connected via 100MBit Ethernet. One Workstation is used as Server (Data-, Name- and Mailservice, Backup), one PC as a Firewall between the backbone of the Computer Science Division and the intranet of the research group. Beyond it the research group possesses 2 Laptops which are mainly used for presentations and teaching.

Talks and Publications

Talks

H. Lichter: *Software Entwurf - Methoden und Techniken,* Seminar at Access Materials + Processes, Aachen, February 2001

H. Lichter: *Software Product Lines - Chances and Risks,* ITG Conference on "Individualsoftware aus der Schublade - SW-Produktfamilien als Lösung"

H. Lichter: *Requirements and Testing,* Requirements Days 01, Langen, November 2001

H. Lichter: *Test Case Design and Validation Costs,* Requirements Days 01, Langen, November 2001

H. Lichter: *Systematischer Softwaretest,* Seminar at Access Materials + Processes, July 2001

H. Lichter: *Framework based Software Development,* Computer Science Colloquium, University of Mannheim, October, 2001

M. Schnizler: *Testen rahmenwerksbasierter Programme,* Treffen AK Testen objektorientierter Programme (TOOP) der GI-Fachgruppe 2.1.7, Dresdner Bank, Frankfurt/Main, 18.05.2001

M. Schnizler: *Testen rahmenwerksbasierter Anwendungen,* OODACH-Treffen, Software Competence Center Hagenberg, 17.09.2001

M. Schnizler: *Rollenbasierter Test objektorientierter Kollaborationen,* Treffen GI-Fachgruppe 2.1.7 Test, Analyse und Verifikation von Software (TAV), ASQF, Erlangen, 18.10.2001

Publications

H. Lichter, T. von der Maßen: *Modellierung von Variabilitäten in Anforderungen bei Software-Produktlinien,* Tagungsband Informatiktage der GI, November 2001

M. Schnizler: *Rollenbasierter Test objektorientierter Kollaborationen,* Softwaretechnik-Trends, ISSN 0720-8928, Vol 21, Nr 3, pp 9-10.

H. Lichter, M. Glinz: *Software Engineering im Unterricht der Hochschulen,* dpunkt-verlag, Heidelberg

H. Lichter, H. P. Fröhlich, M. Zeller: *Enabling Local SPI in a Multi-National Company,* Proc. of Int. Conference on Product Focussed Software Process Improvement PROFES' 2001, Kaiserlautern, September 2001

H. Lichter, H. P. Fröhlich, M. Zeller: *Software Process Improvement at ABB,* Proc. of CONQUEST 2001, Nürnberg, September 2001

A. Uhl: *Das Framework New Wave Searchables für die skalierbare Internet-Suche,* OBJEKTSpektrum, No 4, 2001,
http://shipping.accesscable.net/uhl/ObjectSpektrum.PDF

A. Uhl: *The Future of Internet Search,* DOA'01 International Symposium on Distributed Objects and Applications, Short Papers, Sep 2001,
http://shipping.accesscable.net/uhl/DOA2001Short.PDF

A. Uhl: *Globale Suche über Web-Anwendungen,* swDevelopment, No 2, 2001

H. Lichter, A. Uhl: *New Wave Searchables: Changing the Paradigm of Internet Scale Search,* International Conference on Advances in Infrastructure for Electronic Business, Science, and Education on the Internet, Aug 2001,
http://shipping.accesscable.net/uhl/SSGRR.PDF