



**TECHNISCHE FAKULTÄT DER
CHRISTIAN-ALBRECHTS-UNIVERSITÄT
ZU KIEL**



Christian-Albrechts-Universität zu Kiel

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Programming Languages and Compiler Construction

The research group „Programming Languages and Compiler Construction“ is interested in the design, implementation and application of programming languages intended to support the reliable implementation of complex systems. The research ranges from object-oriented design methods and the analysis of concurrent and distributed systems to the implementation and application of declarative programming languages, in particular, in the area of web-based systems.

Results

The scientific work of the research group involved all areas related to declarative programming languages, e.g., design, semantics, implementation, development tools, and application of such languages. Declarative programming languages are based on clear mathematical foundations. They abstract from the underlying computer architecture and thus provide a higher programming level, leading to more reliable systems. In particular, much of the research is focused towards the integration of the most important declarative programming paradigms: functional and logic programming. Due to our long-standing research in this area, we were invited to publish a survey on functional logic programming in the Communications of the ACM, the main publication forum of the Association for Computing Machinery, the world's largest educational and scientific society for computing.

In the area of *software technique* related to declarative languages, we collaborated with the Portland State University (Oregon, USA) and developed a transformation tool to support the development of reliable declarative programs. This tool supports the idea of generating implementations from high-level specifications and to use such specifications as assertions for lower-level implementations. Another development in this area is a new approach to combine laziness and faithfulness in the implementation of assertions for functional logic programs.

We also investigated several issues related to the *implementation* of functional logic programming languages. We developed a new compiler that is based on the implementation of nondeterminism in a purely functional language exploiting monads. This monadic approach allows the selection of the concrete search strategy by different monad instances so that various search strategies can be selected and combined at run-time. This also provides a new basis to exploit *parallelism* since one can implement nondeterministic computations by concurrent threads that run on multicores. Furthermore, we also worked in collaboration with the Portland State University (Oregon, USA) on new reduction strategies for the evaluation of nondeterministic operations.

Related to the *application* of declarative languages, we designed and implemented a new framework, called Spicey, to generate complete web applications from a specification of the underlying data as an entity-relationship model. Since the generated implementation is a high-level declarative program, it is easy to adapt this program to various customer requirements. In contrast to other web frameworks, our framework exploits high-level declarative programming techniques so that it yields reliable implementations that avoid data inconsistencies at various levels. Another application area we explored is the matching of regular expressions. We have developed a high-level, but also quite efficient matching algorithm, in the functional language Haskell, which is competitive with matching algorithms implemented in lower-level imperative programming languages.

Our research group was also engaged in activities to train young students. We introduced students from schools in Schleswig-Holstein to basic programming techniques in one-week courses. During this period, the participating students developed a distributed chat program in the concurrent functional language Erlang. This course was organized by Frank Huch (in collaboration with Thomas Wilke).

Personnel

Head of the group: Prof. Dr. Michael Hanus; Secretary: Ulrike Pollakowski
Technical Staff: Dipl.-Ing. (FH) Thomas Heß

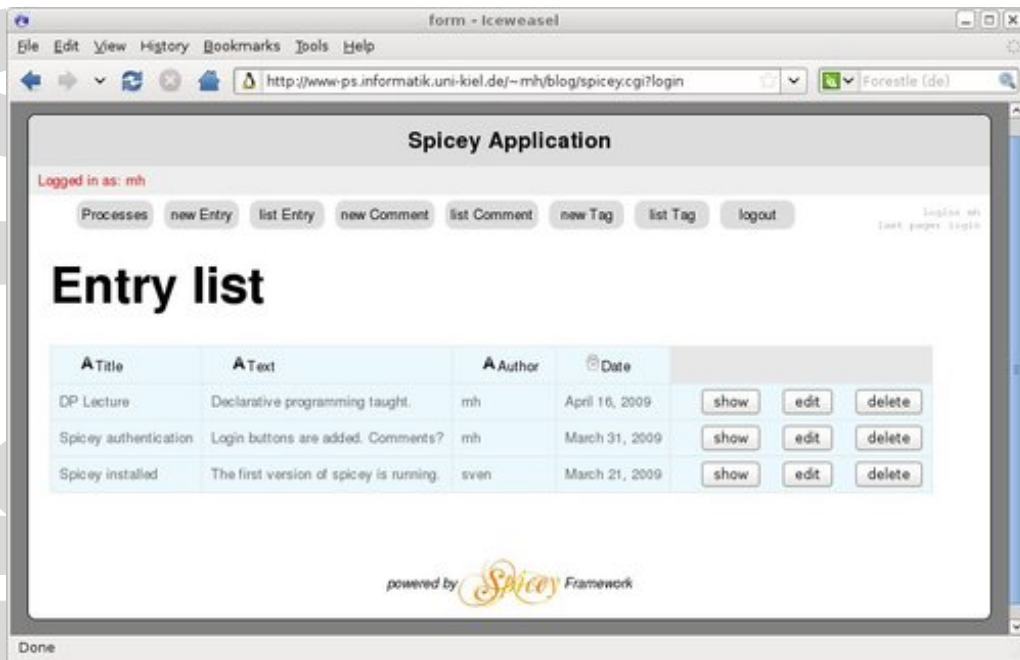


Fig. 1: A simple blog generated by the web framework Spicey

Scientific Staff:

Dipl.-Inf. Sebastian Fischer	01.01.-14.09.2010	CAU
Priv.-Doz. Dr. Frank Huch	01.01.-31.12.2010	CAU
Administration of study programs		
M. SC. Björn Peemöller	01.10.-31.12.2010	
Dipl.-Inf. Fabian Reck	01.01.-31.12.2010	CAU
Dr. Friedemann Simon	01.01.-31.12.2010	CAU

Lectures, Seminars, and Laboratory Course Offers

Winter 2009/2010

Diplomandenseminar, 2 hrs Seminar/Week,
Michael Hanus

Inf-Prog: - Programmierung, 4 (+ 2) hrs Lecture (+ Exercises)/Week,
Michael Hanus (+ Fabian Reck, Christina Otte, Bernd Braßel, Sebastian Eggert)

MS0302: Übersetzerbau, 4 (+ 2) hrs Exercise (+ Exercises)/Week,
Michael Hanus (+ Sebastian Fischer)

NF-Inf-3: Programmiertechniken für die Künstliche Intelligenz für Nebenfächler, 2 (+ 2) hrs Lecture (+ Exercises)/Week,
Friedemann Simon

WI16: Programmiertechniken für die Künstliche Intelligenz, 2 (+ 2) hrs Lecture (+ Exercises)/Week,
Friedemann Simon

Arbeitsgemeinschaft Informatik, Logik und Mathematik, 2 hrs Seminar/Week,
Michael Hanus (+ Rudolf Berghammer)

MSS0302: Seminar - Programmiersprachen und Programmiersysteme, 2 hrs Seminar/Week,
Michael Hanus

MSS0303: Masterabschlusseminar Programmiersprachen, 2 hrs Seminar/Week,
Michael Hanus

NF-Inf-1: Informatik für Nebenfächler, 2 (+ 2) hrs Lecture (+ Exercises)/Week,
Frank Huch (+ Sebastian Fischer, Hauke Fuhmann)

Vertiefende Übung zu: Informatik für Nebenfächler, 2 hrs Exercise/Week,
Frank Huch (+ Sebastian Fischer)

Summer 2010

Systematisches Programmieren, 2 (+ 4) hrs Lecture (+ Exercises)/Week,
Friedemann Simon

Diplomandenseminar, 2 hrs Seminar/Week,
Michael Hanus

Arbeitsgemeinschaft Informatik, Logik und Mathematik, 2 hrs Seminar/Week,
Michael Hanus (+ Rudolf Berghammer)

MS0303: - Deklarative Programmiersprachen, 4 (+ 2) hrs Seminar (+ Exercises)/Week,
Michael Hanus (+ Fabian Reck)

MS0306: - Nebenläufige und verteilte Programmierung, 4 (+ 2) hrs Lecture (+ Exercises)/Week,
Frank Huch

MSS0302: Seminar - Programmiersprachen und Programmiersysteme, 2 hrs Exercise/Week,
Michael Hanus

Systematisches Programmieren für Physiker (NF-Inf-2-Phys), 2 hrs Lecture/Week,
Friedemann Simon

WI09: - Fortgeschrittene Programmierung, 3 (+ 2) hrs Lecture (+ Exercises)/Week,
Michael Hanus (+ Frank Huch, Sebastian Fischer)

Winter 2010/2011

MSS0303: Masterabschlusseminar - Programmiersprachen, 2 hrs Seminar/Week,
Michael Hanus

Inf-Prog: Programmierung, 4 (+ 2) hrs Lecture (+ Exercises)/Week,
Michael Hanus (+ Fabian Reck, Lars Prädel)

Arbeitsgemeinschaft Informatik, Logik und Mathematik, 2 hrs Seminar/Week,
Michael Hanus (+ Rudolf Berghammer)

MS0303: Deklarative Programmiersprachen, 4 (+ 2) hrs Lecture (+ Exercises)/Week,
Michael Hanus

MS0306: Nebenläufige und verteilte Programmierung, 4 (+ 2) hrs Lecture (+ Exercises)/Week,
Frank Huch

NF-Inf-1: Informatik für Nebenfächler, 2 (+ 2) hrs Lecture (+ Exercises)/Week,
Frank Huch (+ Sandro Esquivel)

NF-Inf-1v: Informatik für Nebenfächler (vertiefend), 4 (+ 2) hrs Lecture (+ Exercises)/Week,
Frank Huch (+ Sandro Esquivel)

Inf-ObjPro: Objektorientierte Programmierung, 2 (+ 2) hrs Lecture (+ Exercises)/Week,
Friedemann Simon

Inf-ObjProNF: Objektorientierte Programmierung (für Nebenfächler), 2 (+ 2) hrs Lecture (+ Exercises)/Week,
Friedemann Simon

Further Cooperation, Consulting, and Technology Transfer

During the reported period, the research group collaborated with Prof. Sergio Antoy, Portland State University (funded by DAAD).

Diploma, Bachelor and Master Theses

Julia Mangels, *Marketing im E-Commerce*, 06.10.2010

Max Fritzsche, *Declarative Specification of Platform-Independent User Interfaces*, 17.05.2010

Axel Stronzik, *Evolutionsunterstützung von modellbasierter Programmentwicklung*, 02.08.2010

Benjamin Lücke, *Digital Natives - Herausforderungen für die Didaktik wirtschaftlicher Schulfächer*, 31.07.2010

Gabriel Wicke, *ByteMap: Persistent and Locality-Optimized Trie for Disk and Memory*, 01.12.2010

Andreas Baldeau, *Reguläres Ausdrucksmatching in Trie-Strukturen*, 08.11.2010

Stefanie Pelz, *Verwendung endlicher Automaten in der Betriebswirtschaftslehre insbesondere im Controlling*,
02.09.2010

Deniz Okcu, *Betriebswirtschaftliche Beispiele für grundlegende Konzepte der Informatik*, 13.09.2010

Maike K. Hargens, *Ein Vergleich der Programmiersprachen Groovy und Scala*, 30.09.2010

Florian Micheler, *Extensions to a Haskell based Web-Server*, 30.09.2010

Dissertations / Postdoctoral Lecture Qualifications

Sebastian Fischer, *On Functional-Logic Programming and its Application to Testing*, 27.05.2010

Frank Kupke, *Robust Distributed Software Transaction for Haskell*, 19.11.2010

Publications

Published in 2010

Sebastian Fischer, Frank Huch, Thomas Wilke, *A Play on Regular Expressions (Functional Pearl)*, Proceedings of the 15th ACM SIGPLAN International Conference on Functional Programming, New York, NY, USA, ACM Press, 357 - 368 (2010)

Sergio Antoy, Michael Hanus, *Functional Logic Programming*, Communications of the ACM, **53(4)**, 74 - 85 (2010)

Michael Hanus, Sven Koschnicke, *An ER-based Framework for Declarative Web Programming*, Proc. of the Twelfth International Symposium on Practical Aspects of Declarative Languages, PADL 2010, Springer LNCS 5937, 201 - 216 (2010)

Bernd Braßel, Sebastian Fischer, Michael Hanus, Fabian Reck, *Transforming Functional Logic Programs into Monadic Functional Programs*, Proceedings of the 19th International Workshop on Functional and (Constraint) Logic Programming, WFLP 2010, 2 - 18 (2010)

Michael Hanus, *Lazy and Faithful Assertions for Functional Logic Programs*, Proceedings of the 19th International Workshop on Functional and (Constraint) Logic Programming, WFLP 2010, 50 - 64 (2010)

Sergio Antoy, Michael Hanus, *A Transformation Tool for Functional Logic Program Development*, Proc. of the 24th Workshop on (Constraint) Logic Programming, WLP 2010, 23 - 33 (2010)

- Michael Hanus, Fabian Reck, *Proc. 27. Workshop der GI-Fachgruppe Programmiersprachen und Rechenkonzepte*, Christian-Albrechts-Universität zu Kiel, **Technical Report 1010**, (2010)
- A. Alqaddoumi, S. Antoy, Sebastian Fischer, Fabian Reck, *The Pull-Tab Transformation*, Third International Workshop on Graph Computation Models, 127 - 133 (2010)
- Sebastian Fischer, Frank Huch, Th. Wilke, *Reguläres Ausdruckstheater*, Proc. 27. Workshop der GI-Fachgruppe Programmiersprachen und Rechenkonzepte, 34 - 34 (2010)
- Bernd Braßel, Sebastian Fischer, Michael Hanus, Fabian Reck, *Transforming Functional Logic Programs into Monadic Functional Programs*, Proc. 27. Workshop der GI-Fachgruppe Programmiersprachen und Rechenkonzepte, 129 - 129 (2010)

Presentations

- Michael Hanus, *Lazy and Faithful Assertions for Functional Logic Programs*, 19th International Workshop on Functional and (Constraint) Logic Programming (WFLP 2010), Madrid, Spanien, 17.01.2010
- Fabian Reck, *Transforming Functional Logic Programs into Monadic Functional Programs*, 19th International Workshop on Functional and (Constraint) Logic Programming (WFLP 2010), Madrid, Spanien, 17.01.2010
- Michael Hanus, *An ER-based Framework for Declarative Web Programming*, Twelfth International Symposium on Practical Aspects of Declarative Languages, PADL 2010, Madrid, Spanien, 19.01.2010
- Sebastian Fischer, Frank Huch, *Reguläres Ausdruckstheater*, 27. Workshop der GI-Fachgruppe Programmiersprachen und Rechenkonzepte, Bad Honnef, 03.-05.05.2010
- Michael Hanus, *A Transformation Tool for Functional Logic Program Development*, 24th Workshop on (Constraint) Logic Programming (WLP 2010), Cairo, Egypt, 16.09.2010
- Sebastian Fischer, *A Play on Regular Expressions*, 15th ACM SIGPLAN International Conference on Functional Programming (ICFP'10), 29.09.2010
- Fabian Reck, *Transforming Functional Logic Programs into Monadic Functional Programs*, 27. Workshop der GI-Fachgruppe Programmiersprachen und Rechenkonzepte, Bad Honnef, Germany, 05.05.2010
- Fabian Reck, *The Pull-Tab Transformation - An evaluation technique for functional logic programs*, Third International Workshop on Graph Computation Models, Enschede, The Netherlands, 02.10.2010

Further Activities and Events

- M. Hanus: organization of the 27th Workshop of the GI-Fachgruppe Programmiersprachen und Rechenkonzepte, Bad Honnef (Germany), May 2010.
- M. Hanus: program committee member of WFLP 2010 (19th Workshop on Functional and (Constraint) Logic Programming), Madrid (Spain), January 2010.
- M. Hanus: program committee member of FLOPS 2010 (Tenth International Symposium on Functional and Logic Programming) Sendai, April 2010.
- M. Hanus: program committee member of TFP 2010 (Eleventh Symposium on Trends in Functional Programming), Oklahoma (USA), May 2010.
- M. Hanus: program committee member of LOPSTR 2010 (20th International Symposium on Logic-based Program Synthesis and Transformation), Hagen (Austria), July 2010.
- M. Hanus: program committee member of WLP 2010 (24th Workshop on (Constraint) Logic Programming), Cairo (Egypt), September 2010.
- M. Hanus: Member of the Editorial Board of the Journal of Functional and Logic Programming.

M. Hanus: chair of the executive committee of the Fachgruppe „Programmiersprachen und Rechenkonzepte“ of the Gesellschaft für Informatik e.V.

M. Hanus: member of the steering committee of the symposia on Logic-based Program Synthesis and Transformation.

M. Hanus: Member of the executive committee and vice-chair of the GLP (Gesellschaft für Logische Programmierung), German-speaking branch of the Association for Logic Programming (ALP).

M. Hanus: member of the advisory board of the GLP (Gesellschaft für Logische Programmierung), German-speaking branch of the Association for Logic Programming (ALP).

M. Hanus: member of the selection committee of the DAAD (German Academic Exchange Service) for the project-related support to scientific cooperation with Spain and Portugal.

M. Hanus: member of the advisory board of the „Berufsakademie an der Wirtschaftsakademie Schleswig-Holstein“ .

M. Hanus: referee of the Ph.d. thesis Karl Klose (title: „On the Expressiveness of Declarative Meta-Languages“), Aarhus University, 2010.

M. Hanus: chair of the managing directorate of the Institute of Computer Science, University of Kiel.

M. Hanus: chair of the examinations board of computer science studies, University of Kiel.

M. Hanus: member of the convent of the Faculty of Engineering, University of Kiel.

M. Hanus: member of the Senate Curriculum Committee, University of Kiel.

M. Hanus: vice-member of the Senate Equal Opportunities Committee, University of Kiel.

M. Hanus: research stay related to „Functional Logic Program Development“ at Portland State University (Oregon, USA) with Prof. Sergio Antoy, February 10-24, 2010.

F. Huch: member of the Steering Committee of Symposia on Implementation and Application of Functional Languages (IFL).

F. Huch: chair of the executive committee of the Fachgruppe „Programmiersprachen und Rechenkonzepte“ of the Gesellschaft für Informatik e.V.

F. Huch: organisation (together with Thomas Wilke) of the „Schnupperstudium Informatik für Schülerinnen und Schüler“ , April 6 - 9, 2010, Kiel, 70 participants. Course on introduction to programming: navigation of a pirate ship by means of the programming language Erlang, final project: development and implementation of a distributed chat.

F. Huch: organisation (together with Thomas Wilke) of the „Schnupperstudium Informatik für Schülerinnen“ , October 18 - 22, 2010, Kiel, 22 participants, course on introduction to programming: navigation of the little ladybird Kara by means of the programming language Erlang, final project: development and implementation of a distributed chat.

F. Simon: participation in seminars for students planning professional careers.

F. Simon: „Computer Museum“ , representative of the Faculty of Engineering in the board of control.