

# DATALOGI



# LINKÖPING

PROGRESS REPORT

## Software Systems Research Center

## Progress Report 1981

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1981

Software Systems Research Center (SSRC, or in swedish *Datalogicentrum*) organizes research activities on software technology within the Linköping Institute of Technology. This progress report summarizes the current status of the work being conducted in the three laboratories, which constitute the research center. The presentation is primarily intended to fulfill the requirements from the Swedish Board for Technical Development, STU, which provides the main funding of SSRC, but hopefully the report should also be of value for other persons with an interest in computer science research.

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## Personnel:

### Principal Investigator:

Erik Sandewall, professor

### Laboratory Leadership and Coordination:

#### *PELAB (Programming Environments Laboratory):*

Pär Emanuelson  
Anders Haraldsson  
Bengt Lennartsson

#### *ASLAB (Application-oriented Software Systems Laboratory):*

Sture Hägglund  
Mats Andersson

#### *AILAB (Artificial Intelligence Laboratory):*

Uwe Hein  
James Goodwin

### Research Associates and Employed Graduate Students:

Kari Dubbelman	Ludmila Ohlsson
Johnny Eckerland	Tommy Olsson
Kristina Ernstsson	Leif Samuelsson
Kent Ericson	Anders Ström
Peter Fritzson	Dan Strömberg
Arne Fäldt	Ola Strömfors
Christian Gustafsson	Eva-Chris Svensson
Hans Holmgren	Erik Tengvald
Lennart Jonesjö	Roland Tibell
Jan Komorowski	Sören Tirfing
Christos Levcopoulos	Torbjörn Wikström
Magnus Ljungberg	Lars Wikstrand
Tomas Lund	Jerker Wilander
Hans Lunell	Olle Willén

### Technical and Administrative Services:

Anders Aleryd	Lisbeth Gunnarsson
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Jan Axing	Lillemor Wallgren
Leif Finmo	Mats Wirén
Ralf Nilsson	Lena Östling

### Guest researchers, 1980-81:

Andrzej Blikle, Professor, University of Warsaw  
1981-02-01-05-31.  
Thomas Christaller, Universität Bielefeld, Västtyskland,  
1981-03-16-04-17.  
Lars Dahlström, Asea, Västerås, extra professor  
1980-07-01-12-31.  
Zbigniew Ras, PhD, University of North Carolina in Charlotte,  
1980-10-03-17.



## General overview

The *Software Systems Research Center* at Linköping Institute of Technology is part of the research programme for *Knowledge development in information processing*, funded by STU (the Swedish Board for Technical Development). The main purpose of the center is to develop a broad competence on various aspects of computer software, to initiate and carry out research projects with relevance for industry and the society in general, as well as projects motivated by pure basic research interests, and to establish a foundation for a high quality educational programme. The research programme emphasizes an experimental approach to studies of software and systems design.

The activities within the center are in certain respects divided into three Laboratories, namely:

1. a Programming Environments Laboratory (PELAB), oriented towards the design of tools for the programmer, including both the general architecture of such tools (programming environments), specific functions which are needed in such tools (program manipulation), and the underlying, theoretical study of such specific functions, and the properties of programs which make them possible.
2. a Laboratory for Application-oriented Software Systems (ASLAB), oriented towards techniques which make computers easier to use for (non-expert) end users or as a tool in a given application; particularly techniques for dialogue between the user and the computer system ("man-machine dialogues") and for modelling (= description) of applications in the computer;
3. an Artificial Intelligence Laboratory, oriented towards the study of natural language, knowledge representation and automatic planning. The laboratory organizes researchers with background in other disciplines, such as linguistics and psychology, as well as computer scientists. Work is concentrated on architectural considerations of intelligent systems.

We assume a considerable homogeneity within the research center, both in terms of a common approach to issues of software architecture, such as the emphasis on programming environments and other interactive techniques for software development, and also in terms of a common organization for administrative matters and for technical support (equipment and basic



software). However, the conduct of projects, thesis supervision, industrial liaison, and related issues should to a large extent be handled within each laboratory.

The three laboratories are similar to projects in the sense that they may have a shorter life-length than the research center, and since researchers at the center will shift between the laboratories for different activities, for example from one year to the next. Modification of the laboratory structure is foreseen as a way to adapt the research center's activities to new needs in the future.

## PELAB

# The Programming Environments Laboratory

The research activities within Pelab are organized into three main projects. The common interest for these projects is the concern for providing powerful tools for program development. Such an interest incorporates studies of the architecture of a programming environment. Good communication between the tools is also essential and an appropriate shared representation of the program and the program development process is needed. The design of the individual program development tools is important and requires knowledge and experience from program manipulators and analyzers. The study of properties of programming languages and the representation for these properties is another issue.

The leadership of the laboratory is shared between Pär Emanuelson, Anders Haraldsson and Jerker Wilander. During three months in the spring term 1981 Professor Andrzej Blikle from Warsaw visited the laboratory. This september another researcher, Bengt Lennartsson, has joined the laboratory. Several new students have also joined the group and current plans are to initiate more implementation oriented project(s) at the autumn 1982.

### 1.1 Program manipulation.

*(Haraldsson, Emanuelson, Komorowski, Strömberg, Wikstrand)*

Within this project properties of program transformations are studied and tools are designed for performing optimizations, simplifications and other kinds of program transformations. Program analysis and methods of formally defining languages and transformations in these languages are also central problems for this group. Much of the work has been concentrated on the partial evaluation concept. The following two subprojects resulted in PhD theses during 1980 and 1981 respectively.

- One thesis presented a method for compilation of patterns by partial evaluation of a pattern interpreter. This work has later been connected to other approaches by providing a formal model as a basis for the interpreter and then proving the consistency with other formal models of pattern matching. (Emanuelson)
- An implementation-oriented specification of an abstract Prolog machine has been developed. This specification has then been used to define partial evaluation in Prolog. This work is the basis for a PhD thesis submitted by Komorowski. An implementation of a partial evaluation system based on this specification has been integrated into a programming environment for Prolog.
- Another subproject studies the construction of programming tools. Most of the tools in a program environment work on the internal representation of a program. If there is a description of this representation such tools may be generated. The problem of finding such a representation and the adaption of the tools is investigated by attempting to translate a parser, pretty printer and code generator from Lisp (within the Pathcal system) to Pascal (Strömberg).

## 1.2 Incremental programming systems.

(Wilander and Fritzson)

The project is concerned with design of programming environments supporting incremental programming development. One main problem is integration of tools for interactive creation, editing, testing and debugging of programs. The project uses Pascal as language. Two sub-activities can be distinguished:

- An implementation of an environment for Pascal, the Pathcal system (Wilander), is completed. It includes a Pascal interpreter, parser for creating an internal structured program form, structure editor, pretty printer, break-handling, undo facility and a state saving mechanism. The system facilities are all treated as Pascal objects (procedures and variables) and are accessible from other Pascal programs. The system is implemented in INTERLISP on our DEC-20 system. The system is under documentation and will be the base for a thesis work of Wilander.
- A distributed environment for Pascal, where the program development facilities and the actual running program are on different machines (Fritzson). This means that the program is created, maintained and compiled on a host machine (PUS) and the resulting machine code is transferred and executed on some goal machine (P). When errors occur or the execution is stopped by breakpoints the PUS takes over and gives the user a possibility to study the contents (data areas etc) in P. Symbol tables and load maps for the running programs in P together with structured source code, object code, comment texts, test cases, debugging information etc. are maintained in a program database in PUS. The host machine is DEC-20 using the INTERLISP system and the P machine is a PDP 11/23. An incremental Pascal compiler is built using the Pathcal parser and the code generation algorithm from the PDPII version of the portable C compiler. Status of this part of the project is that the compiler has been built and is under test. Next stage will be the integration of the incremental compiler, transfer of code to the goal



computer, maintenance of load maps and connection between the running program and the development system.

### **1.3 Compiler writing tools.**

*(Lunell, Ericson)*

The project is studying some aspects on the construction of tools for compiler production. The work has been concentrated on three subprojects during 80/81:

- A thesis work on a study of code generator writing systems (Lunell) is under way. A number of such systems (about 10) are analyzed and an evaluation and systematization of the various techniques used in these systems is presented. The major part of the study is completed and a thesis manuscript for these parts is finished.
- A proposal for an intermediate code for Pascal has been developed. This code is on a higher level than customary codes such as P-code for Pascal. It is designed to suit code generation (Lunell).
- Tools for construction of syntactic analyzers have been studied (Ericsson). The work includes on one hand implementations of two parser generators (of LR-type) and on the other hand an exhaustive study of error recovery/repair techniques in such systems. The implementation of the pure parser generators is finished and the systems are used both as educational tools at the university and as working tools in the industry. The study of error handling techniques is in its finishing phase. A report containing analyzes, evaluations and classifications of almost every known schema today is under preparation.

### **1.4 Interactions with the environment.**

#### **External teaching**

At LM Ericsson two courses have been held by laboratory members.

- A one week course in programming methodology using Pascal for illustrations (Lunell).
- A two week and a one week course on programming methodology and project management applied to the AXE development effort. The course was given to experienced designers and programmers working with AXE. In addition a one day seminar on "Software engineering" for management at LM has been given (Wilander).

#### **Consultations**

Ericson has participated as a consult in the design of an interactive program development system at Datasaab for 3 months. He has also given seminars and minor consultations in the field of compiler technology at ASEA and LM Ericsson.

## Other contacts

Within the SSRC cooperation with Datasaab, Pelab is engaged in a study group for programming environments for the ADA programming language.

## 1.5 Personnel, Pelab

In the presentation of the research personnel below, we have used swedish titles in some cases. Please notice that undergraduate studies are typically four years for technical education (civ ing) and else three years (fil kand, fil mag).

### Pär Emanuelson

*Curriculum vitae:* Born 1949. Fil kand. 1972. Research assistant Uppsala university 1974-76. Employed since 1976, PhD 1980. Research assistant

*Research/Teaching:* Research (65%) on program transformations, partial evaluation and pattern matching. Teaches methodology of program development, programming development projects.

#### *Recent Publications:*

Performance enhancement in a well-structured pattern matcher through partial evaluation" (PhD thesis, 1980)

On compiling embedded languages in Lisp, (Lisp conference proceedings 1980, together with Anders Haraldsson).

### Kent Ericsson

*Curriculum vitae:* Born 1953. Fil kand. 1977. Employed since 1976. Research assistant

*Research/Teaching:* Research (75%) on tools and methods for compiler construction. Parser generators and handling of errors in parsing. Teaches compiler construction.

#### *Recent publications:*

Redskap för kompilatorframställning, (LiTH-MAT-R-80-39).

### Peter Fritzson

*Curriculum vitae:* Born 1952. Civ ing 1975. Employed since 1977. Research assistant

*Research/Teaching:* Research (60%) on methods and tools for program development. Incremental programming environments. Teaches programming in Pascal.

#### *Recent publications:*

Transfer of programs from development to runtime environments, (BIT 4, 1980, together with Dan Strömberg).

Distribuerad PATHCAL - Förslag till ett distribuerat interaktivt programmeringssystem för PASCAL" (LiTH-MAT-R-81-5)

**Anders Haraldsson**

*Curriculum vitae:* Born 1946. Fil kand. 1969. Research assistant Uppsala University 1970-76. Employed since 1976, PhD 1977. Senior lecturer.

*Teaching/Research:* Research (40%) on programming environments and program manipulation. Teaches Programming and Programming Development in Pascal. Data- and Program Structures, Symbol Processing.

*Recent publications:*

Experiences from a Program Manipulation System, (LiTH-MAT-R-80-24).

On compiling embedded languages in Lisp, (Lisp Conference Proceedings 1980, together with Pär Emanuelson).

**Jan Komorowski**

*Curriculum vitae:* Born 1952. Masters degree, Warsaw, 1976. Employed Warsaw university 1976-78. Employed since 1978. Research assistant.

*Teaching/Research:* Research (80%) on logic programming, programming environments and formal definitions of programming languages.

*Recent publications:*

Qlog - The Software for Prolog and Logic Programming, Proceedings of the Logic Programming Workshop, Debrecen, Hungary, 1980.

Embedding Prolog in Lisp: An Example of a Lisp Craft Technique, (LiTH-MAT-R-81-2, together with Jim Goodwin).

Partial evaluation as a means for inferencing data structures in an applicative language: a theory and implementation in the case of Prolog. (To be published in the Proceedings of the 9th Symposium on Principles of Programming Languages)

**Bengt Lennartsson**

*Curriculum vitae:* Born 1943. Civ ing 1967, Tekn lic 1972, Tekn dr 1974. Research and teaching at Luleå University 1972-81. Employed researcher since sept 1981.

*Research/teaching:* Full time research on methods and tools for real time software systems. No teaching.

**Hans Lunell**

*Curriculum vitae:* Born 1944. Fil kand, 1967, employed since 1972. Research assistant.

*Teaching/research:* Research (30%) on tools for development of code generators. Intermediate code for Pascal. No teaching

*Recent publications:*

Redskap för kompilatorframställning, (LiTH-MAT-R-80-39).

Some notes on the terminology for compiler-writing tools (LiTH-MAT-R-80-41).



**Dan Strömberg**

*Curriculum vitae:* Born 1944. Civ ing 1969. employed since 1971. Lecturer.

*Teaching/Research:* Research (50%) on tools for program generation and program translation. Teaches Methodology of Program Development, Program and Data structures

*Recent publications:*

Transfer of programs from development to runtime environments (BIT 4, 1980, together with Peter Fritzson).

**Lars Wikstrand**

*Curriculum vitae:* Born 1951. Fil kand, 1974. Employed since 1977 except for one semester during 1981. Research assistant.

*Research/Teaching:* Research (50%) on program analysis, program generation and program databases. Teaches programming courses.

*Recent publications:*

A System for Program Analysis and its Application as a Tool for Software Development and Program Transfer (LiTH MAT-R-80-30, together with Sture Hägglund)

**Jerker Wilander**

*Curriculum vitae:* Born 1946. Fil kand, 1970. Assistant at Uppsala University 1971-76. Employed since 1976. Lecturer.

*Research/Teaching:* Research (50%) on incremental programming systems. Teaches program development methodology, operating systems.

*Recent publications:*

An interactive programming system for Pascal, (BIT Nr 2, 1980).

**Associated personnel:**

**Christos Levcopoulos.**

Masters thesis work, loop analysis for programs within the REDFUN system.

## 2.

### ASLAB.

## The Laboratory for Application-oriented Software Systems.

The leadership in the laboratory consists of *Sandewall* (thesis supervision, project leadership), and *Hägglund* (thesis supervision, project leadership, laboratory coordination).

Work in the laboratory is oriented towards specialized tools for development of applications software, design of end user environments and office information systems in general. Research problems concerned are methods for modelling of applications, techniques for design of end-user dialogues, architecture for applications software and design of tools supporting automated generation of programs from high-level specifications. In the class of software systems studied within this laboratory, data processing algorithms are typically expected to play a minor role while the specification of information management, the end-user dialogue and communication between subsystems are main problems.

One practical goal for work in the laboratory is to make computers easier to use for people lacking special interest and training in programming. Another goal is the pursuit of higher-level languages and tools for requirements specification, implementation and maintenance of applications software, particularly by observing the possibilities to customize interactive environments for software development.

Research activities are performed with a strong connection to certain reference applications, mainly in office environments and medical applications. For this purpose a number of joint projects are carried out, where research results are applied and feedback from user requirements are recorded. Cooperation with the department for Medical Informatics is well established and several projects are running (mainly staffed from personnel outside the SSRC). A joint activity in the field of library and information sciences in cooperation with the university library is under way, and industry contacts are developed with primarily LM Ericson and Datasaab.

Aslab is organized as two groups, each with its own methodological foundation as described below, and each working with a distinct approach to the common class of research problems:

## **2.1 The group for experimental software architectures and application-oriented tools.**

*(Hägglund, Holmgren, Sandewall, Svensson, Willen)*

This group is primarily concerned with tools for construction of applications software and experimental work on architecture for non-procedural software (emphasis on data and dialogue management rather than application algorithms). The group is mainly using interpretative high-level language (Lisp) for implementations, it studies families of programs together with specialization tools and gives priority to principles before the efficiency of implementation.

**The LOIS/SCREEN/CAROUSEL project.** *(Sandewall et al.)* This project includes the MIL subproject for development of medical (distributed) information systems, which is being performed in cooperation with the Medical Informatics department. Three generations of software tools have been developed within the project. Current activities are:

1. experimental use of the current generation of software in application situations. (Performed at MI department).
2. continued development of the information flow model developed in connection with the MIL project.
3. Experiments with downloading to NORD-100 16-bit computer has been successfully carried through.
4. reconsiderations of the kernel of the system for obtaining a more concise structure, which has resulted in the *Carousel* system.

**The IDECS/MEDICS project.** *(Hägglund and Holmgren)* Within the *IDECS* and *MEDICS* projects a number of tools (implemented in Lisp) for dialogue modelling, data and program management, rapid prototyping and application development in general have been developed. These tools are used and further developed in applications for the purpose of proposing models and architecture for interactive development of application programs. Current work includes a follow-up study of techniques for down-loading simulation programs to mini/micros within the *MEDICS* project and experiments with tools for dialogue simulation. During the year the Mimer relational database system has been connected directly to the Lisp-based *IDECS* system, providing the possibilities to use Mimer as a permanent repository for Lisp programs as well as application data.

## **2.2 The group for advanced end-user facilities.**

*(Gustafsson, Hägglund, Jonesjö, Ström, Strömfors)*

This group is oriented towards the design of advanced end-user environments, providing personal computing and information handling facilities. The group studies software to be used directly by the end user, emphasizes efficient implementation techniques and portability and works mainly with compiler-oriented languages (Pascal, Simula, etc.)



**The ED\* project.** (*Gustafsson, Jonesjö, Strömfors, et al.*) The work aims at studying the design of end-user facilities in an "intelligent" terminal. The general paradigm for this work is to develop the concept of a universal data editor into a general tool for manipulation of text, pictures and formatted data, assuming the usage of hierarchical structuring as an aid to managing the stored information. The kernel of the system is the ED3 text editor, which provides services for preparation of hierarchically structured documents, including directory facilities usually provided by the operating system. ED3 is implemented in Pascal and extensively used on DECsystem-20, DECsystem-10, VAX and PDP-11. An experimental extended version supporting graphics as well as text data has also been implemented. Another interesting extension to the ED3 kernel system allows the definition of layouts (electronic forms) for text leaves, providing facilities for interactive definition of forms with an arbitrary internal structure and subsequent maintenance of collections of such forms (masters thesis by *Eckerland*).

### 2.3 Interactions with the environment.

Since much of the work within Aslab is performed in cooperation with external parties in various application-oriented projects, we give a list of such activities below:

1. **The MIL project** for the study of distributed information systems for medical applications. (Cooperation with the Medical Informatics department, where three researchers are working on the project.) This project involves the application of information flow models and supporting tools previously developed at SSRC, together with transformation of programs to a MUMPS environment. This work also serves as a reference application for the Carousel project (*Sandewall*).
2. **The MEDICS project**, also in cooperation with the Medical Informatics department and with the Surgery department. This project is concerned with medical educational simulations, particularly the design of an interactive author environment. Current development activities are mainly performed at the MI department and involve transfer of simulation programs to execution environments on small computers. Our contributions are presently limited to project leadership and advising tasks (*Hägglund*).
3. A laboratory for library and information sciences (LIBLAB) has been planned jointly with the university library during the year. The funding of Liblab is not yet definite, but it is anticipated that the activities will involve some graduate students at our department and some joint projects concerning for instance application of AI techniques, user interface design, database organization, or office applications.
4. **Videotex applications.** During this fall, Aslab is cooperating with the department of electrical engineering, the local municipal authorities of Linköping and Luxor (manufacturer of TV sets and personal computers) on a pilot application of computer-based videotex services for public information. The aim of the project is to specify requirements for a system based on teledata, teletext and ordinary computer technology, specially tuned for public information services.

From our point of view, this is but a special case of the design of systems for text/picture preparation and information retrieval, which is a central research topic for Aslab.

5. **Industry contacts.** The main activities during 1980/81 have been liasons with LM Ericson and Datasaab. In addition to some seminars, two LM-oriented projects have been initiated within Aslab. A system suited for experiments with the style of man-machine interaction, particularly for technical equipment, such as telephone exchanges has been implemented as a masters thesis work (*Roland Tibell*) in connection with the IDECS project. *Lennart Jonesjö* has spend a couple of months at LM in order to study the problem of documentation production and maintenance, as an application for the ED\* project.

Currently joint projects with Datasaab (now part of the LM Ericsson concern) are to be proposed by four study groups, treating such subjects as information flow models for business applications, query systems and editor tools.

Several presentations of current research have been made both externally and for visiting groups from e.g. Saab-Scania, SCA, Statskonsult, SRA, Gavleverken and Asea.

Within SSRC cooperation with Ailab is performed primarily in the area of dialogue models, and with Pelab on the subject of software (data)bases.

## 2.4 Personnel, Aslab

In the presentation of the reserach personnel below, we have used swedish titles in some cases. Please notice that undergraduate studies are typically four years for technical education (civ ing, TM) and else three years (fil kand, fil mag).

### Christian Gustafsson

*Curriculum vitae:* TM electrical engineering 1970, Lecturer LiTH 1970-, director of studies for undergraduate computer science courses.

*Teaching/research:* Part time (25%) research: Design of end-user facilities, particularly universal tools for editing. Manages the ED\* project and supervises master's theses work on related subjects. Teaches programming languages and methodology, data structures, etc.

### Sture Hägglund

*Curriculum vitae:* Fil kand, Uppsala 1971, research assistant, Uppsala University 1972-76, LiTH 1976-, PhD 1980.

*Research/Teaching:* Mainly research, with an emphasis on topics related to application development tools, design of interactive software and office information systems. Teaches database courses.

### Recent Publications:

Development of Tools for Interactive Design of Applications Software (PhD dissertation 1980)

80-talets elektroniska kontor. Erfarenheter från LOIS-projektet.  
(Experiences from an Office Information System project)  
Dialogue models for man-machine communication. A practitioner's view.  
(In *Proc. of the workshop on Models of Dialogue*, Linköping 1981)  
A system for Program Analysis and its Application as a Tool for  
Software Development and Program Analysis. (Together with Lars  
Wikstrand)  
Implementing Feedback and Tuning Facilities in a System for Patient  
Management Simulations (In *Proc. of the 3rd Congress of Medical  
Informatics Europe, Toulouse 1981*. Together with Olle Rosin et al.)

#### **Hans Holmgren:**

*Curriculum vitae:* Civ ing, Stockholm 1977, Research assistant LiTH 1977-, on  
leave 1981-82.

*Teaching/research:* Half time research, mainly development of software for  
the MEDICS project and integration of DBMS facilities into Lisp 1.6.  
Teaches information systems.

*Recent Publications:* Co-author of reports from the MEDICS project, see list  
of publications.

#### **Lennart Jonesjö**

*Curriculum vitae:* Fil. kand. Linköping 1979. Assistant/research assistant 1977-.

*Teaching/research:* Half time research (81/82 75%) on text editing tools and  
requirements for text databases. Current interests involve methods and  
tools for preparation and maintenance of documentation for complex  
systems. Teaches programming languages and systems.

*Recent Publications:* The Implementation and Experiences of a  
Structure-Oriented Text Editor (Together with Ola Strömfors)

#### **Erik Sandewall**

*Curriculum vitae:* Fil kand Uppsala 1964, fil lic 1966, PhD 1969. Head of  
Datalogilaboratoriet, Uppsala Universitet -1975. Visited Stanford during  
1966/67 and spring 1970 and MIT 1974/75. Professor of computer  
science, Linköping, 1975-

*Teaching/research:* Head of research at SSRC. Thesis supervision and project  
leadership primarily within Aslab. Teaches graduate courses on  
incremental systems and theory of computation.

*Recent Publications:* A System of Communicating Residential Environments.  
(Together with Sörensen and Strömberg)  
Software Architecture Based on Communicating Residential  
Environments. (Together with Sörensen and Strömberg)  
Unified Dialogue Management in the Carousel System.



**Anders Ström**

*Curriculum vitae:* Civ ing 1979, Assistant/research assistant LiTH 1978-

*Teaching/research:* Half time research (81/82 75%). Has recently joined Aslab with interests focused on design of integrated personal computing environments and database facilities. Previous experience with program manipulation techniques as well as implementation of text editing and formatting tools. Teaches programming systems and data structures.

**Ola Strömfors**

*Curriculum vitae:* Civ ing 1977, Assistant/research assistant 1977-

*Teaching/research:* Half time research (81/82 75%) on design and implementation techniques for interactive software, particularly for text management. Teaches operating systems and systems programming.

*Recent Publications:* The Implementation and Experiences of a Structure-Oriented Text Editor (Together with Lennart Jonesjö)

**Eva-Chris Svensson**

*Curriculum vitae:* Fil mag Stockholm 1966. Industrial employment (Saab-Scania) 1966-71, Lecturer in administrative data processing, Linköping University, 1973-

*Teaching/research:* Half time research with orientation towards methods for description of information flow models and information processing in administrative applications. Aspects of user participation during analysis and design of systems. Director of studies for undergraduate courses in administrative data processing.

**Olle Willén**

*Curriculum vitae:* Fil kand Uppsala 1971. Research assistant Uppsala University 1970-76. Lecturer LiTH 1976-

*Teaching/research:* Half time research with main emphasis on user-interface design and graphics applications, particularly animation and certain aspects of videotex systems. Teaches programming languages and systems.

*Associated personnel:*

**Mats Andersson**, manager of SSRC computing facilities. In charge of planning for terminal equipment, personal computers and communication networks.

**Johnny Eckerland**. Masters thesis ("examensarbete") ED\* project.

**Roland Tibell**. Masters thesis ("examensarbete") IDECS project.

3.

**AILAB.**

## **Artificial Intelligence Laboratory**

In May 1980 Hein and Goodwin initiated a research group on artificial intelligence at the SSRC in order to organize research in this field. During 1980 discussions about research topics and research methodology were thus the main activities in the group. These efforts have been documented in a series of papers and memos.

During the years 1980 and 1981 several new members joined the group and it soon became desirable to give the group a more official and independent status within SSRC. As a consequence a proposal was submitted to STU to support a third, artificial intelligence laboratory within SSRC. STU agreed, although under modified conditions. Thus, a laboratory on artificial intelligence was officially installed in June 81. At present the laboratory has six members. One of them has an educational background in linguistics, and another in psychology.

Since cooperation with other disciplines is of vital interest for the AI laboratory, due to its interdisciplinary research domain, some efforts have been spent to establish contacts with related disciplines. In January 1981 AILAB together with ASLAB organized a workshop on "models of dialogue". About 35 researchers from Sweden and Europe participated, representing disciplines such as psychology, linguistics and computer science. In the end of 1981 a course on artificial intelligence will be held for interested people outside SSRC.

One of the first choices facing the new AILAB was to narrow down the field of interest. For several reasons we decided to focus on knowledge representation, natural language and automatic planning, whereas vision and robotics would be neglected at present. Learning has also been considered relevant, but should rather be seen as an integral part of the above

Within this framework our interest concentrates on architectural considerations of intelligent systems, since we believe that this question has been neglected for a long time and that many misunderstandings arise when architectural issues of intelligent systems are not acknowledged appropriately. Therefore, many of the ongoing activities in the artificial intelligence laboratory can be seen as attempts to evaluate particular architectures. Currently the major activities in AILAB are:

**Non-monotonic inheritance (*Goodwin*).** Inheritance hierarchies are a well established technique for factoring knowledge in domains where the relevant concepts (classes of objects or situations) typically overlap frequently rather than factoring orthogonally. But existing approaches are limited by their inability to deal with exceptional instances and subclasses. If a large, complex unit of knowledge has been designed, it should be applicable even to a case which differs in one or two details. Dependency networks (truth maintenance) is a new technique developed at MIT, which we are applying to the problem of representing exceptions. The effect is to generalize the inheritance relation to a more broadly applicable operator for expressing packages of implications.

**Constraint-based knowledge systems (*Hein*).** In this exploratory study an attempt is made to evaluate the advantages/disadvantages of constraint based computations for knowledge representation systems. Of particular interest are the following questions: how can we provide a better description of the processes concerned with the manipulation of knowledge? Can we provide a better computational foundation for data-driven processes? For experimental purposes a constraint language, CMI, has been implemented. CMI provides facilities for creating networks of constraints as well as abstraction schemes. Some experiments have been performed in CMI with parsing/generation networks which convert small numbers from natural language into decimal representations and vice versa.

**Deterministic parsing (*Ljungberg*).** A simple deterministic parser has been implemented in accordance with a proposal made by M Marcus. The interest stems from the more general interests in resource limited understanding systems. Small experiments on the parser mechanism have been carried out and the usability of the system is being investigated.

**Abstraction in automatic planning (*Tengvald*).** This study is an evaluation of current AI planning techniques. The main interest is to find out how plan abstraction can be used to cut down combinatorial explosions in planning. This raises the general question of how to structure the control component in AI planning systems. Of further interest are control questions encountered when one tries to integrate planning and plan execution.

## Personnel, Ailab

### Uwe Hein

*Curriculum vitae:* PhD. 1978. from the University of Duesseldorf. Docent in Computer Science 1981.

*Teaching:* seminar series on knowledge representation, graduate course on artificial intelligence

*Recent Publications:* Interruptions in dialogue.

Artificial Intelligence and the study of language. (Together with James Goodwin.)

Natural and artificial communication: some observations.

Vad är artificiell intelligens?

### James Goodwin

*Curriculum vitae:* B.A. Harvard 1968.

*Recent Publications:* Artificial Intelligence and the study of language. (Together with Uwe Hein.)

Why Programming Environments Need Dynamic Data Abstractions.

Embedding Prolog in Lisp: An Example of a Lisp Craft Technique. (Together with Jan Komorowski.)

### Magnus Ljungberg

*Curriculum vitae:* Master of Science in Control Engineering at Aston University, Birmingham, Great Britain. Civilingenjörsexamen "linje Y" 1981 at Linköping Institute of Technology.

*Teaching:* Teaching assistant in several courses.

### Erik Tengvald

*Curriculum vitae:* Fil kand Uppsala University 1976.

*Teaching:* Introduction to computer science

*Recent Publications:* En intuitiv förklaring till Kildalls algoritim.

An Note Comparing Two Formalizations of Data Flow Algorithms.

### Ludmila Ohlsson

*Curriculum vitae:* M.Sc. Warsaw University 1975.

*Recent Publications:* Przetwarzanie języka naturalnego. Wydawnictwo Naukowo-Techniczne (accepted for publication in 1981).

The Natural Language Question-Answering system DIALOG. (IJCAI-81 Proceedings.)

### Torbjörn Wikström

*Curriculum vitae:* Fil. kand. in philosophy and psychology 1972 University of Gothenburg.





## Publications 1980-81

### EXTERNAL PUBLICATIONS.

Articles and refereed conference papers by members of SSRC published 1980-81 are listed below. Most of these papers are also available as research reports from SSRC.

1. Johan Elfström, Jan Gillqvist, Hans Holmgren, Sture Hägglund, Olle Rosin, Ove Wigertz: A Customized Programming Environment for Patient Management Simulations. *Proc. of the 3rd World Conf. on Medical Informatics*, Tokyo, 1980.
2. Pär Emanuelson, Anders Haraldsson: On Compiling Embedded Languages in Lisp. *Proc. of the 1980 LISP Conf.*, Stanford, Calif, 1980.
3. James W. Goodwin: Why Programming Environments Need Dynamic Data Types. *IEEE Trans. Software Eng.*, vol SE-7, no 5, 1981.
4. Sture Hägglund, Johan Elfström, Hans Holmgren, Olle Rosin, Ove Wigertz: Specifying Control and Data in the Design of Educational Software. To appear in *Computers & Education*, 1981.
5. Uwe Hein: Interruptions in Dialogue. Also in D. Metzger (ed), *Dialogmuster und Dialogprozesse*. Hamburg, Buske, 1981.
6. H. Jan Komorowski: QLOG - The Software for Prolog and the Logic Programming. *Proceedings of the Logic Programming Workshop*, Debrecen, Hungary, 1980.
7. H. Jan Komorowski: Partial evaluation as a means for inferencing data structures in an applicative language: a theory and implementation in the case of Prolog. To be presented at the *Symp. on Principles of Programming Languages*, Albuquerque, 1982.
8. Olle Rosin, Hans Holmgren, Sture Hägglund, Implementing Tuning and Feedback Facilities in a System for Patient Management Simulations, *Proc. 3rd Congres on Medical Informatics Europe*, Toulouse, 1981.
9. Erik Sandewall: Unified Dialogue Management in the Carousel System. To be presented at the *Symp. on Principles of Programming Languages*, Albuquerque, 1982.

10. Erik Sandewall et al: Provisions for Flexibility in the Linköping Office Information System, *Proc. of the National Comp. Conf.*, Los Angeles, 1980.
11. Erik Sandewall, Claes Strömberg, Henrik Sörensen: Software Architecture Based on Communicating Residential Environments. *Proc. of the 5th Int. Conf. on Software Engineering*, San Diego, 1981.
12. Erik Sandewall, Henrik Sörensen, Claes Strömberg: A System of Communicating Residential Environments. *Proc. of the 1980 LISP Conf.*, Stanford, Calif, 1980
13. Dan Strömberg, Peter Fritzson: Transfer of Programs from Development to Runtime Environments. *BIT*, vol 20, no 4, 1980.
14. Ola Strömfors, Lennart Jonesjö: The Implementation and Experiences of a Structure-Oriented Text Editor. *Proc of the ACM SIGPLAN/SIGOA Symposium on Text Manipulation*, Portland, Oregon, June 8-10, (SIGPLAN NOTICES, vol 16, no 6) 1981.
15. Jerker Wilander: An interactive programming system for Pascal. *BIT*, vol 20, 2, 1980.

#### OTHER RESEARCH REPORTS:

16. Kenth Ericson, Hans Lunell: Redskap för kompilatorframställning LiTH-MAT-R-80-39
17. Peter Fritzson: Distribuerad PATHCAL: Förslag till ett distribuerat interaktivt programmeringssystem för PASCAL. LiTH-MAT-R-81-05
18. James W. Goodwin and Uwe Hein: Artificial Intelligence and the Study of Language. LiTH-MAT-R-80-36
19. Anders Haraldsson: Experiences from a Program Manipulation System. LiTH-MAT-R-80-24
20. Sture Hägglund: Towards Control Abstractions for Interactive Software. A Case Study. LiTH-MAT-R-80-37
21. Sture Hägglund et al: 80-talets elektroniska kontor: Erfarenheter från LOIS-projektet. LiTH-MAT-R-81-04
22. Erland Jungert: Deriving a Database Schema from an Application Model Based on User-defined Forms. LiTH-MAT-R-80-35
23. H. Jan Komorowski, James W. Goodwin: Embedding Prolog in Lisp: An Example of a Lisp Craft Technique. LiTH-MAT-R-81-02
24. Hans Lunell: Some notes on the terminology for Compiler-Writing Tools LiTH-MAT-R-80-41
25. Alexander Ollongren: On the Implementation of Parts of Meta-IV in Lisp. LiTH-MAT-R-81-07
26. Östen Oskarsson: Construction of Customized Programming Languages. LiTH-MAT-R-81-10
27. Östen Oskarsson, Henrik Sörensen: Integrating Documentation and Program Code LiTH-MAT-R-81-01
28. Dan Strömberg: Datorn - hjälpreda eller hot i det lilla företaget? LiTH-MAT-R-81-06

29. Erik Tengvald: En Intuitiv Förklaring till Kildalls Algoritmn  
LiTH-MAT-R-80-27
30. Erik Tengvald: A Note Comparing Two Formalizations of Dataflow  
Algorithms. LiTH-MAT-R-80-28
31. Lars Wikstrand, Sture Hägglund: A System for Program Analysis and its  
Application as a Tool for Software Development and Program Transfer.  
LiTH-MAT-R-80-30

#### GENERAL:

32. Anders Beckman: Varför jag inte kan vara datalog: en diskussion av  
värderingar. LiTH-MAT-R-80-40
33. Andrzej Blikle: Notes on the Mathematical Semantics of Programming  
Languages. (Lecture notes.) LiTH-MAT-R-81-19
34. Uwe Hein: A Proposal for an Artificial Intelligence Laboratory at SSRC,  
Linköping, 1980.
35. Uwe Hein: Vad är artificiell intelligens? LiTH-MAT-R-81-13
36. Uwe Hein, Sture Hägglund (eds.): Proceedings of the Workshop on Models  
of Dialogue. Theory and Application, Linköping, 1981. (With contributions  
from Hein and Hägglund.)
37. Sture Hägglund, Jon-Erik Nordstrand (eds.): A Study on Directions for  
Research and Development of Scientific and Technical Information  
Systems. (With contributions from Hein, Hägglund and Sandewall.)
38. Hans Lunell: Tre skisser om datalogi som vetenskap LiTH-MAT-R-81-16
39. Dan Strömberg: Datorn - hjälprea eller hot i det lilla företaget?  
(LiTH-MAT-R-81-06)

#### SYSTEMS DOCUMENTATIONS 1980-81:

40. MEDICS - Systemdokumentation och användarhandledning. Hans  
Holmgren, Sture Hägglund, Olle Rosin. (SSRC Systemdok. 17)
41. MEDICS - Författarmanual - Preliminär version. Hans Holmgren, Sture  
Hägglund, Olle Rosin. (SSRC Systemdok. 18)
42. MINISCOPE - Användarhandledning. Lars Wikstrand. (SSRC Systemdok.  
19)
43. IDECS3 Reference Manual. Sture Hägglund. (SSRC Systemdok. 20)
44. ED3 - Användarhandledning. Ola Strömfors. (SSRC Systemdok. 21)
45. SCREBAS - Provisional Reference Manual. Erik Sandewall. (SSRC  
Systemdok. 22)
46. Ett gränssnitt mellan LISP 1.6 och MIMER på DEC-10 vid LIDAC.  
Användarhandledning. Hans Holmgren. (SSRC Systemdok. 23)
47. ALGOL68C - Release 1.271, Users Guide. Arne Fäldt. (SSRC Systemdok. 24)
48. Handledning i användande av PIC. Olle Willen. (SSRC Systemdok. 25)



## Full list of reports from SSRC 1976-81

### PhD theses (Linköping Studies in Science and Technology Dissertations.):

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| No 14 | Anders Haraldsson: A Program Manipulation System Based on Partial Evaluation, 1977.  |
| No 18 | Mats Cedvall: Semantisk Analys av processbeskrivningar i naturligt språk, 1977   |
| No 22 | Jaak Urmi: A Machine Independent LISP Compiler and its Implications for Ideal Hardware, 1978   |
| No 33 | Tore Risch: Compilation of Multiple File Queries in a Meta-database System, 1978.  |
| No 51 | Erland Jungert: Synthesizing Database Structures from a User Oriented Data Model, 1980.  |
| No 54 | Sture Hägglund: Contributions to the Development of Methods and Tools for Interactive Design of Applications Software, 1980. (Contains LiTH-MAT-R-79-39, LiTH-MAT-R-80-01, LiTH-MAT-R-80-37, and LiTH-MAT-R-80-38) |
| No 55 | Pär Emanuelson: Performance Enhancement in a Well-structured Pattern Matcher through Partial Evaluation, 1980.   |
| No 69 | H. Jan Komorowski: A Specification of an Abstract Prolog Machine and its Application to Partial Evaluation, 1981.  |
| No 71 | René Reboh: Knowledge Engineering Techniques and Tools for Expert Systems, 1981.   |

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| LiTH-MAT-R-76-8 | Erik Sandewall: Some observations on conceptual programming. Also in Elcock, E.W., Michie, D. (eds), <i>Machine Intelligence 8</i> , Edinburgh University Press, 1977. |
| LiTH-MAT-R-76-9 | Erik Sandewall: Programming in an interactive environment: The LISP experience. Also in <i>ACM Comp. Surveys</i> , vol. 10, no   |



- 1, pp 35 -71, march 1978.
- LiTH-MAT-R-76-11 Anders Beckman: Programvarukvalitet, En nordisk förstudie.
- LiTH-MAT-R-76-13 Sture Hägglund, Östen Oskarsson: En teknik för utformning av användardialoger i interaktiva datasystem.
- LiTH-MAT-R-76-14 Erik Sandewall: Personal data bases and the design of man computer dialogues.
- LiTH-MAT-R-76-17 Jaak Urmi: String to string correction.
- LiTH-MAT-R-76-18 Jaak Urmi: A shallow binding scheme for fast environment changing in a "spaghetti stack" LISP system.
- LiTH-MAT-R-77-2 Jim Goodwin: A guided tour of the interlisp system
- LiTH-MAT-R-77-26 Anders Haraldsson: A partial evaluator, and its use for compiling iterative statements in Lisp. Also in *Proc. of the Fifth Annual ACM Symposium on Principles of Programming Languages*, Tucson, 1978.
- LiTH-MAT-R-78-1 Anders Beckman, Sture Hägglund, Gunilla Lönnemark: A program package supporting run time variation of text output from interactive programs.
- LiTH-MAT-R-78-8 Kenth Ericson: Pascal i Sverige.
- LiTH-MAT-R-78-19 Erik Tengvald, Sture Hägglund: En metadatabas för Cobolssystem.
- LiTH-MAT-R-78-20 Jerker Wilander: Interaktiv programutveckling i Pascal - Programmeringssystemet Pathcal.
- LiTH-MAT-R-78-21 Erik Sandewall: Programmeringsteknik för flexibilitet.
- LiTH-MAT-R-78-22 Erik Sandewall: LOIS - An Overview of Facilities and Design. Also in *DATA*, vol 9, nr 1-2, February 1979. Revised version as "Provisions for Flexibility in the Linköping Office Information System", *Proc. of the National Comp. Conf.*, Los Angeles, 1980.
- LiTH-MAT-R-78-23 Claes Strömberg, Henrik Sörensen: Beskrivning av fontsystemet och erfarenheter vid systemutvecklingen.
- LiTH-MAT-R-78-24 Erland Jungert: Generering av databasstrukturer från en formulärbaserad datamodell.
- LiTH-MAT-R-78-25 Pär Emanuelson: A case study of Qlisp: Representing knowledge taken from medical diaries.
- LiTH-MAT-R-79-3 Arne Börtemark, Hans Lunell: Implementering av Pascal på minimaldatorn: en tillbakablick.
- LiTH-MAT-R-79-5 Jim Goodwin: Taxonomic Programming with Klone.
- LiTH-MAT-R-79-7 Pär Emanuelson: A comparative study of some pattern matchers.
- LiTH-MAT-R-79-10 Arne Börtemark: Felbekämpningsmedel, en första översikt.
- LiTH-MAT-R-79-18 Hans Lunell: Automatic generation of code for conceptual machines: A problem discussion.
- LiTH-MAT-R-79-19 Jan Komorowski: QLOG interactive environment - the experience from embedding a generalized Prolog in INTERLISP.
- LiTH-MAT-R-79-21 Erik Sandewall: Biological Software. Also in *Proc. of the 6th Int. Joint Conf. of Artificial Intelligence*, Tokyo, 1979.

- LITH-MAT-R-79-22 Erik Sandewall: Self-description and reproduction in distributed programming systems.
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- LITH-MAT-R-80-08 Dan Strömberg, Peter Fritzson: Transfer of Programs from LISP to BCPL Environments: An Experiment. Revised version as "Transfer of Programs from Development to Runtime Environments" in *BIT*, vol 20, no 4, 1980.
- LITH-MAT-R-80-18 H. Jan Komorowski: QLOG - The Software for Prolog and the Logic Programming. Also in *Proceedings of the Logic Programming Workshop*, Debrecen, Hungary, 1980.
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- LITH-MAT-R-80-22 Erik Sandewall, Henrik Sörensen, Claes Strömberg: A System of Communicating Residential Environments. Also in *Proc. of the 1980 LISP Conf.*, Stanford, Calif, 1980.
- LITH-MAT-R-80-23 Uwe Hein: Interruptions in Dialogue. Also in D. Metzger (ed), *Dialogmuster und Dialogprozesse*. Hamburg, Buske, 1981 (to appear).
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- LiTH-MAT-R-81-01 Erik Sandewall, Claes Strömberg, Henrik Sörensen: Software Architecture Based on Communicating Residential Environments. Also in *Proc. of the 5th Int. Conf. on Software Engineering*, San Diego, 1981.
- LiTH-MAT-R-81-02 H. Jan Komorowski, James W. Goodwin: Embedding Prolog in Lisp: An Example of a Lisp Craft Technique.
- LiTH-MAT-R-81-03 Ola Strömfors, Lennart Jonesjö: The Implementation and Experiences of a Structure-Oriented Text Editor. Also in *Proc of the ACM SIGPLAN/SIGOA Symposium on Text Manipulation*, Portland, Oregon, June 8-10, (SIGPLAN NOTICES, vol 16, no 6) 1981.
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