Visit to ICOT
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Dr. Mark Grundy
Center for Information Science Research
The Australian National University

Overview

This was my second visit to ICOT, the first being in May 1992. This visit continued work begun then, with members of ICOT's Fifth Laboratory, and with Dr. John Slaney, also of CISR, whose visit coincided with mine. This visit took place under the Memorandum of Understanding signed by the Australian National University and ICOT in 1992. In the roughly three weeks of our stay at ICOT, Dr. Slaney and I were able to discuss our continuing work not only with our collaborators at ICOT, but with members of the Parallel Theorem Proving group associated with ICOT, and with research groups in Kyoto and Nara.

Development

For this visit, the bulk of my time was spent in the development and refinement of a prover prototype called SC/MGTP. This is an acronym for *Semantically Constrained* MGTP, and as the name suggests, it is an extension of the Model Generation Theorem Proving software developed at ICOT.

MGTP has already placed itself among the most successful theorem proving software in the world, demonstrating excellent performance on a parallel architecture [1], and a capacity to solve open problems [2]. The extension that I am developing combines both ground– and non–ground forms of MGTP into a general–purpose system that is sensitive to both problem–related knowledge, and the developing proof. The principal is based upon an idea developed in a collaboration between Dr. Slaney of CISR and Drs. E. Lusk and W. McCune of Argonne National Laboratories, and which has been implemented as the prover SCOTT [3]. SCOTT is built of two component programs, FINDER and OTTER, which are respectively comparable with ICOT's ground and non-ground MGTP programs, and so it is of interest to compare the performance of SCOTT with that of SCMGTP over similar problems.

The first stage of this research was begun prior to my visit to ICOT last May, when I developed preliminary KL/1 software on a Sequent computer, using ICOT's

KL/1 interpreter pdss. On arriving at ICOT, this software was then refined and developed on a PSI/3 under the PIMOS operating system. The software was designed to interface directly with existing non-ground MGTP (N/MGTP) code, permitting output from ground MGTP (G/MGTP) to be used to direct the proof search. Design discussions were held with Dr. R. Hasegawa, M. Fujita and M. Koshimura of ICOT's Fifth Laboratory, and the code that was developed required very little change to existing N/MGTP code. The extension software is called CHECKER.

At the same time, I developed graphic software for comparing the performance of SC/MGTP with SCOTT. This software has since undergone development at ANU by Dr. Slaney and myself, and the latest version was installed at ICOT during this visit.

The current stage of research involves improving the speed of the CHECKER. The main function of the CHECKER is to evaluate clauses produced by N/MGTP, using a data-set provided by G/MGTP. This evaluation is then used to control the direction of N/MGTP, resulting in a more efficient proof. Because SC/MGTP may typically need to check thousands of clauses in a single proof, improved efficiency in the CHECKER procedure is very beneficial to the speed of the proof. In this visit, the CHECKER was altered from a breadth-first clause evaluation algorithm to a more efficient depth-first algorithm, and several new speed-enhancing heuristics were incorporated. This software development continued under discussions with Hasegawa-san and Koshimura-san.

Future plans for this research involve adaptation of the CHECKER code for efficient parallelisation, and extensive testing on ICOT's range of parallel inference machine architectures. This development will continue at ANU after my return, using the PSI/3 workstations which ICOT has loaned to ANU, and discussions will coninue by electronic mail.

Discussions

During this visit I had opportunity to present a talk on my work to the Parallel Theorem Proving group in a seminar held at ICOT. The talk was entitled *Semantic Constraint for Model Generation Theorem Proving.*

Also for this visit, ICOT kindly arranged for Dr. Slaney and I to visit Kyoto and Nara, where we held research discussions with the research group of Dr. Sawada, of Kyoto University, Dr. Sakama of the Advanced Software Technology and Mechatronics Research Institute of Kyoto, and with the Information and Technology and Research Laboratories (Corporate R&D group) of Tenri-Sharp Corporation Limited. In every case, our reception was warm, friendly and stimulating, and we were given extensive tours of each of these facilities.

Miscellaneous

For this visit, Dr. Slaney and I were accommodated in the Tsukasa apartments in Nakanobu. These are conveniently situated, less than twenty minutes by rail from Mita station, and proved to be very comfortable.

As with my last visit, I continue to be impressed with the quality of research conducted in ICOT's Fifth Laboratory, and with the capable assistance provided by ICOT staff. In particular, I would particularly like to thank Mr. K. Narita for arranging our accommodation and his aid with travel details, Mr. A. Imai of Sharp Corporation, Mr. Y. Shirai of ICOT, and Mr. Kumeno of MRI for their kind assistance in our travel to Kyoto and Nara.

Finally, to ICOT, my warmest thanks for their generosity in making this visit possible, for their kind coverage of the travel costs for our Kyoto trip, and for their continuing support for our collaboration.

References

[1] H. Fujita & R. Hasegawa *A Model Generation Theorem Prover in KL1 Using Ramified Stack Algorithm*, Proceedings of the Eighth International Conference on Logic Programming (Paris, France), pp. 535–548, 1991.

[2] M. Fujita, J. Slaney & F. Bennett *Automatic Generation of Some Results in Finite Algebra*, Technical Report TR-ARP-5/92, Automated Reasoning Program, The Australian National University, Canberra, 1992. Proceedings of IJCAI '93 (forthcoming.)

[3] J. Slaney, *SCOTT: A Model-Guided Theorem Prover*, Technical Report TR-ARP-4/92, Automated Reasoning Program, The Australian National University, Canberra, 1992.

Curriculum Vita

Personal

Name	Mark Denis Grundy
Address	5/72 Canberra Ave, Griffith, ACT 2603, Australia
Phone	+61 6 249 0159
Home	+61 6 295 9943
Date of Birth	22/05/63
Marital Status	Married
Nationality	Australian
Occupation	Postdoctoral Research Fellow, Center for Information Science Research, ANU

Education and Awards

BSc. (Hons I)	awarded at University of Sydney, 1985.
Ph.D.	awarded at University of Sydney, 1992.
ARC Postdoctoral Research Fellowship	awarded at ANU, 1990.

Active Projects

The design and realisation of a language for programming cameo--based prover systems.

The incorporation of model--based reasoning into syntactic proof procedures.