Report on my Visit to ICOT
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1   Introduction

I visited ICOT for three weeks from 26 November to 17 December 1989. This visit resulted from many contact I have had with the researchers in ICOT. I first visited ICOT during a tour of Japan in 1985 for one day, and attended the FGCS'88 exactly one year before my visit. I have had many contacts with ICOT researchers, in particular with Dr. Koichi Furukawa over many years. I was very honoured to be invited to ICOT.

My main research interests are in using Logic for reasoning. This includes nonmonotonic reasoning, diagnosis, recognition and design. I am one of the designers of the Theorist system for hypothetical reasoning. I am interested in theoretical issues, implementation and applications. This is a very exciting research area at the moment throughout the world, and there is some very interesting work in the theory, implementation and applications being done at ICOT now.

2   Summary of the visit

During my visit I gave three talks:

1. On Wednesday 29 November, I gave a talk entitled "Logical and probabilistic interpretations of default reasoning". This talk gave an

overview of work over the last decade to characterise default reasoning. These approaches are based on defaults being logical statements or being statements of qualitative conditional probability. In this talk I showed some problems in each of these views and showed how combining the views could offer advantages of both. I received many interesting questions both at the talk and after, and I hope many people enjoyed the talk.

2. Following discussions with Dr. Koichi Furukawa, I gave a second talk on Thursday December 7, entitled "(Towards) Efficient Implementation of Hypothetical Reasoning and Prolog". In this talk I showed how my Theorist to Prolog Compiler worked and showed problems in implementing membership in all extensions, and briefly discussed a way to implement Pure Prolog based on constraint satisfaction. This talk lead to many discussions. Parts of it were closely related to the work of Katsumi Inoue and Nicolas Helft, and collaboration and much discussion resulted in the writing of one new paper.

3. My third talk was given on Tuesday 12 December and was entitled "Causal and Evidential Reasoning". This talk was about the pragmatics of using logic for representing knowledge, and discussed four logical ways to allow both causal and evidential reasoning. This talk covered in detail abductive and consistency based diagnosis in a continuous domain.

I talked to many ICOT researchers about their research.

I spend much time working with Katsumi Inoue and Nicolas Helft. These discussions concentrated on proof procedures for nonmonotonic reasoning, and results on linear resolution. There was much overlapping of ideas and interests in this area, cumulating in a paper (see section 3 below).

I discussed issues related to design with Katsumi Inoue and Yoshihiko Ohta, and was given an impressive demonstration of the APRICOT/0 system. There is much overlap between the Theorist work and the APRICOT work, although each system has concentrated on different areas. There is much that we learnt from the discussion.

Ken Satoh and Jun Arima are doing very interesting work on nonmonotonic reasoning. I found Ken Satoh's work on consequence relations and probabilistic reasoning very interesting. I think I now understand the work of Lehmann and others on consequence relations for nonmonotonic reasoning. I did not understand it until Ken explained how it worked. I found

his original research particularly interesting because it ties together many different views of nonmonotonic reasoning and shows exactly where they differ. This line of research is much needed in the nonmonotonic reasoning community. I also found Jun Arima's work on moving circumscription to the syntactic domain so that we can formalise syntactic minimisation using circumscription. I found this interesting because other characterisations of syntactic minimisation (e.g., Theorist) lack such a foundation. Such work may lead to new insights into such reasoning.

I also discussed constraint satisfaction with Mr. Nagai and some of the CAL group (Dr. Aiba and David Hawley). I believe that work on constraint satisfaction in logic programming will be the new wave of the future in logic programming. I also discussed the related issues of ATMS and CMS implementation and use with Katsumi Inoue and Nicolas Helft. Understanding these issues is very important in AI research. I learnt much from this discussion. I think that we all understand the issues better now.

I discussed legal reasoning with Dr. Nitta. I found his work to be very impressive. I discussed the view of reasoning as arguments for and against propositions. This has long been realised by legal experts, but is only now being implemented in systems such as Theorist. I also discussed parallel implementation of dialectical reasoning systems with Dr. Nitta and Katsumi Inoue. This seems to be feasible and very exciting, but I, unfortunately, did not have time to pursue this issue further during my stay.

I had a very productive meeting with Dr. Koichi Furukawa, in which we discussed implementation of reasoning systems. We discussed the relationship of the Theorist implementation to the Prolog Technology Theorem Prover of Mark Stickel. The implementations turn out to be very similar, although we have both concentrated on different issues. We also discussed implementations of nonmonotonic reasoning and the relationship between ATMS, constraint satisfaction and Prolog implementations. After this discussion, Dr. Furukawa, asked me to give a talk on this topic (talk 2 above).

I also visited Prof. Ishizuka's Laboratory at the University of Tokyo. He is doing some very interesting work in applying the hypothetical reasoning framework to design. He has done some very interesting work in improving the efficiency of hypothetical reasoning.

I also ported my Theorist to Prolog compiler to the symmetry machine at ICOT, and made it available for researchers at ICOT to use. I gave a demonstration of the program to many researchers on Thursday November 30.

3 Research Results

The main "result" that came out of my stay was a paper that I co-authored with Nicolas Helft and Katsumi Inoue, entitled "Answer extraction for Circumscription". We are submitting this paper to the International Workshop on Nonmonotonic Reasoning to be held in California in June 1990. We may also submit a version to CSCSI (the Canadian AI Conference) or to AAAI (the American AI conference). This paper shows how one simple idea can lead to improvement of capabilities (the ability to give answers to existential queries) as well as an improvement of efficiency. This is based on the observation that we only need to compute few explanations of a goal, in general to determine whether it follows in all extensions (i.e., from the circumscribed theory). Both Kurt Konolige and Jack Minker who were also visiting ICOT were very interested in this result. A copy of this paper is attached.

I also did some implementation to show how Theorist could be used for constraint satisfaction problems. It was then compared to implementations of Nicolas Helft and Kurt Konolige. The Theorist implementation inspired Nicolas to improve the efficiency of his program, and we learnt about the dramatic improvements that could be incurred by utilising the indexing of Prolog.

Following discussions with Dr. Koichi Furukawa and Katsumi Inoue, I improved the implementation of Theorist, by adding sound unification, and making the interface nicer by adding a better "help" facility.

I also completed a paper on "Dialectics and Specificity" (basicly the topic of my fist talk) while I was here. Discussion with various members of ICOT helped me improve the ideas and the paper.

4 Assessment

I was very impressed with the standard of research I found at ICOT. Everyone I talked to was doing very interesting research.

I was a little disappointed that the multi-PSI was not as straight forward to use as I had hoped. When it is easy to run Prolog on each machine and let the machines communicate, then I have a very interesting application. I did not have the time to pursue this while I was here, although Katsumi Inoue expressed interest in this endeavour.

One problem with the field of nonmonotonic reasoning is is the lack of people testing the theories by building applications and testing them on

real domains. I see the potential for ICOT to be a world leader in this area. There are people who are very good in the theory area and people who are very good in the applications area. If the applications people see themselves as people who are testing these theories, and the theory people see the applications as test-beds for their theories, then I foresee much exciting research. There is a void in the world now in this area, and this is a niche in which ICOT seems to fit perfectly. This could be done without the use of parallel hardware, but I would expect even more dramatic results if this research can be done taking full advantage of the parallel architecture. This experimental research should be seen as very different but complementary to either theoretical research or just development of applications.

5   Thanks

I would especially like to thank Katsumi Inoue for being the perfect host while I was here. He looked after me extremely well. I would also like to extend my gratitude to Dr. Kazuhide Iwata for looking after my accommodation, taking me to his home, showing me around, and making sure I was well looked after; to Kumiko Karakawa for always being friendly and willing and happy to help, and for finding a good bar in Golden Gai; for Nicolas (Nikko) Helft who also helped make my stay enjoyable and for sharing his experience as a gaijin in Tokyo. Finally I would like to thank the management and directors of ICOT: the executive director, Mr. Hiroshige, the Director of the Research Center, Dr. Kazuhiro Fuchi, the Deputy Director, Dr. Koichi Furukawa, and the chief of the fifth laboratory Mr. Kenji Ikoma for supporting my stay at ICOT.

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Degrees

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