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The panel on a future direction of new generation applications

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1 Introduction

This paper introduces a panel to be held at the application track of FGCS'92 conference. This panel will be devoted to a future direction of new generation applications. The goal is to discuss about the applications with various paradigms which have been explored in the areas of knowledge representation, logic programming, machine learing and parallel processing. It is my hope that by expressing different perspectives of the panelists, we will understand the importance of the underlying paradigms, the real problem areas, and a direction of next generation applications. The word paradigm itself is originally come from T. Kuhn's book called "The Structure of Scientific Revolution (1962)". Recently, this word is referred by the AI researchers because of its sophisticated meanings which indicates a current research trend or a future direction. Here, I will use this word in this context that implies new bases and views for exploration of applications without too much philosophical discussion.

In this short paper, I will attempt to outline the perspectives represented by the panelists. Althouth the ideas and the positions papers will be represented in the following pages in the proceedings, I will try to guide the rough views which will be necessary for this panel discussion. The context is my subjective impressions on the current trends and research directions.

2 KR paradigm

Ronald J. Brachman will talk about his knowledge representation language called Classic and his experiences through the use of Classic for the developments in applications. He might refer the knowledge representation as KR which follows his research community. KR might be the starting point for any AI based application system. KR is one of the main paradigms of AI researches including natual language understanding and coginitive science. There are a lots of attempts in the design of KR language and systems such as KRL, FRL and KLONE in the late 1970's. The 1980's was the following productive period for KR system developments and theories. The first dedicated international KR conference was held recently, and many important ideas and foundations were presented in the conference. This state of art has been reviewed by R.Brachman at the AAAI meeting in 1990. He has presented KR and issues which are related to the field, history, development of the 1980's, the future of KR and open research problems. I am especially interested in his highlights for the future of KR which predicts the current trends of common knowledge base and ontology. Now, KR should be standardized for the further developments for any knowledge systems. The related paper for Classic will be presented at the technical session and he will talk about his position based upon his paper presentation. The panel will start with KR and related topics.

3 CLP paradigm

Catherine Lassez will represent the constraint logic programming(CLP) which is a new face for handling constraints in Operations Research, Computational Geometry, Robotics and Qualitative Physics. Reasoning with constraint is very important for these application areas. These problems are sometimes required heavy computational resource and are related to combinatorial characteristics. The novel aspects of CLP is the unified framework of knowledge representation for numeric and non-numeric constraints, solution algorithm and data query system. Also, CLP has been implemented as the programming languages such as CLP(R), CHIP, CAL, Prolog-III and Triton. These languages are used for the various application domains which are linkage between AI and OR. As for the financial applications, CLP is very good affinity for describing the financial equations and relations. Constraint is also useful to the handling qualitative knowledge in Computational Geometry and Naive Physics. In order to show the expressive power of CLP, it is necessary to demonstrate the speed and performance for the same problems which are OR people's proposed. This is challenging for any AI researchers and Logic programmers to persuade other field researchers through the recent progress on programming which can avoid the brute forces of numerical calculation. She will

present her experiences on the developments on the theories and applications. The details will be shown in her very intensive long position paper in this panel.

4 ILP paradigm

Stephen Muggleton will represent his recent notion of inductive logic programming(ILP) which uses the inverse resolution and relative least general generalisation. ILP is newly formed research area in the integration of machine learning and logic programming. Machine learning is very attractive paradigm for knowledge acquisition and learning which any AI system is addressed. With the advent of machine learning research, there are a lots of developments in tools for classifying large data using concepts learning and neural network methods. Muggleton's recent development for his ILP is called GOLEM which is a first order induction algorithm for generating rules from given examples. Each example is a first order ground atom and each rule is a first order Horn clause. Rules can be used to classify new examples. GOLEM is implemented in SUN's using C and very efficient for inducing rules from examples. Another example of ILP will be presented in the invited speaker, Ivan Bratko and he will talk about learning qualitative model of dynamic system using GOLEM learing program. ILP is different from CLP, but in its spirit, idea is come from the logic programming paradigm. As is well known, Shapiro's work on Model Inference System(MIS) is implemented using Prolog and it is very clear logical model for learning. Using logic programming paradigm, ILP is unified approach to induction and deduction which provides knowledge system with more powerfull inference facilities. Namely, as for inductive component, IPL is very useful for inducing rules from data and then, using the rules, system infers deductively data into known diagnostic states. Therefore, ILP is new approach to application with very large data which are further classified into categorization. These kinds of applications are found in the area of protein engineering and fault diagnosis for satellites. He was the organizer of the first ILP workshop and the second workshop which will be held after the FGCS conference. ILP is very young paradigm for machine learning and there will be another exploration in theory and application. He will talk about the recent research with the relationship between Valiant's PAC-Learning framework. Machine learning is most active research area and it will be the next stage that it will deal with realistic problems.

5 PP paradigm

Kazuo Taki will represent the Parallel Processing(PP) paradigm which the Fifth Generation Computer System Project aims to explore and to develop both sides of hardware and software derived from the concurrent logic programming which shows affinity for both expressing concurrency and executing in parallel. With the continious efforts in langualge and implementation research in the FGCS project, KL-1 has expressive for describing many complex applications programs with efficient performance. Most important aspects in the use of the concurrent system are to built large scale parallel software which is further accumulated as the experiences in parallel programming. A new style of programming requires a new thinking way of programming and the model of computation. This is also true for KL-1 language and for applying it to complex applications such as VLSI-design, DNA analysis and legal reasoning system. Basing upon these experiences, he will focuss on the parallel language culture which is necessary for the next generation computer like multi-PSI and PIM. The hardware progress has made rapidly compared with software technology and the accumulation of parallel programming experiences are very important for the re-use and the economy of coding. The current issue of parallel programming is how to transfer knowledge in software technology developed by the FGCS project in order to explore the culture of the concurrent system. Therefore, as for the future directions, PP paradigm is how to use in the widely adopted computational environment. He will talk about the issue of the parallel programming culture and the experiences in the use of KL-1 for applications.

6 Future directions

I will introduce the various paradigms for knowledge information processing starting from KR to PP. Each paradigm has distinctive and novel features for exploration of applications. As for my position, I am interested in the research on the fusion of paradigms which is the integration of CLP and ILP for example. I will call this paradigm as Inductive Constraint Logic Programming(ICLP not conference name!) which is the natural extension of constraint logic programming into inductive inference for constraints in Spacial Geometry and Robotics. This framework is also useful for the Naive Physics and qualitative reasoning system without large amount of background knowledges for rules generations. We will examine our approach to Naive Kinematics and simple image processing for spacial reasoning. At this stage, the application domain is very simple, but for the research on Robotics that learns, the inductive component is very important in the knowledge acquisition on the constraints and then deductively use the constraints for the further moves. The fusion of paradigms will be necessary foundation for the next generation applications. We should re-examine the current paradigms for the different problems areas such as OR, Robotics and Computational Geometry.