AI RESEARCH IN CHINA: A REVIEW

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ABSTRACT

Since 1970's AI research has been getting more and more active in China and certain useful results have been achieved. This paper is intended to review briefly what was and is going on in AI field of China.

INTRODUCTION

In China AI research activities began ever from early 1960's, but it had been cofined only to a small circle until the end of that decade. From then on many university departments majoring in computer science were set up. They were trying hard to expand applications of computer and develop theories, expecting that computer would bring about improvement in productivity process control. Considerable efforts have been made in this direction, but the results were not so satisfactory since a practical process is too complex to be identified. However the fact that a veteran worker or a technician often deals sith the control task some hat better than a computer. The fact suggested that AI might be a succesful approach. On the other hand, to tackle some open fascinating problems linguists and psychologists were also drawn into AI. And now AI research has been getting more and more active in China and certain useful results have been achieved. This paper is intended to give a brief review on the following topics:

1• machine translation and natural language understanding,
2. theorem proving,
3. expert consulting system,
4.. computer aided education,
5. others*

MACHINE TRANSLATION AND NATURAL LANGUAGE UNDERSTANDING

Machine translation is the earliest AI research work in China and experinoed its ups and downs. We may list the following three systems, the first one was developed by the Science Technology Information Institute and the other two by the Computer Technology Institute,Academia Sinica.

1. ECTA (English-Chinese Automation Translation) system (1) , which processed correctly a science-technologe text consisting of 1600 words (25 words/sentence in average, 60 words/sentence of the longest; with a direct Chinese character output in June, 1981. The accuracy was 90.*8%* when it dealt with a 3600-word article with most errors to be corrected hy slightly modifying dictionary or program. The system works in following procedures:

Sentence segmetation -- to segment a sentence according to prpositions, conjunctions, articles or punctuation marks.

Template match -- to match each segment with its template and label with feature data.

Segment tree formation -- to link segment with one other and result in a tree structure.

Tree scan-to turn out the goal language sentence.

2. English-Chinese Title Translation System (2) , which could process no leas than 5000 metallurgical items with an accuracy of 80$ and a speed of 100 items/ 60min. For the errors oocuriag 6o% was of lexical nature and easy to eliminate, and the remaining 40% was grammatical.

3. JF-111, a universal machine translation system (3) » which could theoretically process any language, if grammars of the two languages to be translated into each other were stored in the system.

Research on natural language understanding is mainly centred on Chinese.

The system RJD-80 [4] , developed in the Institute of Linguistics, Chinese Academy of Social Sciences, is a typical one. It is a QA system run on a small knowledge base of Chinese literature. In the following are a few typical sentences between man and the system-

- (man;:

"Is the Author of the drama 'TEAHOUSE' LAOSHE?"

A (machine): "是的"
"Yes."
Q: "巴金写过剧本吗 ?"
"Has BAJIN ever written any drama ?"
A: "没有."
"No."

This system is a linguistic model of understanding modern chinese on basis of linguistic theory.

Another sucessful project concerning natural language is the interface for the Rice Resource Retrieval System, which was the system in English eliminating the need for users to memorize long boring string of commands. The system extracts key words and supplemented with syntactic and semantic analysis. At first, sum up several typical questions in retrieval procedure, for example "Find out the value V, of attribure A| corresponding to the value V_2 of attribute A_2 i.e., Q(A, A_2 V_2). ATN network method is employed in parsing (syntactic analysis) and each node represents a key word.

Zhejiang University have also developed another similar system, a language interface for Warehouse Management System. One can inquire the system in any language if the system has been trained beforehand.

To understand Chinese language by machine, some institutions have set out to explore certain specific methods and fundamental corresponding theory. For instance, Qinghua University proposed a 4-level hierarchy structure: sentence--component--structure--word.

THEOREM PROVING

Prof. Wu Wenjun, Institute of System Science, Academia Sinica, has established a novel approach on the decision problem and the mechanization of theorem-proving in elementary geometry. Its basic idea, restricted to theorems with betweenness out of consideration and based on an entirely different principle, aims at giving a mechanical procedure which permits to prove quite non-trivial theorems in elementaty geometry even by hands. His algorithm has solved certain practical problems that have been hard huts to crach.

Prof. Wang Xianghu, Jilin University, has proposed a generalized Resolution Principle, its basic idea is as follows: In theorea proving the axiom often takes implication form (P->q, R—s,...). While turn it into Skolem normal form they will take disjunction form(P V q, R V S, ...) and lose the explicit meaning involved in primitive form. In order to make deduction more effective and natural he suggested to keep the natural form of Implication. The clause in natural form is named gerenaliaed clause, corresponding resolution is described as Generalized Resolotion. He proved that generalized resolution is complete for first order predicate logic and many improved algorithm, developed in recent years, can be applied to generalized resolution, (e.g., lock resolution, linear resolution, semantic resolution etc.).

EXPERT CONSULTING SYSTEM

By the end of 1970's there were only certain small prototype Expert Systems. After a few year groping and experiences accumulating R&D work on some large practical systems had begun. Most of these system. This is resulting from the fact that traditional Chinese medicine diagnosis is mainly by experinece, and so to simulate doctors' or physician's diagnosis procedures has aroused a great interests among AI researchs. The first system of this kind is for hepatitis, developed jointly by Beijing Academy of Traditional Chinese Medicine and the Institute of Automatiion, Academia Sinica. The fuzzy set theory was applied in the system to make decisions in process of diagnosis. And the program is in BASIC. This system has been successfully employed in practice, diagnosing dozens patiants a day.

Anther system of this sort was developred by Shanghai Institute of Computing Technology, named General Diagnosis System of Traditional Chinese Medicine. The main idea of the system is the concept of "consciousness package". The program are divided into several small pieces named consciousness package. Once a certain condition has been met the corresponding consciousness package would become active. And the package can also be activited by other package. This is a simulation of association thinking of human being. A consciousness package is a basic unit of knowledge. *For* example, a prescription of Chinese herbal medicine may be described as a package in which its natures, what kind of disease to be cure, contraindication etc. are involoved.

Based on similar idea the Institute has also developed a control system of blast furnace recertly. As chemical reaction in blast furnace is so complicated that it could not get desired result with traditional identification. The system adopted a veteran's strategy to control some key parameters. And they have achieved

same operating level as a group chief does with this system.

There are still certain others of medical diagnosis system, such as for gynaecology diseases developed in Jilin University. It diagnosed 204 patients with a correctness rate of 91.75. The system is programed in BASIC, has a 17K main storage. The system for heart diseases, developed in Zhongshan University, it achieved 90$ correct diagnosis rate. The system for nephitis, developed by Nanjing Technology College, it provided 278 different prescriptions from 98 symptoms with a speed of 1 diagnosis/minute. There are also system for lung disease, paediatrics diseases and other diseases. Some of these are still prototype system while some others have been put into practice. Most of them are simulating a doctor and-supplemented by some math processing. Some of them are MYCIN--like system.

A group in Zhejiang University tried to tackle certain technical problems in agriculture and sideline production with Expert System, crossbreeding of silkworms is an example. Conventional crossbreeding is to select parents to generate a hybrid and then with two new generations hybridized again to bear sencond generation of hybrid and so on. After several times of hybridization a nice variety would be yielded. Following such a way there are two major drawbacks: long period and low rate of success. Computer aided crossbreeding system, in which certain experi ences of veteran technicians have been embodied, not only selects the parents based on knowledge rules but also describes properties of new generation beforehand. So that one oould made a comparision choose the best scheme. This system adopts MYCIN BACKWARD Masoning.

Zhejiang University also developed systems for wheat crossbreeding and disigning patterns printed on cloth. In the last system a set of formal language were adopted to describe pattern structure rules.

COMPUTER AIDED EDUCATION

Jinlin University have developed a Factoring System, one can factorize polynome with positive integers of coefficients and exponentials with this system. It provided 16 standard formulas which sould be solved directly: (a^2-b^2), $(a^3\pm b^3)$ (a^4+4b^4), $(a^2\pm 2ab+b^2)$, ... If a polynome to be solved is not a standard formula as metioned, the system factorizes them, till standard formulas. The system is capable of showing the whole procedure in detail, helps students understand the whole course. 90$ questions in junior middle school exercise in math oould be solved with this system and the way is rather the same as human being does. ATEP System, capable of solving trigonometric equations, has solved 110 out of 138 of trigonometry questions appeared in textbook of senior middle school. SSH system simulates a student to solve various applied arithmetic problems.

OTHER FIELD IN AI

1. Program Synthisis. Beijing Aeronautical Institute has worked out a system for synthesizing recursive program on the base of structure induction approach. Some simple functions have been synthesized with this system, such as SORT (L) REVERSE (L).

2. Robotics. Shenyang Institute of Automation, Academia Sinica, has developed a playback-type robot. It has 5 freedoms: arm stretch out, draw back, pitching movement and turn round; wrist turn round and swing; it has been implemented computer control in two ways: point to point and linear track and speed. In point-yo-point control the playback accuracy is less than +. 1•5 mm, in linear-track control retracking accuracy not more than 10 mm, the maximum weight grasped by the hand is about 35kg.

3. Modal Logic about "knowing". Prof. Ma Xiwen, Beijing University, established a predicate calculus of modal logic about "knowing", including its formal system W; provided its semantic interpretation JS; discussed certain principal features of system of W-KS; by some typical examples, especially with wellknown puzzle "Mr. S and Mr. P".

4. LISP-130 Interpreter, developed in Shenyang Institute of Automation, Academia Sinica, was on a domestic minicomputer. It is based on LISP 1.5 having 94 functions and programed in Assembly. This is the first implementation in China (1980). LISP-3000 was developed by Beijing University in 1982 written in WISP language. One of its peouliarities is the ability to transplant to any oopputer. They also develop a language called FT (From Translation;, by which WISP oould be translated into FASP, a specific assembler language.

REFERENCES