AI in Eastern and Central Europe

Matjaž Gams and Ivan Bratko
Jožef Stefan Institute, Jamova 39, 61000 Ljubljana, Slovenia
Phone: +386 61 17-73-644, Fax: +386 61 161-029
E-mail: matjaz.gams@ijs.si, WWW: http://www2.ijs.si/~mezi/matjaz.html
University of Ljubljana, Slovenia
E-mail: ivan.bratko@fer.uni-lj.si

1 Introduction

In 1995, the General Assembly of ECCAI (the European Coordinating Committee for Artificial Intelligence decided to publish a critical assessment of the state of Artificial Intelligence in Europe and recommendations for its future. The ECCAI action is coordinated by its president Nicolaas Mars [1]. During this action, the authors of this paper were invited to prepare the report for Eastern Europe, Switzerland and Austria. Representatives from countries concerned were invited to submit a report. The summarised report will be published as part of the official ECCAI report, the extended version here. In addition, reports from specific countries follow this paper.

This report was partially influenced by reports in the popular press concerning the "death" of artificial intelligence (AI). Basically, the press described saturation of the traditional, old AI. At the same time, two new directions of AI are emerging: new, weak AI and the industrial, invisible AI. Current status of AI is not well defined, and may change rapidly.

In USA, different reports have appeared describing the AI situation, and recommendations for a basic AI research agenda. The ECCAI effort is intended to provide a description of academic and industrial research, as well as applications. The report was not intended to be another commercial for AI, rather it is aimed at highlighting AI strengths and weaknesses.

Each author was invited to structure his/her report according to the following items, however, the form was not intended to tame the subject:

- Research: major organisations (companies, research institutions, universities, etc.), areas of research.

- Development: AI applications.

- Use: AI techniques, systems.

- Education: institutions, degrees.

- Funding: national, multi-national, EU stimulation programs for AI.

- Impediments to AI.

2 Group Report

State-of-the-art in the reported countries follows. There are the following groups

- Switzerland and Austria with their long established AI activities, healthy economy and neutral political positions. Especially Austrian AI with, e.g., the Applied Artificial Intelligence journal is highly active at the European and world-wide level. Nevertheless, funds for basic research in general, funds for AI and interest in AI are not growing as fast as they were a couple years ago, and in some areas it is decreasing. In specific surroundings, a small disillusion from vendors is present. Some of them remember big promises, e.g., of the 5th generation, not fulfilled. Due to respected tradition, AI was already relatively slowly introduced and is about staying at the same level in the last years.

- Countries in transition (ECCAI members: Bulgaria, Czech Republic, Hungary, Slovakia, Slovenia, Ukraine; and non-ECCAI members: Croatia, Macedonia, Poland, Romania) have generally long tradition in AI. Government-sponsored basic research in general and AI research proportionally have severely declined due to political and market changes – e.g. shock-therapies. Therefore, state-of-the-art report is bound to change rapidly. Several of these countries

have their own AI and/or computer-science journals, and good ties with EU resulting in many joint research projects. Due to changes, the problems with AI saturation emerging in specific western countries have not played a significant role. After the shock and decline in economic terms and research funds, many AI communities have oriented more towards real-life applications. The growing optimism is related to a constant growth of information-technology (IT) products, combining IT products with AI techniques, and expected economic growth.

- Ex-Yugoslavian countries hit by war (Bosnia and Herzegovina, Yugoslavia). While AI activities in some ex-Yugoslav counties (especially in Slovenia with the highest GNP in Eastern Europe, partially Croatia and Macedonia) are comparable with other countries in tradition, AI activities decreased or even ceased in Bosnia which was the heaviest hit by the war, and Yugoslavia (Serbia, Monte Negro) due to international isolation. Yugoslavia was once reasonably prosperous AI country with several important AI applications even in the military area.

Overall, funding basic AI research, and AI activities in general are in a small decline. Currently, research prototypes made for the purpose of making new publications look interesting still dominate. Many scientific events such as conferences still have a distinct scent of academic isolation thus distancing themselves from real life and real problems. A reasonable optimism in AI is present in Central and Eastern Europe orienting more towards real-life applications and integrating AI with modern information technology. AI is changing from the science unsoundly claiming to change the world into a modest and reasonably successful intelligent-systems IT discipline. New bold ideas are rare yet there is a feeling that there are many fundamental questions only AI integrated with related disciplines can investigate.

3   Summary Report

3.1   Research

The basic and applied research in the field of AI is done mainly at universities, governmental in-

stitutes and national academies of sciences. The proportion of AI research activities between different institutions varies from country to country. In several Eastern European countries, national academies cooperate research activities of several single institutions. Largest national AI groups have usually around 10 researchers, exceptionally over 20 researchers. A typical AI group has only a couple of researchers. AI groups are often organised as laboratories or even informal groups in larger computer departments with several 10 people. Number of all people involved in AI research in a country is typically a couple of 10, but less than 100. The exceptions are: around 200 researchers in Austria and fewer than 20 active AI researchers in Croatia and Macedonia.

Major research institution:

- Austria: 43 university and research institutes and departments of companies work in the area of AI, the largest among them being the Austrian Research Institute for AI (OFAI), the Christian Doppler Institute for Expert Systems, both located in Vienna, and the Research Institute for Symbolic Computation (RISC) in Hagenberg near Linz.

- Bulgaria: research institutions in Bulgarian academy of sciences: Institute of Information Technologies (IIT) and in the Institute of Mathematics and Informatics (IMI).

- Czech Republic: universities in major cities, especially Prague: Czech technical university, Charles university, Institute of computer science, Academy of sciences of the Czech republic.

- Hungary: Computer and Automation Institute of the Hungarian Academy of Sciences (SZTAKI), the Central Research Institute for Physics of the Hungarian Academy of Sciences (KFKI), the Computer Research and Innovation Centre (SZKI) and the Computing Applications and Service C. (SZAMALK).

- Slovakia: universities in major cities, especially Bratislava: Slovak technical university, Comenius University, and government research institutes, including those of the Slovak Academy of Sciences.

- Slovenia: Jozef Stefan institute and Ljubljana University.

- Switzerland: Universities of Geneva, Neuchatel, Zurich and the Swiss Federal Institute of Technology in Lausanne and Zurich, private research institutions funded by the Dalle Molle Foundation, and a couple of companies such as The Union Bank of Switzerland or Swissair.

- Ukraine: Association of Developers and Users of Intelligent Systems (ADUIS, Kiev), Taras Shevchenko National University (Kiev), V.M. Glushkov Institute of Cybernetics.

- Croatia and Macedonia: Smaller AI groups exist in Croatia (University in Zagreb, Rudjer Boskovic Institute) and a couple of AI researchers exist at the Macedonian university.

- Poland: universities (among others: Krakow University of Mining and Metallurgy, Poznan University of Technology, Wroclaw University of Technology) and Research Institutes (e.g. Institute of Computer Science of the Polish Academy of Sciences in Warsaw – IPI PAN).

- Romania: Center for Advanced Research in Machine Learning, Natural Language Processing and Conceptual Modelling of the Romanian Academy (RACAI), Research Institute for Informatics in Bucharest (ICI).

3.2   Area of interest

- Austria: medical expert systems, machine learning, intelligent agents, knowledge-based systems, computer vision, robotics, neural networks, natural language, speech understanding, knowledge representation, knowledge acquisition, intelligent tutoring systems, cognitive science, AI and society, connectionism, user interfaces, deduction systems, AI software technology, nonmonotonic reasoning, qualitative reasoning, planning and configuration, diagnosis and classification, knowledge engineering, dialogue models, philosophical foundations of IAI, image recognition, cognitive modeling.

- Bulgaria: knowledge representation and reasoning, knowledge-based systems, intelligent tutoring systems, intelligent computer algebra systems, natural language processing, logic programming, machine learning, case-based reasoning, neural networks.

- Czech Republic: distributed AI, evolutionary computing, expert systems (medical, probabilistic), fuzzy systems, ILP, image processing, industrial applications, knowledge engineering, logic programming, machine learning, machine vision, qualitative reasoning, robotics, natural language, philosophical foundations of AI, neural computing, probabilistic methods, knowledge discovery in databases, pattern recognition, speech recognition, artificial life, multi-agent systems.

- Hungary: expert systems, cognitive aspects of AI, Intelligent decision support systems, neural networks, image processing, knowledge-based systems, speech generation/synthesis, robotics, data bases, simulation, Prolog, logic programming.

- Slovakia: intelligent support in software construction, knowledge based programming, software reuse, knowledge based software system configuration management, intelligent processing in distributed and parallel databases, neural networks, speech recognition and pattern recognition, robotics, constraint logic programming, configuration design, genetic algorithms, computational logic, declarative programming, expert systems, knowledge representation, knowledge-based systems, uncertainty in nonstandard logic, approximate reasoning, application of graph theory, Prolog compiler, modelling of discrete event dynamic systems and synthesis of their intelligent control.

- Slovenia: machine learning, ILP, expert systems, multistrategy learning, AI in medicine, decision systems, knowledge engineering, logic programming, qualitative reasoning, natural language, philosophical foundations of AI, neural computing, probabilistic methods, data mining, pattern recognition, speech synthesis, genetic algorithms, intelligent agents.

- Switzerland: expert systems, knowledge-based systems, computer vision, robotics, neural networks, natural language, machine learning, AI and perception, speech understanding.

- Ukraine: decision making and planning systems, expert systems, knowledge discovery systems and their application in chemistry and material science, systems for classification, diagnostics, forecasting, systems for processing natural language texts, processing of encyclopaedial knowledge, neural networks, theorem proving, dialogue natural language systems, visual image processing, medical diagnostics, situational management systems, application of AI methods in CAD-CAM.

- Croatia: logic programming, ILP, philosophical foundations of AI.

- Macedonia: machine learning, AI in robotics, intelligent information systems.

- Poland: intelligent control systems, image recognition, automatic learning, decision analysis, expert systems, distributed intelligent multiagent systems, intelligent information systems.

- Romania: multistrategy learning, knowledge acquisition, intelligent adaptive agents, inductive logic programming, natural language processing, conceptual modelling, knowledge representation, knowledge acquisition, intelligent tutoring systems, cognitive science, automatic programming, genetic algorithms, intelligent manufacturing, simulation, deductive databases, expert systems, neural networks, constraint processing, knowledge-based modelling and simulation, computational logic, artificial life, fuzzy theory and systems.

3.3 Development

Typically, institutions active in basic and applied research occasionally develop mostly experimental prototypes. However, there are some very interesting applications in specific countries. Only a couple of specialized AI companies exist mainly in the Czech republic and Switzerland:

- Czech Republic: Rockwell Automation, Ltd., Research Center Prague (distributed AI, knowledge acquisition and KB systems), and a private company HEM. Romania: a small company (VEDA).

- Switzerland: development groups in many large companies. Each of the three large Swiss banks (Union Bank, Credit Suisse, Swiss Bank Corporation) has at least a small group working on AI and neural networks. Several small companies are selling AI services, the most active one being Synlogic AG in Binningen close to Basel. Swissair has a large (15 people) group developing AI software for various airline applications. These are also sold to some 40 other airlines worldwide. Swissair is using about 200 Lisp machines worldwide.

3.4 Use

The current use of AI techniques is typically restricted to experimental prototypes. Such systems are normally tested by domain experts and occasionally by end-users. Very few of them reach the stage of daily use. However, there are several very interesting systems used in many practical applications, some of them in practical use for a longer period.

- There are many systems developed in Austria, however, no clear description is available.

- Bulgaria: experimental prototypes of decision support and expert systems are developed. Such systems use typically rule-based, case-based or based on neural networks. Examples: A rule-based expert system for classification of historical-geographical texts, two expert systems for diagnosis and treatment of plant diseases, classification and evaluation of musical structures, a rule-based system for diagnosis of glaucoma eye diseases. An expert system, called "Medicotox Concillium", for urgent toxicology is used in a Medical University and in about 10 hospitals throughout Bulgaria. A multi-agent based system for computer simulated military exercises is used in the Bulgarian army. A rule-based expert system for classification of

coins and coin treasures is used in several historical museums in Bulgaria.

- Czech Republic: several industrial AI systems are in routine daily use: production planning system TEPRO (running in TESLA Kolin since 1988, in CKD-Tatra since 1989); ES IZOLEX for technical diagnostics in the domain of electric net (Czech electric power distributor CEZ); ES for evaluation of the actual state of air-pollution and its impact on living organisms (Czech Institute of Hydro-Meteorology, Usti nad Labem). TEPRO is a production planning system offering creation of a correct and errorless production plan using information base consisting of manufacturing data relevant to the scope of the considered production type and knowledge about local production constraints. The system is based on heuristic search in state space. Financial effect of TEPRO system was evaluated to 6 mil. Kc/1 year in both factories using it. Prototype ES were developed for genetic counselling and a KB system supporting decision making in pathology. Several original systems have been developed and they are being tested actually, e.g., GUHA for data-mining and the linguistic system TIBAQ. GUHA is an elaborate system searching for propositional dependencies in data (characterized through a set of unary attributes). TIBAQ (text-and-inference based answering of questions) is a model of a build-up of an automatic "encyclopaedia". Its algorithms analyze the input texts (in Czech) and perform natural language inferencing.

- Hungary: RECOGNITA PLUS, an OCR product with 14000 installations in 24 countries, 1500 installations of MProlog in 25 countries all over the world, CS-Prolog is now in use in 13 countries. Application areas and the number of projects: building industry (7 projects), chemistry (10), computing (6), energetics (7), medicine and health service (16), other industrial projects (11). Products and developers: ALLEX PLUS (ALL), GENESYS (SZAMALK), MProlog Shell (IQSOFT), KASNES (SZTAKI), METABOLEXPERT (CompuDrag Ltd.), PANGEA (RMF), REALEX (BME), OPSQL

(KFKI). An expert medical system for young children has been in use for several years.

- Slovakia: a prototype for prediction of technological parameters of selected devices at a nuclear power plant. An AI application for IIASA, Laxenburg, Austria: a knowledge based checking of the correctness of (a huge) amount of data for the RAINS model and knowledge based wizards supporting a user of the RAINS model. An expert system shell Codex has been in a routine use in more than 15 applications throughout not only Slovakia, but also in the Czech republic.

- Slovenia: Around 10 systems used occasionally or regularly for real-life applications, e.g., machine learning systems used for medical diagnoses. These systems are: DEX – a decision support system, machine learning systems Assistant, Ginesys, Golding, expert systems developed for signal processing, genetic and CLP algorithms for scheduling tasks in industrial process optimisation, Golding – a system for constructing equations from data. Systems were regularly or occasionally applied at several institutions in Slovenia and sold also in several other European countries. Over 60 prototype or real applications were performed for various users and contractors. The major Slovenian applications were implemented at the Jesenice still mill factory. The expert system controlling quality of the rolling emulsion in the Sendzimir rolling mill has been in regular every-day use for over 5 years.

- Switzerland: Expert systems and other applications using AI technology are in use in many companies and organizations, e.g., in the electronics, chemical, insurance industries. Swissair is a major user of AI technology with measurable and very substantial benefits.

- Ukraine: There are 15 intelligent systems in occasional or regular practical use. CONFOR is intended for knowledge discovery, object classification, diagnosis and prediction. CONFOR operates with examples and non-examples of investigated class of objects (processes, situations, phenomena, etc.) that

are represented as sets of attribute values. Original method of inductive CONcept FORmation based on the growing pyramidal network is taken as a principle in the CONFOR system. CONFOR passed successful long-term examination in Ukraine, Russia and USA in such fields as material science, chemistry, medicine, geology, technology, astronomy, economy, sociology, etc. Examples of application tasks: prediction of existence of predefined chemical compounds, search for new materials having desired properties (electro-optical, ferro-electric, superconducting, semiconducting), classification of economic situations, discovery of regularities that characterize diseases, disease diagnostics, prediction of solar activity, diagnostics of failures in technical units and so on. MANAGER complex makes it possible to design systems intended for situation analysis and decision making in various spheres of administrative and economical activity. Application domains: management in offices, enterprises, regions, for business activity support and may be used as a manager training system.

- Poland: Applications of prototype systems in histological images recognition (diagnosis of brain and liver cancer), evolutionary techniques to task scheduling, multiagent systems for resource allocation and multiagent system for task assignment.

- Romania: Natural language interfaces and expert systems have been actually used in the past 10 years. Examples: DISCIPOL, an expert system able to learn from examples and intelligently assist a technolog in choosing the best technological solution in loud-speakers manufacturing (used at thé "Electronica" Factory in Bucharest), DEXTY, an expert system for designing industrial halls using typified elements. It integrates frames (structured objects) with rule-based knowledge and also with existing programs for stress verification written in conventional languages. This expert system was used at the Civil Engineering Design Institute in Bucharest. IURES, a natural language interface building system. The system (based on se-

mantic grammars and conceptual graph modelling) has been used to develop Romanian language interfaces to an information retrieval system (Institute for Metallurgy Research in Bucharest), a DATATRIEVE personnel database ("FLARO" Factory in Sibiu).

3.5 Education

AI education is available at graduate and PhD level as part of computer and information sciences in practically all countries. There are university programmes at institutions mentioned in the research section.

3.6 Funding

In practically all countries concerned, the major part of AI research funding comes from the state. Educational activities are usually funded through Ministries of education. Research activities are supported by Research ministries or National science foundations or grant agencies or committees. A substantial source of funding for the AI research and AI-related activities are EU programs and bilateral cooperation.

- In Austria, the Austrian Research Institute for AI alone is at present partner in six EU projects and member of 4 Networks of Excellence. There are many other Austrian institutions involved in EU-projects. In the Austrian report for 1994, there are 149 cooperating partners, 87 in Austria and 62 abroad – of these 80

- In Bulgaria, there are two TEMPUS programs in the field of AI education. There are also PECO and Copernicus research projects and European Networks in AI related areas.

- In the Czech Republic, 4 TEMPUS projects have been finished already, 1 is still running, 8 PECO AI related projects are running actually.

- Slovakia: 2 TEMPUS projects have been finished already, cooperation in COPERNICUS programme.

- Slovenia: 7 active EU projects – TEMPUS and COPERNICUS projects, Networks of Excellence.

- Poland: TEMPUS and COPERNICUS projects.

- Romania: Network of Excellence in Language and Speech-ELSNET-Goes-East, Network on Inductive Logic Programming-ILPNET, and Trans European Language Resource Infrastructure-TELRI), a European joint project (Multilingual Text Processing-MULTEXT).

3.7 Impediments

Among the countries in transition, the major impediment for the usage of AI results is the present state of economies. There are not yet major private enterprises or major investors which could invest in AI. In general, lack of interest in industry and declined funding for basic research are seen as two negative factors for further AI progress. Another problem is that some AI product and service providers did not meet the expectations created by themselves and this is still remembered by the managers.

Acknowledgements

References

[1] Nicolaas Mars (1995), Instructions for the ECCAI Report "The Future of Intelligent Systems in Europe", pp. 3.