SZÁMKI TANULMÁNYOK
Kiadja a Számitógépalkalmazási Kutató Intézet

SZÁMKI Tanulmányok 1.

ISSN 0134-0220

Budapest, 1977. november

COMPUTER SCIENCE IN HUNGARY

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I am most happy to welcome you to the Second Hungarian Computer Science Conference on behalf of the organizing bodies. Our meeting has been arranged by the Hungarian Academy of Sciences (MTA) and J. Neumann Computer Society (NJSZT), cosponsored by the Organization of other Socialist Academies in the field of *Scientific Problems of Computer Techniques*, under the auspices of Central Physical Institute and the Computer and Automation Institute of the Hungarian Academy of Sciences. We hope that the exchange of ideas and expecially the personal contacts of scientists from different countries would serve the mutual understanding of nations as well.

The last few years has brought us a rapid change and progress in computer science. The computer oriented practice, science are few examples of the development which has opened new scope in the field of computer science.

I.

1. Before reviewing the situation and the results of the computer science in Hungary, I should like to talk shortly about the surroundings and previous achievements determining the background of our research.

   During the 70's some clear-cut results were achieved in developing the hardware-base and what we call "computing culture" in Hungary. Our hardware-factories started to work resulting in hundreds of R10's, manufactured by VIDEOTON and TPA's, manufactured by KFKI (Central Research Institute for Physics), already working (quite a few of them abroad). For these machines software-systems were also developed, consisting not

1/ Lecture on the opening session of the Second Hungarian Computer Science Conference (27 June-2 July, 1977, Budapest).

only different operating systems, but compilers, application packages as well; there are some telecommunication applications in network systems, too. Beside mainframe-manufacturing we also have built other equipments, for example

- a planning and controlling system for printed circuits developed in SZTAKI (Computer and Automation Institute Hungarian Academy of Sciences),
- a special equipment for R40-R10 connection, which was done in VEIKI (Institute for Electrical Power Research),
- minicomputers manufactured in VILATI (Institute for Electrical Automation) and EMG (Works for Electronic Measuring Gear),
- an image-recognition system used in medicine (SEGAMS) developed in GAMMA, for which the software was made in Szeged.

This, rather fast development of manufacturing was made possible by the Central Development Program for Computing and the cooperation of the socialist countries. The above projects were coordinated by the OMFB (State Office of Technical Development).

2. In establishing the application base for computers a number of governmental organizations, like MTA, KSH (Central Statistical Office), OT (Planning Office), PM (Ministry of Finance), took an important part, where good results were achieved in measurement automation, statistical applications, national planning and financial control systems. Certain firms and institutes had a leading role in applications, too, mainly for using computers in management information systems. Some of the largest industrial firms, such as Csepel Iron and Steel Works, Rába or Danube Iron Works, had developed complex computing systems mainly with their own people with the help of their existing and continuosly improving organizations. Of course, one could continue this roll-call with a number of other examples.

   I should like to say a few word now about my personal experience. In 1971 we made - amongst other projects - an order-handling and - control system on the CDC 3300 (belonging to the MTA) for the Danube Iron Works. Today they have their own computing center and they already had realized a large part of a complex information system, used in the daily operations, too. The basic elements of their success were neither the utilized techniques, nor the scientifical experiments or methods, but the clear-cut, direct, well-planned management connecting every aspect of the pro-

ject, knowing that to raise the level of effectivity can be realized only by using new methods, by using computers.

The creation of the application-base in Hungary has started in the few years and gives a good foundation for our future activities. We can proudly say, that computing technique became an indispensible tool for control, applications and research in Hungary.

3. During the last period there were serious improvements in the field of the education, too. In the universities, the form of lectures in computer techniques were - more or less - finalized. Computing centers and other application areas have already received the first programmers, system programmers, system analysts and hardware-engineers with university degrees.

   The creation of this activity in Szeged and the role of Professor Kalmár was already discussed. The University of Sciences in Budapest has a very important role in software education, because in addition to their own efforts, they have used and are continously using the resources and results of the research institutes. Besides doing the lectures, they are working on several research projects as well. However, all of our universities must make serious efforts to improve their computing facilities.

   Another side of the computing education has been done very successfully by the SZÁMOK (International Computing and Education Centre), controlled by KSH; the level of their training courses is comparable to the international standard.

4. The research projects in computing started at the same time as the hardware-manufacturing and application developments. In the very first period they concentrated on the discussion of the general principles of computing sciences and computing machines. These were followed by projects concerned with programming languages and programming methods. As computational facilities became better, a large number of the world-wide researched problems got into the first line, concerning the internal working of machines and their software, such as automata-theory, the problems of complexity, operating systems, compilers, program-proving, etc.

   During the development of large application packages certain research projects came into life, which are requiring the study of very general and complex systems. Beside the numerical methods, statistical methods and evaluations, and operation research certain important works has been

started in the fields of information-retrieval based on data base systems, computer-aided design, etc. These application systems are requiring suitable computational facilities, new methods in programming, theoretical researches (mathematical methods), economical and engineering studies, usable information systems and a large amount of practical experiments, real work.

5. The first Hungarian Computer Conference held in '73 was the first attempt to assess our researches. That conference was organized in limited circumstances and only a few results were discussed. From that time on there were real improvements in our internal and international conferences. The work in this field has been actively supported by the committees and institutes of MTA, and by the NJSZT. At this point I should like to stress again the fruitful experience of the scientific cooperation between the socialist countries. As an example, one should mention the results achieved by the "winter school" (held in each January), which - working in the field of the theory of operating systems - arrived to some important results in the studies of effectivity, parallel processes and computer statistics. It is no chance by any means that our international publications are geared to those results.

   There were similar conferences in collaboration with IFIP. In this conference a number of lectures will be given by the members of the Computing Centers of KFKI, MTA SZTAKI, KSH SZÁMKI (Research Institute for Applied Computer Sciences), OMFB SZKI (Institute for Coordination of Computer Techniques) and other educational computer centers and organizations. Most of these lectures will discuss new developments and existing, working systems. We tried to include papers of scientists in computers, but users, too, who dealt with real problems.

6. One can learn about our results in computer science by studying the existing systems and reading articles in relevant periodicals. In Hungary there are three important periodicals publishing articles about computing: Acta Cybernetica, Information and Electronics and the Journal for Applied Mathematica. The research journals of our institutes, like NIM IGÜSZI (Institute of Industrial Economy and Management of the Ministry of Heavy Industries), OT Computing Center, SZTAKI, KFKI give additional coverage of this important field.

   During the last four years our researchers have achieved some very important, internationally published results. Amongst those I ought to

mention the studies in programming languages, in the effectivity of computers and in computer-aided design. This all shows that our backlog has diminished in the past period compared to the present "state of art". This is my main reason, for selecting certain topics to be discussed further.

II.

1. To a very difficult question: what <u>is</u> computer science? - one can give the following answer (which tries to substitute a long formal definition):

   Computer science is the scientific way of solving problems connected with computers (hardware and software included) and their applications. This definition mostly applies to practical usage, and because this conference will discuss mainly software and application problems, I want to reiterate the wide area covered by this definition. The firmware and wide usability of computing techniques in all of our everyday life creates a need of scientific solutions. This need must be satisfied by computer science, which formed some important and new directions:

   a) Even in the last century questions about the structure of the language and their mathematical studies resulted important and widely usable theories. The first and still most useful model for the language was the theory of Markov-chains (although it describes no living language in a natural way). The syntactical and semantical studies of linguistical problems led the way to mathematical logic and the use of its results. The application of previous researches for creating compilers, checking programming languages and testing of programs gave such practical results, without which computing technique would not exist and could not solve most of the practical problems. The solutions of the theoretical questions in programming languages led to exceptionally useful practical successes, which made possible the management of large data bases (unthinkable 10-15 years ago). Naturally this is just one side of the many-faceted studies for the given problem area.

   b) The effectiveness study of operating systems for large computers needs the application of the newest results in queuing theory, and created the necessity of further researches in the field of priorities. The probabilistic models used in this area are giving first-rate effectivity functions - even for everyday operations - with the help of

daily statistical informations. The statistical studies of operating systems and the approximations for their controlling structures and sequences started new researches, like nonlinear filtration applied to point processes and the problems of separation principle.

c) The application of virtual storage to increase the size of the main memory led to studies of stochastic sequences not done before, like the inclusion of independent, or Markov-dependent sequences into LRU stack-models. The possible connection of independent reference strings and LRU stack-models created a new research area.

In the above examples I mentioned only a few specific line of existing studies - without trying to cover the whole field -, which are proving the existence of a new branch of science, already having a lot of results and a tremendeous amount of publications.

Nowadays it is quite common to divide computing science into different areas of research. One of these divisions is reflected in the sections of our conference.

From the application areas I should like to stress those fields, where the inclusion of hardware into a system means becaming the integral part of it and this process will basically modify the work of the given area, like in computer-aided design, data base and information retrieval systems, automatic measurement and control of complex systems, etc.

2. The study of the mathematical foundations of computing science, the development of mathematical models is one of the most important part of the science. This is true even if we know that computing science is rather experimental, and it can be better compared to experimental physics rather than theoretical physics.

However, the experimental character is two-sided here:

- the existing programs, programming systems are algorithms with dynamic execution, whose logical structure, statistical behaviour depending on the job-stream, complexity and stability require not only practical solutions, but theoretical studies as well. The mathematical studies of those properties in the theory of algorithms are not developing with the same strength in each direction, because the "experimental side", the actual problems to be solved need strict schedules to satisfy concrete requirements.

- The research areas - mentioned in the previous paragraph - were rather successfully covered in Hungary; starting from that observation, that to be able to formulate the necessary mathematical model, one should know about and apply the newest results and trends of mathematics. To raise computer science to a high level for providing reliable solutions it is necessary to form and study equivalent mathematical models. This process has been started all around in the world, led to very important results, used high-quality mental resources, the type of which one can find in Hungary.

Our country has a tradition in the mathematical foundations of experimental researches. Because we cannot think of Hungary as a leading producer of hardware and basic software, only in the field of theoretical foundations based on our experience in the application and effectivity of compunting technique can we join the leading research-areas. From our living traditions I should like to mention the role of F.RIESZ and B.SZŐKEFALVI-NAGY, whose works have been heavily used, utilized and still quoted not only in pure, but in applied mathematics (e.g. in statistics and numerical analysis we cannot find volume which does not quote them). As for the present, this type of mathematical approach is still carried on in process-control by F.CSÁKI[1/] and in operation research by A.PRÉKOPA.

3. In determining the tasks of computer science in Hungary one must start from the following thoughts: Without forgetting some of the classical problems (measurement automation, process control, numerical analysis, statistics and operation research) we should concentrate on improving our work in the field of planning and data-acquisition (statistical applications). To keep the requirements of our economy in mind, we ought to see, that the success of our plans are strongly connected with the reliability and speed of the statistical applications.

In the methodology of planning the mathematical programming, in the methodology of statistics the statistical analysis and probabilistic models are playing a definitive role. To improve those we have to implement practical computing systems, which will raise the effectivity level. Therefore, computing science has tremendeous tasks to be carried out for the future of Hungary.

1/ For the Hungarian science it is a great loss that academician F.Csáki (1921-1977) died soon after the conference.

The purpose of this conference is to investigate some new and promising field in computer science and to investigate the use of computers. In both direction we are far from the situation when we had only ideas and theoretical results. The time has come to raise questions, as this conference will, of how we go defining the efficiency of computers, the efficiency of models used for practical purposes. Earlier a response to these questions about efficiency was: more speed, larger memory, paging, multiprogramming, multiprocessing etc.

Now we have the questions: are we concerned about optimizing the models of the real problems and the troughput of the jobs in the computer in well defined time-frame? From whose standpoint do we evaluate efficiency?

As I see the present state of the art of the field is paradoxical: there is, on the one hand, wealth of experience and there are, on the other hand, theoretical models, whose conclusions are not verified.

In order to help the participants the Organizing Comittee has published the *Preprints*. I would like to express my thanks to all those, who helped in preparing this meeting. Finally, I should like to reiterate our great pleasure in welcoming you here and to invite you to enter the formal and informal discussions of the Conference, I should like to express our sincerest gratitude to the speakers from near and far, in helping us to make this Conference a success.

SZÁMÍTÓGÉP ALAPÚ INTELLIGENS TERMINÁLOK

(R10 számítógépen megvalósított projektek)

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BEVEZETÉS

Az intelligens terminálok (IT) létrehozása egy lépés a kisszámitógépek távadatfeldolgozási és adatátviteli hálózati felhasználásának utján.
Az intelligens terminálok a nagy, közép (HOST) és kisszámitógépek kapacitásainak jobb kihasználását teszik lehetővé a felhasználók számára. Az intelligens terminálok felhasználása a kisgépes oldal teljes kihasználtságát biztositja a számitógép egyidejü, többcélu alkalmazásával.

Az intelligens terminál felhasználója egyidejüleg két alapvető szolgáltatást kap:

- remote-job-entry(RJE) a nagyszámitógép felé,
- helyi batch feldolgozás.

1. AZ INTELLIGENS TERMINÁLOK KONCEPCIÓJA

Az intelligens terminál olyan kisszámitógépre kifejlesztett rendszer, amely a kisszámitógép totális kihasználtságát biztositja. Az IT felhasználója feladatait megoszthatja két számitógép között. Kisebb feladatait saját számitógépén elvégezheti, a további munkáit pedig adatátviteli kapcsolaton keresztül nagyobb számitógépekre továbbithatja.

A közép és nagygépes rendszerek közül azokat veheti igénybe, ahol a felhasználók számára biztositott a távoli (RJE) elérés. A kisgépek közül azon tipusokon lehet intelligens terminált kialakitani, amelyek alkalmas háttértárral rendelkeznek és hardware adottságaik elsősorban real-time jellegüek. Az R10 adottságainál fogva megfelelt a kisgéppel szemben támasztott követelményeknek.

Az IT egyidejüleg két szolgáltatást ad:

- RJE lehetőség nagyszámitógép felé (adatátviteli kapcsolaton keresztül),
- saját batch feldolgozás.