Computer Socie Fifth Annual Meeting in Ma

For Greater Flow of Information

By Lt. Col. A. Balasubramanian

(President, Computer Society of India)

DIGITAL compute their appearance computers in India their appearance in India around 1956, a decade after their appearance in the U.S. with the installation of the HEC 2M, at the Indian Statistical Institute. Calcutta The growth in the number of systems was initially rather slow. However, since 1962 the numbers have increased rapidly bers have increased rapidly and to-day there are over 120 installations in the country.

It was at the initiative of Prof. Harry D. Huskey, a well-known name in the field of computers, who was in India as a Visiting Professor at the ITT. Kanpur, that an organisational meeting of computer theorems of control of computer the state of the control of computer the state of computer users was called at the IBM Education Centre in Delhi on June 6, 1964. This was attended by 16 persons from var-ious institutions and the All-In-dia Computer Users Group (AICUIC) was formed. The perious institutions and the All-India Computer Users Group (AICUG) was formed. The primary aims of the Group were to organise, develop and support computational activities and improve the efficiency of computational processes in the country.

OBJECTIVES

The AlCUG met for the first time at the TIFIR in Bombay in October 1964. At its second meeting at Kanpur in December, 1964, it was generally telt that there was a vital need for a professional body which would have broader objectives than functioning merely as a Users' Group. The AlCUG was, therefore, to formed into the Computer Society of India (CSI) in December, 1964, with the following objectives:

- (1) To organise, develop and support computational activities and improve the efficiency of computational processes in Inda;
- (2) To increase the flow of information for the benefit of all;
- (3) To exchange the benefits of the experience gained in the field of computer and information processing.
- (4) To take active steps in enacating people in the field of computers
- (5) To spread computer know-how and applications.

(6) To create a brotherhood amongst the personnel engaged in such pursuits.

The CSI has rapidly grown in strength and also in its activities. At present, it has 70 institutional members and 275 individual members. The anajor computer installations, manufacturers, design groups and other users are represented on the Society.

Buring the current year, the CSI has significantly enlarged its activities by the formation of

ing of computers.

The Society currently relies for the furtherance of its aims on the medium of meetings that enable communication through personal contact. These meetings which are held on a monthly basis at the Chapters culminate in an annual three-day conference. Judging by the active participation and contributions at these conferences which have been held at Bombay Calcutta, Hyderabad, Kanpur and Trivandrum over the previous years, and the interest evinced in this year's meeting at the College of Engineering Guindy, in Madras on January 8, 9 and 10, 1970, the Society can look back with a sense of achievement on its growth during these formative years.

The CSI publishes a quarterly

The CSI publishes a quarterly News-Letter. These News-Letters, apart from providing information on the activities of the various Chapters and on the trends in the computer field in the country, contain articles of a technical nature dealing with application areas, programme development and so on. The News-Letter it is to be hoped, would soon evolve into a quarterly journal.

TREMENDOUS POTENTIALITIES

Computers, the most significant products of technological endeavour in this era of intelectronics forming part of the electronics age have contributed to the extension of human intelect by electronics. In a developing economy such as ours, we cannot avoid falling in line with the developed countries in adopting the tremendons potentialities gained by these advances in solving our day-to-day problems. This adoption will naturally make considerable temands on utried. considerable demands on our edu-cational systems research and development and manufacturing activities in the country Our-next generation will have to de-velop a sense of appreciation of computers and their capabilities in the same way as the present generation had of machines, radios, and so on.

Most of the members of the So-

Most of the members of the So-ciety have been involved directly in their individual capacities. In the improvement of the efficiency of computer processes and educa-tion. While early in 1962, the potential users had to be entirely guided by the manufacturers' re-presentatives with regard to selec-

Chapters at Bombay. Calcutta, the condition of suitaJamshedpur. Hyderabad and ble systems, the conditions to-day are altered. The expertise in system and Bangalore. The chapters are lettered activity such as Delhi and Bangalore. The Chapters have been organising monthly meetings and seminars and generally tostering the understanding of computers. tion and implementation of suitable systems, the conditions to-day are altered. The expertise in system analysis is no longer the prerogative of the manufacturers. Users can handle these problems competently by and large. The Computer Society could also further contribute directly in helping the users in this regard.

As early as in December, 1965, he Computer Society of India As early as in December, westthe Computer Society of India
had advocated the setting up of
regional computation centres to
maximise the return on our investment in computers on a national
basis This concept, which is generally finding acceptance now, will call for considerable co-ordination and organisational effort in plan-

CSER LIAISON

Manufacturing programmes that Manufacturing programmes that are currently in vogue in the country would need restructuring based on user experience and potentialities for further areas of application. The Computer Society of India should bring about the necessary user liaison, and provide feedback into the manufacturing area for improvement in systems hardware and software.

In the field of education, there has been much confusion caused lately by the proliferation of organisations teaching programming systems analysis, etc. While one camont have any valid objection to any organization imparting training and getting paid for 11 there are cases in which applicantaine misled with prospects of employment with four-figure salaries at the end of a 3-month course. It is only an insignificant proportion of those who go through these courses that get employed, and that too perhaps only because they were already associated with an organization which had installed a computer. The majority of the students who had hopefully diverted themselves for a career as programmers from other opportunities get disillusioned. disillusioned.

The time is not yet ripe in the country for "Freedance" programming", Whilst the elements of programming can be learnt through such courses, training in systems analysis cannot be easily obtained through casual courses. Systems through casual courses. Systems analysis is an area where expertise has to be built up in every organization primarily from within to match up with its particular requirements.

BROAD-BASED APPROACH ESSENTIAL

The adage "specialisation leads to triviality" is true in computed sciences, in spite of the rapid expansion of information growth in the yarious disciplines. Interrelathe various disciplines. Interrelation between these various discr

plines has made a broad-based ap princes has made a production of a proposed very necessary. The Computer Society should create an atmosphere wherein all disciplines that form part of the computer sciences are brought together to form a professional activity which may be termed Computer Engineering. Based on the broad definition of Engineering as the application of science to increasing prosperity of mankind, such an acticity would include fields such as medicine, psychology, sociology, economics, education and management.

The Society should, therefore, strive to create this broad-based understanding and also establishingh professional standards. Protessional standards are not precisely definable but there is no doubt that we should endeavour to build up ethics, professional behaviour and social responsibilities amongst the members in order to establish the CSI as the accepted professional body in the computer field in the country. m the country.

There is no doubt that comput-ing and information processing activities have attained sufficient maturity in India. The Society should enlarge its activities toshould enlarge its activities to-wards the achievement of its ob-lectives purposefuly. Our obliga-tions as specialists and competent professional personnel are very clear.

clear.
The Computer Society of India acknowledges gratefully the coacknowledges gratefully the co-operation of Tin linor and the advertisers in the production of this Supplement.

Computer Co Guindy Eng.

By Prof. K. S

Pro Cpal, College of

THE establishment of a computer centre at the College of Engineering, Guindy, with an IBM 1620 marked the beginning of full-scale digital computer activities in Madras.

Since 1965, the College has been offering courses in programming, numerical analysis and computational methods to engineering students and teachers at appropriate levels. The College has been the levels. The College has been the pioneer centre for three advanced Summer Schools on computer prosummer schools on computer pro-gramming and numerical analysis at an althodia level since (1966, Computer tipne is also available for research by students and staff of this College, as well as other educational and research institu-

Through such courses and ex-tension of facilities and by its can direct insoftement, the Col-lege has stimulated considerable amount of computer; oriented re-search and development.

By way of an administrative application, the centre has developed a computer programme for

ciety of India Madras on 8, 9, 10 Jan. 1970

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Computer Design And Development in India

Professor of Electronics and Computer Science, Indooper University, Coleania

ing prosperity acticity would as medicine.

A CTIVITY in the area of electronic computer development started in India in 1954 at the Tata Institute of Fundamental Research (TIFR), where a pilot model general purpose computer was completed in 1956. Subsequently, a full-scale version was commissioned in 1960. This ma-chine, named TIFRAC, was iff operation till 1964 and many early computer users in the country had their first experience of aunad their first experience of au-tomatic computing using TIF-RAC. The pioneering project TI-FRAC helped to spread computer consciousness among the research scientists of TIFR as well as other institutions.

> The TIFRAC project, carried out in the first generation computer era, used the electronic hardware readily available at that time, era, used the electronic hardware readily available at that time, namely, vacuum tubes, semiconduc-tor diodes and the territe core memory. The design of TIFRAC was in pace with the state of the art of the time, But the spectacu

The fifth annual general conference of the Computer Society of India is being held in Madras for three days from to-day at the College of Engineering Guindy. Dr. B. D. Nag Chaudhuri, member, Plan-ning Commission, will inaugurate the conference. Mr. P. Sivalingam, Director of Technical Education Tamil Nadu, will be in the chair at the inaugural session.

(Programme on Page IV)

lar and rapid progress of the comlar and rapid profites of the com-puter (cefunology elsewhere made it an obsolescent first generation machine by the time it was com-pleted, along with all other ma-chines of the period.

The first attempt in India to develop a general purpose second geheration computer was undertaken jointly by the Indian Statistical in stitute (ISI) and the Jadavpur Conversity in Calculta in 1963

The newly formed department of Electronics and Tele Communication Engineering of Jodaypur University welcomed the idea of the Statistical Institute to take up a programme jointly to develop a computer. a programme jointly to develop a small-to-medium sized computer. This project, while necessarily limited in scope because of considerations of cost, became operational in 1966 and was christened ISIJ1-tater the names of the two institutions.

Both the TIFRAC and the con-JU-1 projects resulted in the grow-tic of a nard-core of personnel in the country with professional know-how in the various facets technology. The It of a nard-core of personnel in the country with professional knowshow in the various facers of computer technology. The ISIJU-I has been used in teaching programming and computer circuit design, as well as insolving research problems of moderate size. The limitations arise postly from the limited memory size. A notable use of this computer has been in a U.N. project of industrial planning in South-East Asia.

Both TIERAC and ISIJU-I were built using imported electronic components and peripheral units components and peripheral units. The semiconductor industry was started in India in the early 60's primarily to need the needs of the entertainment industry. in the last 2 years or so that se-ndconductor devices, suitable for high-speed reliable—computer applications, have become available

The Computer Division of the Electronic Group of the Trombay Atomic Energy Establishment, now known as the Bhabna Atomic Research Centre (BARC), developed

ing problems primarily arising in connection with nuclear reactor designs. Subsequently, their pro-duction unit manufactured and duction and manufactured and sold analog computers to scienti-fic and teaching institutions. The Computer Group investigated the possible applications of real-time computers in the various ageices within the Department of Atomic Energy (DAE) and elsewhere in India, and started a project in 1955 name, and scarred a computer. It was to develop such a computer. It was planned that the DAE's newly formed public sector undertaking the Electronics Corporation of India (ECIL)—at Hyderabad. would later manutacture and sell these computers on a commercial

Read-time computers, as gui hed from general purpose computers, are used to control the plant machinery of steel, petro-feum, chemical and other plants, nuclear reactors, etc. They are also used in air-traffic controls and sateilite tracking and communication. tellite tracking and communication. Such computers supervise the complex processes in a real-time environment by acquiring all vital data of operations in progress, and after processing them, by sending back control signals to direct or guide the various equipment of the complex altreat including and the complex altreat including altreat including and the complex altreat including and the complex altreat including altreat including and altreat including altreat including altreat including and altreat including altreat including altreat including altreat including a second and altreat including a second altreat altr complex almost instantaneously.

EDUCATIONAL PURPOSES

The BARC real-time computer (named TDC-12) became opera-fonal in 1969, and the group has already moved to ECIL to launch already moved to ECIL to launch their production programme. The IDC-12 project has taken tuff advantage of locally available semiconductor devices and other electronic components. No more than 25 per cent of the direct cost of components and peripherals in producing these computers would be in foreign exchange. The TDC-12 computer, apart from meeting the need in India for real-time systems—would also be useful, according to the designers, for educational and training purposes. The production programme of computproduction programme of compu-ters at ECH, marks an important stage in Indian industry, as now the country is ready for the ma-

nutacture of computers completely nesigned in India.

The Computer Group at the Tata Institute of Fundamental Research turned its attention to the design of special purpose computers with indigenous electronic components after the installation there of a CDC 3000-160A system in 1964 to function as a national computational facility. To this effect, they also took up the problem of designing a real-time data processor, OLDAP (On-Line Data Processor), which flas some similarities to the TDC-12 in its design approach a) special purpose computers with to the TDC-12 in its design appro-

Apart from the developmental enorts we have been discussing so far, there have also been some are there have also been some equipment oxyclopment activities in India that fall in the category of computer techniques. The most significant of these are the message switcoing electronic exchange now under development at the Telecommunication Research Centre of the Pest and Telegraph Department in New Defin, and datalogging sys-New Delhi, and data-logging sys-tems developed at the National Aeronautical Laboratory. Banga-lore, Detence research laboratories may also be developing special purpose systems.

ELECTRONIC DESK CALCULATOR

Special purpose computers tor nuclear research, and multichannel analysers have been developed New projects continue to be taken New projects continue to be taken up in these areas at the Atomic Energy—Department's research centres, as well as at one or two universities. Another equipment on which much attention is now tocussed is the electronic desk calculator. It may be expected took this will be followed by the development of midday computers.

to the major problems that confront development projects in the area of computers in India at present, mainly arise from component, and neighboral non-available. sent, manny arise from compo-nent and peripheral non-availab-fity. The types of basic hardware items required in computers cover a wide range, viz., semiconductor devices, discrete resistors, capaci-tors and transformers print devices, discrete resistors, capacitors and pulse transformers, printed circuit boards, edge connectors and cable connectors to name some important ones. Integrated some important ones. Integrated circuits and microelectronic pack ages were available in the West in the early 60's, and in substantial commercial quantities, about 1965. The third generation computers were ushered in around that time built out of integrated and hybrid circuits.

It is unfortunate that the ECIL programme, taking shape in the 70's, has to be based on second generation technology sheeause of the non-availability, locally, of misome important ones.

Continued on Page IV

iter Centre at , Eng. College

By Prof. K. S. Hegde

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dministrative ap-tre has developprogramme for

processing the results of the exarainations conducted by the Tainit Nadu Board of Technical Education. This programme has been in operation for the past lew operation for the

Computing facilities have since been established at the Integral Coach Factory, Southern Rallway, IBM, Binny's and the Physics Department of the University of Madras. The tast ope is entitly accorded to scientific presented, with management, production control and accounting. Nadres has thus recorded an

Madras has thus recorded an all-round development in computer applications.

The College of Engineering Cuindy, deems it an honour to have this opportunity to host the fifth annual conference of the fift, annual conterence of the Computer Society of India. It is our firm belief that the deliberations of this Conference, apart from their technical contribution. will serve to add considerably to the computer awareness among the students and the various pro-fessional members in this region.

a general purpose analog compu-ter in 1960 for handling engineer-

Sophisticated Programmes: Good Scope

By Dr. Mathai Joseph

(Computer Group, Tata Institute of Fundomental Research, Bombay).

THERE are two components to system the complex and sophisticated collection of equipment we call a computer system; first. there is the physical circuitry. the electro-mechanical devices and the memory devices which. together, represent the 'hardware of the system; secondly, there is the corpus of programmes which provides the instructions for the sequences of operations to be performed by the These programmes computer. are now characterised by the term 'software'. Software includes not only the programmes: to perform, say, a series of complicated calculations, but also the system programmes which allow a programmer to state his problem in an easily understood language. The yeason one needs

system programmes becomes clear when we consider how a computer works.

computer works.

A computer is an electronic machine which has the capability of storing information and which can perform calculations using this information. For reasons of circultry, the information which it stores is in the form or binary numbers. Some of these numbers represent instructions to the computer and some of them are the data on which these instructions are to be performed. The instructions are to be performed. The instructions are to be performed and actions as addition, subtraction, multiplication or comparison, but a large number of more complex operations may be synthesized out of these elementary steps.

The drawback in using just besebasic instructions is, however that the programmer is required to break down his problem into a large number of minute steps, and to represent his problem as a series

becomes of numerically coded instructions. This requires not only painstaking accuracy but also fairly intimate knowledge of the internal working of the computer, making this of circuith it stores numbers to the view of computers would that the use of computers would that the use of computers would not spread until it wis made easier for the average scientist, engineer or bustness man, to write program mes.

This situation was remedied around 1956 by the introduction of higher-level programming languages. These are artificial languages often destricted for the soft tion of particular types of problems, but which allow the programmer to give instructions in a more easily understood format than the basic instruction code. A problem coded in a higher level aliguage has, however, still to be converted to this basic instruction code before it can be executed by the machine, and this function is performed by a system program-

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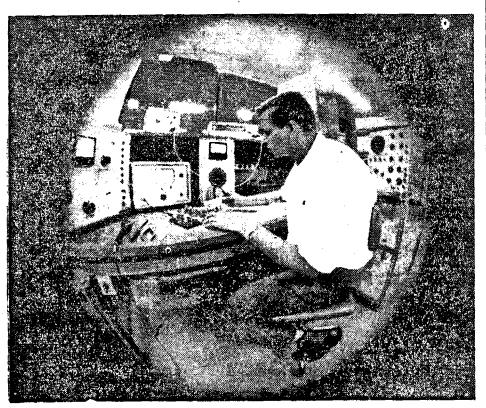
me called the compiler for that language. Thus, the computer is used not only for the actual solution of the problem but also for the translation of the problem from the higher-level language.

from the higher-level language. The higher level languages (such a EDITTIAN and ALGOL) are desirted to allow a general user to code his mathematical problems in a torm more natural to him thom mere numerical code. For example, algebraic equations can often be written down in standard algebraic notation and there are lostroctions such as PRINT and RFAD, etc. and the compiler in the computer will translate these instructions into the numerical code that the computer can execute. Thus, an engineer or a physicist can, within a tew days, learn to programme his problem without being too concerned with how the computer works.

The next step up from higher-level languages was the introduction of standard programme packages to perform repetitive operations suck as inventory control, the solution of particular type of differential equations, etc. These packages remove even the burden of programming from the user, and often all that is required is that the user specifies the particular characteristics of his problem

"MONITORS"

As computer systems grew larger and more complex, and as the number of peripheral devices (such as punched card readers, printers, magnetic tape units, etc.) increased, it became necessary to organise these devices so that they operated efficiently. This was a responsibility that could not be leaft to each individual user, so a supervisory system programme was allocated the duty of controlling their operation. Supervisors or Monitors, as these programmes are called, are complex programmes which attempt to optimise the use of the tacilities available in the computer system by allowing a number of activities to proceed concurrently. Thus, it became possible for the computer to be executing one programme while the cards for a second programme were being read on the card reader and while the output from a previously executed programme was being printed. In fact, in multiprogrammed computers, the supervisor arranges for several



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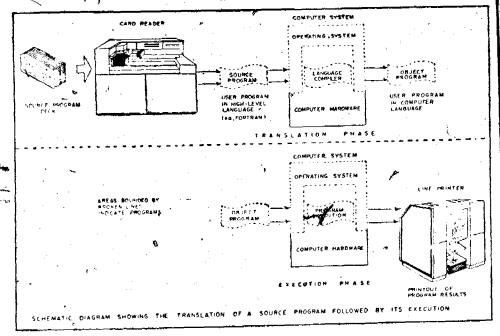
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becomes of numerically coded instructions that have now a a couracy but also fairly intimate a knowledge of the internal working knowledge of the internal working of the computer, making it a job for an expert. Programming the early computer was, therefore, a tedious job and it was evident that the use of computers would not spread until it was made easier for the average scientist, engineer or business man, to write program mes.

This situation was remedied around 19.6 by the introduction of higher-level' programming languages often desireed for the sofution of particular types or problems, but which allow the programmer to give instructions in a more easily understood format than the basic instruction code. A problem coded in a higher-level language has, however, still to be converted to this basic instruction code before it can be executed by the machine, and this function is performed by a system program. performed by a system program-



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The next step up from higher-level languages was the introduc-tion of standard programme pare-kages to perform repetitive opera-tions such as inventory control, the solution of particular type of differential equations, etc. These packages remove even the burden of programming from the user, and often all that is required is that the user specifies the parti-cular characteristics of his pro-blem

"MONITORS"

As computer systems grew larger and more complex and as the number of peripheral devices (such as punched card readers, printers, magnetic tape units, etc.) increased, it became necessary to organish these devices so that they operated efficiently. This was a responsibility that could not be left to each individual user, so a supervisory system programme was allocated the duty of controlling their operation. Supervisors or Monitors, as these programmes allocated the duty of controlling their operation. Supervisors or Monitors, as these programmes are called, are complex programmes which attempt to optimise the use of the facilities available in the computer system by allowing a number of activities to proceed concurrently. Thus, it became possible tor the computer to be executing one programme while the cards for a second programme were being read on the card reader and while the output from

gramme is, therefore, the sala-ries of the system designers and the coders.

Already, approximately 40 per cent of the cost of a computer system is spent on the software that is supplied by the manufacturer. As manufacturers begin to supply more software in the form of problem-oriented languages and special packages, and as the price of the hardware decreases with improved technology, that is spent on software will increase rapidly. approximately 40 per Already. crease rapidly.

But, more important, the types of applications and system programmes that users require are upidly diversifying and after a point, these programmes have to be developed by the users themselves. With the lower salary ievels of this country, there is the tremendously competitive possibility for system programmes and packages to be develop-

ed here and, possibly, eyen exported. This requires, primarily, the development of a large base of programming know-how so that specialised programme packages can be written. The drive for the local manufacture of computers has gained some momentum and it is imperative that a parallel, development of software capabilities be initiated. Software development unlike manufacture, is something that requires no foreign exchange and no imported know-how. Once manufacture, is something that requires no foreign exchange and no imported know-how. Once a certain capability in writing software is established, the prospects are virtually unlimited for the development of suphisticated programmes for national requirements and for the export market. One could, then, envisage a future where foreign computer manufacturers and other organisations would assign software contracts to Indian organisations to capitalise on the lower software costs here. costs here.



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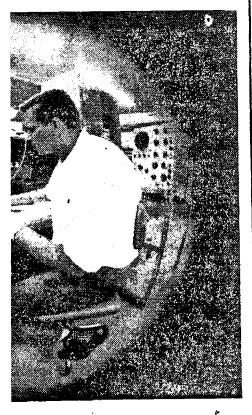
It is often forgotten that all programmes cost money and that system programmes cost a great deal of money. While the coding of programmes is a skilled job requiring some training, the design of how the problem is to be solved is the job of an expert. The system designer has to lake a number of considerations into account when making the specifications for the design of the programme; following this, a coder, can use well-understood techniques in writing the steps of the programme. One major component of the total cost of the programme.

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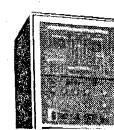
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'MACHINES



ot Studying Behaviour

By Dr. R. Narasimhan

(Brofessor, Computer Group, TatoInstitute of Fundamental Research, Bombay).

CAN computers replace hu-man beings? Science-fie-tion thrives on the assumption that they can and that, in fact, they will, very soon, Recently, they will, very soon, Recently, an extremely, popular movie had, as its central character, a computer that could not only think, but laugh, and ery, and fall in, love, and become jealous! Of course, what this proves is not necessarily that computers are human, but that our science-fiction—and movie with science-fiction and movie wri-ters cannot easily transcend their anthropocentric imaginations. Still, is there any substance in these fantasies? How does this myth about compu-human beings ters replacing arise?

COMPUTING ON NUMBERS

In order to probe deeper into the relationship between the behaviour of computers and that of human beings, we have to formulate our original question somewhat, differently, Instead of asking, can computers only compute on numbers? we should ask what does one mean by computing on numbers? What is the nature of this process that we recognise for refer to as computation on numbers? What is its structure? What are its various aspects? If we can satisfactorily answer these questions, then we can proceed to enquire whether other types of behaviour diaman behaviour, me particulars can be described in similar terms thousing, for example, or or other other tone example, or or other other other contents. terms: thousing, for example, or problem-solving or reading hand-writing, or generating speech; and, maybe even composing mu-sic, and constructing theories.

Assuming for a moment that e can, indeed, show that these existies of behaviour can be escribed in ways similar to our we can indeed, varieties of b we can, indeed, show that these-varieties of behaviour can be described in ways similar to our description of a computation process on numbers, we come to the central question, does at their follow—that machines can be constructed to exhibit these kinds of behaviour in much the same way as we know how to build machines to carry out a computation—process on numbers. same way as "we know how to build machines to carry out a computation process on numbers? It we can, in tact, build such machines, will they look exactly like our present-day computers (i.e., have the same structure, and tunction similarly? Or should their design be based on completely different principles? on completely ples?

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ples:
In 1936, almost a decade before the first digital computers became operational, the English logician, A.M. Turing, published a seminal paper in which he provided definitive answers to our first set of questions concerning the nature of computational processes. He analysed the structure of a computation in terms of the

behaviour of an extremely ele-mentary type of computer. These machines are now known as Tur-ing machines. Turing proved the remarkable result that there exist universal Turing machines that could imitate the behaviour of any other given Turing machine; and these universal Turing machines bave exactly the same ele-mentary structure. hines have exactly mentary structure.

mentary, structure,

At first sight, this result may seem somewhat paradoxical. For, intuitively, we tend to feel that universal, machines have to be more complicated, in some sense, than any specific machine that is not universal. The paradox, however, disappears once we understand the nature of a computation process, and the manner in which a universal Turing machine imitates any other given Turing machine.

A computation process (i.e. a

arise?

Usually, when we talk of computing we only have in mind such members and arithmetic. Somewhat more sophisticated computer users may include solving matrix equations, differential equations, and so on, as aspects the for computing. But, is this all last item read; write the sum in there is to computing? Can digitally computers computers and performing operations on numbers? It this were true, there cannot be much substance in the claim that computers can replace human beings do not deal with numbers at all except in trivial ways; for example, counting their laundry items, and so on.

COMPUTING ON NUMBERS

In order to probe deeper into the relationship between the behaviour of computers and that of human beings, we' have to for.

Turing machine.

A computation process (i.e., a sixt member of well-defined computation) consumpter can read the next item; write it in the next square on well-defined computation steps; write the next item; write it in the pear add this to the last read item in the star place of these star place of the last read item in a language. In our example, counting their haundry items, and so on.

COMPUTING ON NUMBERS

In order to probe deeper into the relationship between the behaviour of computers and that of human beings, we' have to for. of statements in a language

Turing's result can now be interprefed as follows. One can con-struct an extremely elementary language, in terms of whose statements all specific computations could be described. Thus, a univer-

to imitate any specific Turing machine, all we have to do is to write down the sequence of statements down the sequence of statements that defines this specific machine; a specific machine carries out a single, fixed, computation process. The universal machine can, then, icad these statements one by one, and carry out the intended operations. By so doing, it precisely imitales the first machine. This performance is something, analogous tates the first macrine. 1008 per-formance is something analogous to that of an actor trying to imi-tate another actor, by reading the portion of the script intended for the latter, and mimicking his ac-

STRUCTURAL COMPLEXITY

Our present-day computers enormously more complicated than Turing machines. But this completheoretical power. They are no acceptowers with the meaning to do with their theoretical power. They are no acceptowers. What their complexity buys us is the ease with which computational specifications can be written for these to do with their computational specifications can be written for them; (incidentally, this is the activity that is usually referred to as programming).

Abother way of looking at this complexity is as follows: It is extremely difficult for human beings to function in a language that does not have a certain minimal com-plexity. Hence, computers, to be a good match to human beings, must be built to understand languages of this minimal complexity. This automatically makes them complex structurally also,

Can computers imitate human beings? The answer is yes, pro-vided we know how to describe the human behaviour that is sought the human behaviour that is sought the numan benaviour that is sought to be imitated as a sequence of statements in some well-defined language; that is, in other words, as a programme for a computer, (The catch is in the technical notion: 'well-defined language.') (The catch is in the technical notion: well-defined language.) What is a well-defined language? We know one class of well-defined well-defined than the same of th languages, namely, computer languages. Are there other classes of well-defined languages?)

Do we know, at present, how to Do we know, at present, now to specify such programmes for any interesting set of behaviours? The answer is "yes-and-no"; more 'no', than 'yes', unfortunately. However,

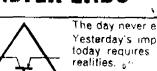
of 'artificial intelligence studies, has been slowly picking up momentum. Programmes that enable a computer to play board-games (like chess, checkers, go), solve word problems as found in high school science and mathematics text-books, read handprinted letters and numerals, scan and analyse pictures of a restricted variety, and so on, have been more or less successfully debeen more or less successfully designed. During the last few years, everal groups in the U.S. have been experimenting with artificial hands driven by computers provided with a TV camera to serve as an eye. Tasks such as picking up toy cubes and building towers with them have been successfully at them have been successfully at-tempted. Speech generation and bave analysis, using computers, been demonstrated.

Needless to say, only the most radimentary aspects of behaviour in any modality have so far been tackled. We still have a long way to go before computers can function like a human stenographer, and convert a dictated letter into a typescript; or, like a human draughtsman, and convert a rudimentary sketch with marginal comments into an engineering drawing.

Our primary motivation for wanting computers to imitate these tasks is, of course, not to get them to replace human beings. Ultimately, our concern is to study behaiviour and inderstand it. Imitation is one efficient method of studying behaviour. In fact, it is not clear that, where cognitive behaviour is concerned, any method, other than successful imitation, is available as a viable methodology.

In spite of the spectacular pro-of gress of science in the last 200 years, very little is known about the functioning of the human brain. We do not even have an adequate language in which we can discuss its behaviour. The sterile philosophic problems associated with the mind-brain dichotomy merely testify that we have yet to learn to discuss 'describe' cognitive behaviour in other than reasonable hope that computers and behavioural studies that use computers as effective tools may teach us how to do this.

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SEMICONDUCTORS

Imitation as A Method of Studying Behaviour

(Professor, Computer Group, TataInstitute of Fundamental Research, Bombay).

computers replace human beings? Science-fic-tion thrives on the assumption tion thrives on the assumption that they can and that, in fact, they will, very soon. Recently, an extremely popular movie had, as its central character, a computer—that could not only think, but laugh, and ery, and fall in love, and become jealous! Of course, what this proves is not necessarily that computers are human, but that our science-fiction—and movie wriscience-fiction and movie wri-ters cannot easily transcend their anthropocentric imaginations. Still, is there any sub-stance in these fantasies? How does this myth about compuhuman beings ters replacing

Usually, when we talk of computing, we only have in mind fixed specific, computation consumbers and arithmetic. Somewhat more sophisticated computations well-defined computation steps: ers a. more sommay numbers and artumetic. Somewhat more sophisticated computer users may include solving matrix equations, differential equations, and so on, as aspects of computing. But, is this all there is to computing? Can digital computers compute only in this sense of dealing with numbers and performing operations on numbers? If this were true, there cannot be much substance in the claim that computers can replace human beings; for, a human being does very much more than merely deal with numbers. In fact, most human beings do not deal with numbers at all except in trivial ways; for example, counting their landry items, and so on.

COMPUTING ON NUMBERS

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In order to probe deeper into the relationship between the behaviour of computers and that of human beings, we have to hormulae our original question somewhat, differently, Instead of asking can computers only computer on numbers?, we should ask what does one mean by computing on numbers? What is the nature of this process that we recognise for reter to; as computation on numbers? What is, its structure? What are its various aspects? It we can satisfactorily answer these questions, from we can proceed to enquire whether other types of behaviour chiman behaviour, in particular the structure. thuman behaviour, in particular) sean be described in similar erms, thinking, for example, or roblem-solving or reading hand-filing, or generating speech; and maybe many convey for thuman problem-solving writing, or generating speech; and, maybe even composing mu-sic, and constructing theories.

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Assuming for a moment that we can, indeed, show that these varieties of behaviour can be described in ways similar to our the contral question, does it then follow that machines can be constructed to exhibit these kinds of behaviour in much the same way as we know how to build machines to carry out a computation process on numbers? If we can, in fact, build such machines, will they look exactly like our present day computers (i.e., have the same structure, and function similarly)? Or should their design he based on completely different principles?

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At first sight, this result may seem somewhat paradoxical. For intuitively, we tend to feel that universal machines have to be more complicated, in some sense, than any specific machine that is not universal. The paradox, however, disappears once we understand the nature of a computation process, and the mauner in which a universal Turing machine imitates any other given Turing machine. At first sight, this result may Turing machine.

sists in performing a sequence of well-defined computation steps; for example, read the next item; write it in the next square on the storage tape; add this to the last item read; write the sum in the place of the last read tiem on the tape; and so on. Let us call each of these steps an instruction. A computation process consists in executing a sequence of these instructions. Each instruction is, in fact, a statement in a language. In our example. nstruction.

in fact, a statement age. In our example, have the language. in a language. In our example, all these statements have the form of a command; do take we form of a command; do this, do that, etc. In special cases, we could have statements which are of the nature of descriptions (e.g., the last read item is a number), or of the nature of questions (e.g., was the last read item a number?) Thus, a computation process, eigen for described or In special cases, we statements which are descriptions a mimber?) Thus, a computation process is given (or described, or defined, or specified as a sequence of statements in a language.

Turing's result can now be inter-reted as follows. One can conpreted as follows. siruct an extremely elementary language, in terms of whose state-nents all specific computations ments all specim could be described Thus, a univer-

sal Turing machine need only know how to execute the operations defined by the statements of this language. For, then, to get it to imitate any specific Turing machine, all we have to do is to write down the sequence of statements. sal Turing machine only chine, all we have to do is to write down the sequence of statements that defines this specific machine; (a specific machine carries out a single fixed, computation process). The universal machine can, then icad these statements one by one, and carry out the intended energy. and carry out the intended opera-tions. By so doing, it precisely imi-tales the first machine. This pertates the first machine. This per-formance is something analogous to that of an actor trying to imi-tate another actor, by reading the portion of the script intended for the latter, and mimicking his ac-

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Another way of looking at this complexity is as follows: It is extremely difficult for human beings to function in a language that does not have a certain minimal complexity. Hence, computers, to be a good match to human beings, must good match to numan beings, must be built to understand languages of this minimal complexity. This automatically makes them complex structurally also.

Can computers imitate beings? The answer is human beings? The answer is 'yes vided we know how to de describe the human behaviour that is sought to be imitated as a sequence of statements in some well-defined language; that is, in other words, as a programme for a computer. The catch is in the technical notion: "well-defined language." What is a well-defined language? We know one class of well-defined. the human behaviour that is sought what is a web-nearing language; We know one class of well-defined languages namely, computer langu-ages. Are there other classes—of well-defined languages?)

Do we know, at present, how to specify such programmes for any interesting set of behaviours? The answer is "yes-and-no"; more 'no'. answer is "yes-and-no"; more 'no', than 'yes', unfortunately. However,

in the last ten years, in the com-puter sciences, research in this area, which goes under the name of artificial intelligence studies. has been slowly picking up momen-tum Programmes that enable a computer to play board-games (like chess, checkers, go), solve word problems as found in high school science and mathematics text-books, read handprinted letters and numeread handprinted letters and numerals, scan and analyse pictures of a restricted variety, and so on, have been more or less successfully designed. During the last few years, several groups in the U.S. have been experimenting with artificial hands driven by computers provided with a TV camera to serve as an eye. Tasks such as picking up toy cubes and building towers them have been successfully at-tempted. Speech generation and have analysis, using computers, been demonstrated.

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innecessarily, and there is also the danger of stock-outs of other forgings which are made on the

same press.

If the production run is too short, then a considerable amount

sary to have appropriate tooling ready at the right time. The Tool koom in the Auto Division makes dies, jigs, fixtures, etc. From the dies, jigs, fixtures, etc. Each job or work order is of a different type. Same of these work orders

Emergence of a New Discipline

By V. Rajaraman

(Professor of Electrical Engineering and Head, Computer Centre, Local Estitute of Technology, Estimates

DEVELOPMENTS in computer D technology during the last two decades have demonstrated that it is a misconception to think that computers are useful only in complex and engineering calculations. Computers have become invaluable tools in diverse areas like economic planning and medical diagnosis. The technical and sociological implications of and sociological implications of the widespread use of computers have not yet been fully under-stood, but it is certain that their impact will be more significant and will occur over a much snorter period as compared to the first industrial revolution.

It is, thus, important to look at to its thus, important to low at the growth of an entirely new dis-cipline called computer science and understand how computers have affected the exists a methods or formulation and solution of

With the advent of highly com With the advent of highly complex software packages, two important areas of study in computer science have developed. The first area, with immediate practical application, is that of systems programming or software engineering. This subject deals with the design of programming language. mg This subject deals with the design of programming language translators and operating system. Important problems like the optimisation of the translation procedure and the mechanisation of translator writing systems are discussed in this subject and, thus, this area of study is vital for professional computer programmers and scientists. Inasmuch as a major portion of the work of a modern computer is the translation of user-oriented. Imaginger it of user-oriented languages it i important for the computer de-signer also to be familiar with this

COMPUTATIONAL LINGUISTICS

A parallel development in computer science of fundamental theoretical interest, is the theory of programming. Tanguages, "Albamain topics in this area of study are the formulation of the syntactic and semantic description of programming languages. A number of concepts from linguistic theory tof natural or spoken languages are borrowed and refined to suit the description of programming languages and, thus, this area of study is also known as compute, tonal linguistics. study is also kr-tional linguistics.

tonal linguistics.

Even though programming languages have been in trumental in catapulting computers to their present eminers, por fine institution, computer selection engineers was mitiated by computer designers who were primarily electrical or electronic engineers. We will now consider the areas of study which arose during this phase of the development of computer technology.

Computer acquaint Systems de

verpoment or computer technology, computer were and systems design. The design of a computing system may be broadly divided into three areas. These are the feeting of the electronic circuits of a computer in The sectional of the local to be performed by a computing used and the realization of this logic by notivious allowed even of which copieters as elementary logical operations in The streammentum of the logic local transfer in the such as not dies and input notiput divides to reasie a comput divides. output devices to reame a compat

ry. This area of study deals with the abstract modelling of computing devices with a view to determining their fundamental limitations. Questions regarding the existence of algorithms, i.e., well-specified rules for solving certain types of problems on an idealised model of a computer, are answered. This area of study is important as it clarifies what kind of problems cannot be solved by computers.

The design of individual electronic circuits which make up a computer is not the real concern of a computer scientist. This area is 31 interest to electronic engineers, and with the advent of interestate so distance and systems design have become more important even for electronic designers. me designers.

Non-numerical computation Computers were originally conceived to operate on numbers and mainly perform numerical calculations. Thus, numerical analysis is one standard topic in Computer science. However, it was soon realised that computers could be meaningfully employed with non-numerical data i.puts, in fact, the translation of a user-oriented language to the machine language is stell a non-numerical computation, as character strings, correponding to the user language, on-stitute the data and the programme operates on this to produce the machine language. Non-numerical computation

The interest In non-numerical computation began with attempts at translating one natural language like English to another like Russian. This problem is quite difficult due to the ambiguous nature of spoken languages and the sensitiveness of the meaning of the words to their context and is, as yet, not satisfactorily solved. It, however, gave rise to interest in natural language input to computers for problems in information retrieval and for general problem-solving.

RECORNITION OF The interest in non-numerical

RECOGNITION OF PATTERNS

Another group of researchers started working on computer programme to play games. The idea was to investigate if some 'incelligence' could be endowed to high the control of the control o ramme to play gards and area in a play as to investigate if some intelligence, could be endowed to computer programmes. Another related area of interest is pattern recognition. This subject includes diverse recognition problems such as recognising hand-written characters, recognition of landmarks from aerial pictures recognition of bacterial colonies in medical dides recognition of finger prints, etc. Special programming languages for expressing patterns and tatistical techniques for recognising them are in their developmental stage. This is tast becoming an important area in computer science.

Applications of computer schen-ces. Aim ist all areas have galaced by the advent of computer schene-frie man impact in oughteering design and scientific research has been the teasibility of realistic formulation of problems. Before computers become widely availa-ble, a number of unnecessary as-sumptions were made to simplify solution to a problem as other solution to a problem as other vise the sheer enginety of calculations or the lack of mathematical tools would have made the

able computers.

able computers.

The consumer market in electronics to-day in India is mainly in the entertainment field. As such, in general, our manufacturers have not had much incentive to exercise superior quality control over electronic components. Professional grade equipment like computers and office sophisticated system in Defence; call for the use of very high grade components are at present imported. It is thus necessary for our industry to invest in the production of high grade components for these professional needs.

Peripherals take up a substantial

Peripherals take up a substantial part of the cost of a computer. The very nature of the peripheral equipment makes their pro-

know-how for their products. They should be in a position to take up some of these reasibility

Ferrite cores are likely to do-minate the field as memory ele-ments for several more years. The core fabrication technology has de-veloped to such an extent that very high-speed switching cores can be purchased to day at a cheap price in balk quantities. The Na-tonal Physical Laboratory, New Delhi, has been trying to develop computer grade ferrites for seve-ral years, it the NPL makes avail-pites cores that contorm to the requisite standards they could be fabri, at d into memory plames and movints. This is a highly la-bour intensive activity with low

India's Future and the Computer



the growth of an entirely new orcipline called computer science and understand hose computers have affected the existic method of formulation and solution of science

problems.

With the advent of highly complex software packages, two important areas of study in computer science have developed. The first area, with immediate practical application, is that of systems programming or software engineering this subject deals with the description of the programming language translators and operating system-Important problems like the optimisation of the translation process. Important problems like the opti-misation of the translation proce-dure and the mechanisation of translator writing systems are dis-cussed in this subject and, thus, this area of study is vital for pro-fessional computer programmers and scientists. Inasmuch as a major portion of the work of a modern computer is the translation of user-oriented languages it important for the, computer de-signer also to be familiar with this subject.

COMPUTATIONAL LINGUISTICS

A parallel development in com-A parallel development in computer science of fundamental theoretical interest, is the theory of programming languages. The main topics in this area of study are the formulation of the syndae in and semantic description of programming languages. A number of concepts from linguistic theory tot natural or spoken languages are borrowed and refined to suit the description of programming languages and, thus, this area to study is also known as compute, noisal linguistics.

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Computer nozer and systems de Computer now and systems design. The crision of a computing
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this such as there exists and input corput decreases to transport computers. Systems the head of such as the pattern one start with the broad requirement to be not be accompaning by the design as system of teteromic term darks such as the reference to the units such a little processor of the control of t

The desire of a computing sys ios, cai sas, i con proper a sasseres sections of ensure and interescential of computing and to meet the re-computing and particular user proof the more criteria are obtained to compute a wind, could be presented in a given time the optimal utilisated of subsystems. In this lines for a particular first to get by week done. The variety of per the action of the collectively times seed in a the system tellaboration.

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BOOKEAN ALGEBRA

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more important even for electro-me designers.

Non-numerical Non-numerical computation Computers were originally con-celved to operate on numbers and mainly perform numerical calcu-lations. Thus, numerical analysis is one standard topic in Computer Science. However, it was soon reaseignee. However, it was soon feel lised that computers could be meaningfully employed with non-numerical data inputs. In fact, the translation of a user-oriented language to the machine language. stage to the maximum transformation to the transformation as character strings, corresponding to the user language constitute the data and the programme operates on this to programme operates on this to produce the machine language.

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Applications of computer seten ces. Almost all areas have gained by the advent of computer science by the advent of computer science. The main impact to engineering design and scientific research has been the teasibility of realistic formulation of problems. Before computers became widely available, a number of unnecessary assumptions were made to simplify actions to a nearblem as other. solution to a problem as other-wise the sheer engrially of calcu-lations or the lack of mathematir. I took woold in problem intractable give made the

The greatest contribution of computers is the behavioural set the mass been the greatloss of quantitative recuniques into the contribution of the quantizative reconseques into the careas. As hehavioural systems are complex no libear systems which are gaste steel only statistically neering file formal mathematical methods have not been successfully applied The advent of competer? I however has made the smulation of systems feasible and experimental in on the simulation models has proved very useful for the problems. Another important contribution of the problems. m dek has proved very useful for a ring an insight ato the pro-blem. Another important contri-bation of computers in social set-once recearch is the case of pro-cessing data obtained from sur-veys by using these machines and the peactical teachints of using statifical techniques in the ana-pair of such data.

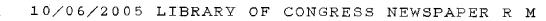
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India is forging the tools today. And training people to make and use them for solving problems of national development. Speeding up progress is IBM.

From 1966, at its Bombay plant, IBM has be making India's first computers- the IBM 14 And for over a decade, a comprehensive range of Unit Record machines and ancilla

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the growth of an entirely new discipling called computer science and understand how computers have affected the existing methods of formulation and solution of problems.

of formulation and solution of problems.

With the advent of highly complex software packages, two important areas of study in computer science have developed. The first area, with immediate practical application, is that of systems programming or software engineering. This subject deals with the design of programming language translators and operating systems, importing problems like the optimisation of the translation procedure and the mechanisation of translator writing systems are discussed in this subject and thus, this area of study is vital for professional computer programmers and scientists. Inasmuch as a major portion of the work of a modern computer is the translation of user-oriented languages. It important for the computer designer also to be familiar with this subject. subject.

COMPUTATIONAL LINGUISTICS

A parallel development in com-oter science, of fundamental A parallel development in computer science, of fundamental theoretical interest, is the theory of programming languages. The main topics in this area of study are the formulation of the syntactic and semantic description of programming languages. A number of concepts from linguistic theory tof natural or spoken languages are borrowed and refined to suit the description of programming languages and thus, this area of study is also known as computational linguistics.

Even though programming lan-Even though programming languages have been instrumental in catapulting computers to their present eminent position, historically computer science development was initiated by computer designers who were primarily electrical or electronic engineers. We will now consider the areas of study which arose during this phase of the development of computer technology.

veipoment of computer technology. Computer ione and systems design. The design of a computing system may be broadly divided into three areas. These are the frequents of a computer in The design of the locationic critication of the location to be performed by a computing unit and the realitation, of this logic by individual broads each of which can be return to the location. The interconnection of the location is the location and input the location are remarked and input to the system.

In the actual design of a com-puter one start with the broad requirements to be mad by accom-puting system designs a system of friterentiaecter units such as the eror, manufication of a ne-memory card reader print er etc. The ign requirements of individual and there hered are personal the dark a Fige of skall rocking these and Finally the crown de-signer designs the individual

The design of a computing sys The design of a computing system is concerned with the proper thories and interroclitetion of computing units to meet the resign ranging of a particular user proup. The man criteria are the amount of computing which could be performed a given time the optimal utilisation of subsystems, the time taken for a particular user to get the work done the street of per transmiss that can be effectively progressed using the system rehability.

BOOLEAN ALGEBRA

The logical design of computing units is based or Boolean algebra which was developed by George Boole in 1854. The use of this algebra in the design of electrical switching criticals was recognised by C.T. Shaham in 1938. Those concepts have been extended to the design of computing circuits and have evolved as switching circuit shours. is based on Boolean at obta

devélopment . A later development on the ather d theoretical side is automata theo- decade,

more important even for electro-nic designers.

Non-numerical computation: Computers were originally confeeled to operate on numbers and mainly perform numerical calculations. Thus, numerical analysis one standard topic in Computer Science. However, it was soon realised that computers could be meaningfully employed with non-numerical data inputs. In fact, the translation of a user-oriented language to the machine language is itself a non-numerical computation, as character strings, corresponding to the user language constitute the data and the programme operates on this to pro-Non-numerical gramme operates on this to pro-ouce the machine language.

The interest in non-numerical computation began with attempts at translating one natural language (like English) to another rike Russlan). This problem is suite difficult due to the ambiguous nature of spoken languages and the sensitiveness of the meaning of the words to their context, and is, as yet, not satisfactorily ing of the words to their consists and is, as yet, not satisfactorily solved. It, however, gave rise to interest in natural language input to computers for problems in information retrieval and for generalized processing the consistency of t ral problem-solving

RECOGNITION OF PATTERNS

Another group of researchers started working on computer programme to play games. The idea was to investigate if some 'inceligence' could be endowed to gramme to play games in the was to investigate if some incelligence, could be endowed to computer programmes. Another related area of interest is pattern recognition. This subject includes diverse recognition problems such as recognition problems such as recognition of landmarks; from aerial pictures, recognition of bacterial colonies in medical slides, recognition of finger prints, etc. Special programming languages for expressing patterns and statistical techniques for recognising them are in their developmental stage. This is tast becoming an important area in computer science.

Applications of computer sciences. Almost all areas have gained by the advent of computer science. ny the advent of computer science. The main impact in engineering design and scientific research has been the feasibility of realistic formulation of problems. Before computers became widely available a number of transparence. ble, a number of unnecessary as-sumption, were made to simplify solution to a problem, as other-wise the sheer engrating of calcu-lations or the lack of mathematie. tools would has problem intractable. have made the

problem intractable.

The greatest contribution of computers in the behavioural set eners has been the injection of quantitative teeningues into the careas. As behavioural systems are complex non-linear systems when are quite often only statistically describable, formal mathematical methods have not been successibly applied. The advent of computer however, has made the simulation of systems feasible and simulation of systems feasible and experimentation on the simulation experimentation on the simulation models has proved very useful for friends an insight isto the problems. Another important contribution of computers in social science research is the case of processing data obtained from surveys by using these machines and the practical feasibility of using that tical techniques in the analysis of such data.

Finally a large number of spe Finally a large number of special purpose computers are used for the control of processes and various and their use is interested particularly because the root of computers is going down and superior performance become consider with no order conspice. Thus a good knowledge of computers has become escential of the designers of process and other control system. It can be safely said that same aspects of the few distipline of computer science would be going said and not every other discipline within the next within the next disophic



India is forging the tools today. And training people to make and use them for solving problems of national development. Speeding up progress is IBM.

From 1966, at its Bombay plant, IBM has be making India's first computers- the IBM 14 And for over a decade, a comprehensive range of Unit Record machines and ancilla

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set-ups, and are fairly complicated, requiring is not made several components to be made, subassembled, and then put together for final assembly. The problem is scheduling of each operation and in the proposed of the problem in such a set of the problem in such as the problem in such way that machine idle time is minimised and deadlines are kept. Without computers, this becomes very difficult as there may be thousands of work orders pending at any given time.

The problem is further complicated by the fact that some work orders have higher priorities than others. It is necessary to take this into account while scheduling. The computerised system for Shop Loading and Monitoring, (SLAM), developed in TELCO, ensures proper tool room scheduling.

Planning in other industries: Computers can also be used to solve the problems of production planning and scheduling in indus-

tries other than those making engineering products. For example. The Tata Iron and Steel Co. makes steel products such as flats, sections, and other rolled products, wheels, tyres, etc. In order to make these products, TISCO has its own/ collieries and mines, blast furnaces, steel melting shops and rolling mills.

and rolling mills.

Iron is made by feeding blast furnaces with a mixture of lime stone, iron ore coke fee. The molten iron is sent to steel melting shops where it is converted into the requisite quality of steel depending upon the ultimate product which has to be rolled. Steel is next poured into ingots and sent to various relling and finished mills where the finished product is rolled out in the shapes and sizes ordered by customers and despatched.

PRODUCTION AND SALES

PRODUCTION AND SALES CONSTRAINTS

Thus, the production planning problem is to determine the best rolling programme for the mills such that output is maximised. In order to do this, the following constraints have to be taken into consideration:

(a) Production constraints, such as the rolling rates of each type

of product, the rolling and anctiliary facility capacities, the minimum and maximum restrictions on the tonnage that can be rolled at a given time, etc.

places, the hot metal starts coofing and solldifying, and may have to be scrapped. Also, extra cure and maintain at a given time, etc.

(b) Sales constraints, such as customer requirements, priorities and commitments, and modifica-tions.

However, it will be unrealistic to determine a rolling programme without taking into account steel without taking into account steel making restrictions. Thus, the problem is one of not only determining rolling programmes but also giving related schedules for steel making, taking into account production restrictions at the steel melting shops. Further, the actual steel production may occasionally differ from what was ordered for and, thus, decisions have to be made for allocating steel for mills.

Simulation studies: Computers are also used to conduct simulation studies. Consider, for example, the problem of determining the optimum number of ladles to carry hot metal from blast furnaces to the steel melting shops. Basically, if there are too few ladles, then blast furnaces have to walt. Thus, production of from suffers. If there are too many ladles, queues build up at various

Computers were used to simulate actual working conditions for several months. Each simulation experiment was conducted tion experiment

P**ro**gramme

JANUARY 8, 1970:

10-00 hrs: Inauguration-By 10-00 hrs: Inauguration—By Dr. B. D. Nag Chaudhuri; 11-45 to 12-30: "Computer Education"—Prof. V. Rajaraman, IIT, Kanpur: 14-00 to 15-30: 1 Operating Systems and Compilers; 15-45 to 16-30: "Software" — Dr. Mathai Joseph, TIFR, Bombay.

JANUARY 9, 1970:

9.00 to 9.45: "Hardware" — Dr. S. Srikantan, ECIL, Hyderabad; 9.45 to 11-15: 2a Switching Logic: 2b. Applications General; 11-30 to 13-00: 3a. Operations Research; 3b. Electrical Engineering 1; 3c. Numerical Techniques 1; 14-30 to 16-00: 4a. Electrical Engineering 2: 4b. Numerical Techniques 1; 14-30 to 16-00: 4a. Electrical Engineering 2: 4b. Numerical Techniques 1. Numerical Techniques 1; 14-30 to 16-00: 4a. Electrical Engineering 2; 4b. Numerical Teputer Education"; Moderator: Prof. K. S. Hegde, Principal, Engineering College, Guindy: 18-00 to 19-00: Popular Lecture on Computers — Prof. R. Narasimhan, TIFR, Bombay bay.

JANUARY 10., 1970:

9-00 to 10-30; 5. Management.

using a different number of lad-les. Thus, the optimum number of ladles, which can minimise the total cost, could be determined.

Optimum production planning and scheduling involves the use of complex mathematical and statistical techniques such as linear programming, regression analysis, economic batch analysis, queueing theory and simulation. Computers are needed to carry out these extensive calculations.

out these extensive calculations.

It must also be stressed that the values of variables, such as stock position, production and rejection rates, efficiencies, requirements, etc., keep changling, often on a daily basis. Unless there is a comprehensive and up-to-date information system, the use of sophisticated operational research techniques is severely hampered. Therefore, the computer's data processing ability is also essential.

Computer Design

Continued from Page 1

croelectronic devices. The integracroelectronic devices. The integrated circuits area should interest the existing semi-conductor magnutacturers and new entrepreneurs. As reasonable-sized computer programme in the country, along with various other uses of integrated circuits in the existing and new equipment, should make the manufacture of integrated circuits economically viable, Integration of circuits would make requirements of other passive components much less in computer applications, and result in more reliable computers.

The consumer market in electronics to-day in India is mainly in the éntertainment field. As such, in general, our manufacturers have not had much incentive to exercise superior quality control over electronic comments. Professional cise superior quality control over electronic components. Professional grade equipment like computers and other sophisticated system in Defence; call for the use of very high grade components. Most of these components are at present imported it is thus necessary for our industry to invest in the production of high grade components for these professional needs.

Peripherals take up a substantial part of the cost of a computer. The very nature of the peripheral equipment makes their pro-

duction capital intensive. Producing these locally may not be an economical proposition at present. However, it should be possible to award long-term and short-term development contracts to work out the production feasibility of at feast some items of peripherals. These could be undertaken by a public sector unit or a national laboratory. One could make a beginning with console typewriters, paper tape equipment and some other sciented items. The Hindustan Teleprinters, Madras, who make the teleprinters for P, and T, applications, are known to have made some development efforts themselves apart from buying the duction capital intensive. Producing made some development energy themselves apart from buying the know-how for their products. They should be in a position to take up some of these feasibility

Ferrite cores are likely to dominate the field as memory elements for several more years. The core fabrication technology has developed to such an extent that very high-speed switching cores can be purchased to-day at a cheap price in bulk quantities. The National Physical Laboratory, New Defhi, has genericying to develop computer grad ferrites for several years If the NPL makes availables cored that conform to the requisite standards, they could be fabricated into memory planes and modules. This is a highly labour intensive activity with low

overheads and hence is exceptionally well suited for a country like India.

The nature of a computer system is such that it is impossible to manufacture all parts of it indigenously. Even the world's giant computer industries have to depend on other specialised industries for the manufacture of subsystems, peripherals and componsystems, peripherals and components. Thus, our policy must be to concentrate on specialising in sysconcentrate on specialising in sys-tems engineering indigenously. This must be done using our own engineers and scientists so as to exploit, to the maximum extent, locally manufactured components and subsystems. Only subsystems not locally available-should be im-ported. Here again all interface electronics should be indigenously carried out. carried out.

Such an effort would provide tellectually challenging tasks to the highly qualified engineers and scientists coming out of Insti-totes of Technology and universitotes of Technology and universities Indigenously undertaken systems engineering would also provide an expanding market to our own local industries A concerted and properly guided effort at the governmental, industrial and institutional levels, should, within a governmenta, industrial main futional levels, should, within a period of about 5 years, enable us to build a viable technological framework in India to meet much of our computer requirements.

India's Future and the Computer



Computer Societ Fifth Annual Meeting in Madr

For Greater Flow of Information

By Lt. Col. A. Balasubramanian President, Computer Society

DIGITAL computers U their appearance around 1956, a dec in India around 1956, a decade after their appearance in the U.S. with the installation of the HEC 2M, at the Indian Statistical Indian Statistics. e India.
Calcutta III. cal Institute. growth in the number of sys-tems was initially rather slow. However, since 1962 the num bers have increased rapidly and to-day there are over 120 installations in the country.

installations in the country.

It was at the initiative of Prof Harry D. Huskey, a well-known name in the field of computers, who was in India as a Visiting Professor at the HT. Kanpur, that an organisational meeting of computer users was called at the IBM Education. Centre in Delia on June 6, 1964. This was attended by In persons from various institutions and the Ali-in dia Computer Users Group (AICUG) was formed. The primary aims of the Group were to organise develop and support computational activities and improve the efficiency of computational processes in the country.

The AICIG met for the first time at the TIFI in Bombay in October 1984 At its second meeting at kampur in December. 1964 it was generally left that there was a still seed for a professional body winch would have broader objectives than functioning merely as a Users' Group. The AICIG was therefore tenered into the Computer Society of India (CSI) in December. 1964 with the former's objective than a quarterly fixed.

(3) To exchange the benefit of the experience go field of computer and internal the tion procession.

(4) To take active steps in equicating people in the find of remputers

how and applications.

(5) To create a brotherhood amongst the personnel engaged in such pursuits.

The CSI has rapidly grown in strength and also in its activities. At present, it has 70 fination tional members and 273 individual members. The major computerinstallations, manufacturers, or sign groups and other insers represented on the Society war. The amongst the personnel engaged computers and it capabilities in such pursuits.

The CSI has rapidly grown in the strength and also in its activities. At present, it has 70 institutional members and 273 individual members and even involved directly have been involved directly installations, manufacturers—design groups and other users—design groups and

ing of computers.

ing of computers.

The Society currently relies for the furtherance of its aims on the medium of meetings, that enable communication through personal contact. These meetings which are held on "Finesthly basis at the Chapters culminate in an annual three-day conference, Judging by the active participation and contributions at these conferences which have been held at Bombay Calcutta, Hyderabad Kanpur and Trivandrum over conferences which have been held at Bombay Calcutta, Hyderabad Kanpur and Trivandrum over the previous years, and the interest evinced in this year's meeting at the College of Engineering Guindy, in Madras on January 8, 9 and 10, 1970, the Society can look back with a sense of achievement on its growth during these termative years.

The CSI publishes a quarterly NewsLetter. These NewsLetters, apart from providing information on the activaties of the various Chapters and on the trends in the computer field in the computer, contain articles of a technical nature dealing with application areas, programme development and so on. The NewsLetter it is to be haped, would soon evolve auto a quarterly journal.

compared to the efficiency of the exportational part of the electromation for the confidence of the exportational part of the electromation part of the exportation part of the exportat ours we can 15) To spread compiler know development and how and applications.

(b) To create a brotherhood to be application to be a brotherhood to be a broth

Chapters at Bombay. Calcutta, tion and implementation of suita-Jamshedpur, thyderahad and ble systems, the conditions to day Ahmedahad More Chapters are are altered. The expertise his sys-computer activity such as Delhi and Bangalore. The chapters to such a suitable to the manufacturers, have been organising monthly competently by and large. The meetings and seminars and gene raily fostering the understand-ing of computers. competently by and large. The Computer Society could also further contribute directly in helping the users in this regard.

As early as in December, 1965, the Computer Society of Indiabad advocated the setting up of tegional computation centres to maximise the return on our investment in computers on a national basis. This concept, which is generally inding acceptance now, will call for considerable co-ordination and organisational effort in place

USER LIAISON

Manufacturing programmes that are currently in vogue in the country would need restructuring based on user experience and population. The Computer Society of India should bring about the necessary user based, and provide feedback into the manufacturing area for improvement in systems hardware and software.

in the field of education there has been much confusion caused lately by the proliferation of organisations traching programs are not exactly and some caused with the confusion caused with the confusion traching and return paid for fill here are cased in which applicably are misled with prospects of employment with our figure salaries at the end of a 3-month course this only as insignificant proportion of the case of the c

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ne to be qualit up in a control primarily from requirements.

BEOAD-BASED APPROACH ESSENTIAL

The adage "special sation leads to trivially" is true in computer sciences, in spile of the rapid expansion of information growth in the various disciplines. Interrelation between these various disciplines.

plines has made a broad-based approach very necessary. The Complines has made a broad-based approach very necessary. The Computer Society should create an atmosphere wherein all disciplines that form part of the computer sciences are brought together, to form a professional activity which may be termed Computer Engineering. Based on the broad debuiltion of Engineering as the application of science to increasing prosperity of mankind, such an acticity would include fields such as medicine psychology, sociology economics, education and management. education and management.

education and management.

The Society should therefore, strive to create this broad-based understanding and also establish high professional standards. From the strong standards are not precisely definable but there is no doubt that we should endeacour to build up ethics, professional behaviour and social responsibilities amongst the members in order to establish the CSI at the accepted professional body in the computer field in the country.

There is doubt that computing and information processing activities have attained sufficient maturity in India. The Society should enlarge its activities towards the achievement of its objectives purposefuly. Our obligaiectives purpose(ui). Our obliga-tions as specialists and competent professional personnel are very

clear.

The Computer Society of India acknowledges gratefully the cooperation of Interfficer and the advertisers in the production of this Supplement.

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Computer Centr Guindy Eng. Co

By Prof. K. 5. Hegde Pincipal College of Engineers

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to 1965, the College has been been esta offered courses in programming. Coach Fauntered matters and computes from the coach fauntered matters and computes from the coach fauntered and teachers at appropriate. The College has been the present control for three savanced Samuer Schools on computer programme and numerical analysis caction of the coach faunter in a second control of the coach faunter in the second coach fau

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Computer Design And Development in India

By Dr. B. Nag

(Projessor of Electronics and Computer Science, Jadocpur University, Calcutta)

ACTIVITY in the area of electronic computer development started in India in 1954 at the Tata Institute of Fundamental Research (TIFR), where a pilot model general purpose computer was completed in 1956. Subsequently, a full-scale version was commissioned in 1960. This machine, named TIFRAC, was in operation till 1964 and many early computer users in the country bad their fart. ly computer users in the country had their first experience of automatic computing using TIF-RAC. The pioneering project TIFRAC helped to spread computer consciousness among the research scientists of TIFR as well as other institutions.

The TIFRAC project, carried out The TIFRAC project, carried out in the first generation computer era, used the electronic hardware readily available at that time, namely, vacuum tubes, semiconductor diodes and the ferrite core memory. The design of TIFRAC was in pace with the state of the art of the time. But the spectacuThe fifth annual general conference of the Computer Society of India is being held in Madras for three days from to-day at the College of Engineering, Guindy. Dr. B. D. Nag Chaudhuri, member, Plan-ning Commission, will inaugurate the conference. Mr. P. Sivalingam, Director of Technical Education Tamil Nadu, will be in the chair at the inaugural session.

(Programme on Page IV)

lar and rapid progress of the com-puter technology elsewhere made it an obsolescent first generation machine by the time it was com-pleted, along with all other ma-chines of the period.

The first-attempt in India to develop a general purpose second generation computer was undertaken jointly by the Indian Statistical Institute (ISI) and the Jadaypur University in Calcutta in 1963

The newly formed department of Electronics and Tele-Communication Engineering of Jadavpur University welcomed the idea of the Statistical Institute to take up a programme jointly to develop a small-to-medium sized computer. This project, while necessarily limited in scope because of considerations of cost, became operational in 1966 and was christened ISIJUlafter the names of the two institutions.

Both the TIFRAC and the ISI-JU-1 projects resulted in the grow-th of a hard-core of personnel in the country with professional th of a hard-core of personnel in the country with professional in the carbon professional the professional the professional the professional the professional technique programming and computer circuit design, as well as in solving research problems of moderate size. The limitations arise mostly from the limited memory size. A notable use of this computer, has been in a U.N. project of industrial planning in South-East Asia.

Both TIFRAC and ISIJUI were

ing problems primarily arising in connection with nuclear reactor designs. Subsequently, their pro-duction unit manufactured and sold analog computers to scienti-fic and teaching institutions. The Computer Group investigated the possible applications of real-time computers in the various agencies within the Department of Atomic Energy (DAE) and elsewhere mindia, and started a project in 1955 india, and started a project in 1959 to develop such a computer. It was planned that the DAE's newly formed public sector undertaking—The Electronics Corporation of India (ECIL)—at Hyderabad, would later manufacture and sell

Real-time computers, as distinguished from general purpose computers, are used to control the plant machinery of steel, petro-leum, chemical and other plants, nuclear reactors, etc. They are also used in air-traffic controls and saused in an entropy and communication. Such computers supervise the complex supervise the complex complex supervised and vital attoring an overall and after processing them, by sending back control signals to direct or guide the various equipment of the complex almost instantaneously.

these computers on a commercial

EDUCATIONAL PURPOSES

The BARC real-time computer (named TDC-12) became opera-tional in 1969, and the group has already moved to ECIL to taunch their production programme. The TDC-12 project has taken full advantage of focally available semi-conductor devices and other electronic components. No more than 25 per cent of the direct cost of Madras. The fast one is chiefly devoted to scientific research while the others are primarily concerned with management, production control and accounting. Madras has thus recorded an all-round development in computer applications.

The College of Engineering Guindy, deems it an honour to have this opportunity to host the fifth annual conference of the Computer Society of India. It is may firm belief that the deliberation.

The Computer Division of the Computer apart from their technical contribution, will serve to add considerably to the computer awareness, among the students and the various professional members in this region, ter in 1960 for handling engineer the country is ready for the group has aiready moved to ECIL to taunch their production professand the group has aiready moved to ECIL to taunch their production professions aiready moved to ECIL to taunch their production professance. The TDC-12 project has taken full advantage of focally available semi-conductor devices and other electronic components. No more than inconductor devices, suitable for miconductor devices, suitable for inconductor devices

nufacture of computers completely designed in India.

The Computer Group at the Tata Institute of Fundamental Research turned its attention to the design special purpose computers with of special purpose computers with indigenous electronic components after the installation there of a CDC 3000-160A system in 1964 to function as a national computational facility. To this effect, they also took up the problem of designing a real-time data processor, OLDAP (On-line Data Processor), which has some similarities to the TDC-12 in its design approaches.

Apart from the developmental enorts we have been discussing so far, there have also been some far, there have also been some specialised system and equipment development activities in India that fall in the category of computer techniques. The most significant of these are the message switching electronic exchange now under development at the Telecommunication Research Centre of the numeration Research Centre of the Post and Telegraph Department in New Delhi, and data-logging sys-tems developed at the National Aeronautical Laboratory, Banga lore. Detence, research laboratories may also be developing special purpose systems.

ELECTRONIC DESK : CALCULATOR

Special purpose computers for nuclear research, and multichannel analysers have been developed. New projects continue to be taken up in these areas at the Atomic Energy Department's research centres, as well as at one or two universities. Another equipment centres, as well as at one or two universities. Another equipment on which much attention is now focussed, the electronic action of the electronic actions will be followed by the development of indiget computers. The major problems that confront development projects in the area of computers in India at present, mainly arise from composition, mainly arise from composition.

sent, mainly arise from compo-nent and peripheral non-available. Hity. The types of basic shardware items arequired in computers cover a wide range, viz., semiconductor devices, discrete resistors, capaci-tors and pulse transformers, print-ed circuit boards, edge connectors, and cable connectors, to name some important ones. Integrated ome important ones. Integrated circuits and microelectronic packages were available in the West in the early 60's, and in substantial commercial quantities about 1965. The third generation computers were ushered in around that time built out of integrated and hybrid circuits.

It is unfortunate that the ECIL programme taking shape in the 70's has to be based on second generation technology because of the non-availability, locally, of mis-

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Computing facilities have since been established at the Integral Coach Factory, Southern Railway, IBM. Binny's and the Physics Department of the University of Madras. The fast one is chiefly devoted to scientific research while the others are primarily concerned with management, production control and accounting. :omputaing sturopriate een the dvanced ter proanalysis ce 1966. available



Computer Societ

Fifth Annual Meeting in Madr

For Greater Flow of Information

By Lt. Col. A. Balasubramanian

computers. their appearance in the a around 1956 a devade after their appearance in the LS with the installation of the HEC 2M at the Indian Statistic growth in the number of SSstems was initially tather sical However, since 1962 the numbers have increased tapid and to-day there are over 120 instaliations in the country

It was at the initiative of the Harry D. Huskey is well-known to the field of computers who was in Professor at the HT. Kanpur that an organisational meeting of computer users was catted at the IBM Education. Centre it Delhi on June 6, 1964. This was attended by 16 persons from various institutions and the Alleli dia Computer (Ser's Group (AICUG) was formed. The primary aims of the croup organise develop and computational settivities and improve the efficiency of computational professors in the country. it was at the indictive obligation arry. D. Huskey, a well-known

OBJECTIVES

The AICLG first for the first time at the TIPE in Bombay in October 1864. At its second meeting at Kanpur in December 1964, it was generally felt that there was a vital need for a processional body which would have broader objectives than functioning merely as a beer's Group. The AICLG was therefore to formed into the Computer Society of India (CSI) as becember 1864, with the following objectives.

supply the develop and supply the following the chiefersy of computational processes in India.

(2) To increase the flow of the formation for the benefit of all.

(3) To exchange the benefits the experience gamed in the aid of computer—and imormation processing

(4) To take active steps in cou-cating people in the field of com-

puters

(5) To spread computer know-bow and applications.

bow and applications.

(6) To create a brotherhood amongst the personnel engaged in such pursuits.

The CSI has rapidly grown in strength and also in its activities. At present, it has it institutional members and 275 individual members. The major computer installations, manufacturers design groups and other users are represented on the Society.

made Chapters at Bombay inotal after Anniedation More Communication and attention of the Computer activity su countie up at other certies of computer activity such as Bellin at Balizziore. The Chaptershave been organisms monthly monthly and sentiary toolers at sentiar and generally toolers at the configuration.

The Society currently reites for the needich of meetings that carlie communication. In rough paper at contact These needings of the hope of the needings of the first of the hope of a monthly basis of the chapters cuminate in a first and the hope of the and contributions at these conferences of the persons of the conference of the previous very and the first concepting at the College of English pages of English previous very services of English pages of English previous very services of English previous very services of English pages of English previous very services of the college of English previous very services of the college of English previous very services of the college of the co The Society currently reites for the previous years and the Pletest extreet in this years heeting at the College of Engineering Councils in Matras on January 5 8 and 10 1970 the Society can look back with a sense of achievement of its growth during these terrolive

The CSI publishes a quarterly Newschetter. These Newschetters, apart from providing information on the activities of the various Chapters and on the trends in the computer field in the country contain articles of a technical nature dealing with application areas, programme development and so on the Newschetter it is to be hoped, would soon evolve into a quarterly journal.

TREMENDOUS POTENTIALITIES

can court of technological endeadur in this era of intelectionics, forming part of the electronic age have contributed to circuits, forming partitioner age have contributed to the extension of human intellect by electronics. In a developing economy such as ours, we cannot avoid failing in line with the developed countries in adoption the fremendous patentiality. the developed continues in some ting the tremendous potentialities gained to these advances in solution out only to day problems. This adoption will naturally scales commercial defineds on our edua) to day problems. commercial denteds on our edu-cialization elements and development and maintesturing activaties in the country that next generation will have to de-velop a series of appreciation of computers and their capabilities in the same way as the present generation has all emerimen-rations, and so on.

trength and also in its active to the present, it has 70 institutional members and 275 isolividual members and 275 isolividual members. The inajor computer installations, manufacturers, "design groups and other users are represented on the Society have been involved directly in their tridividual engageties." In the improvement of the efficiency of computer processes and education. Buring the current year, the Dottellal users had to be entirely CSI has significantly enlarged its squared by the manufacturers reactivities by the formation of presentatives with regard to selec-

iomiss Calcutta from and implementation of sures.

Experiment and the systems the conditions to day one. Chapters are agreed. The expertise in systems there were trees of ten analysis is no longer the present of the manufacturers.

The Chapters (sers can handle these problems and the conditions of the manufacturers). Calcutta tion and implementation of suits teers can hangle these problems competently by and large. The temputer Society could also turnher contribute directly in helping the users in this regard.

As early as in December, 1863 the Computer Society of Tedia had advocated the setting up of regiotal computation centres maximise the return on our i vest matter computers on a matteral pass. This concept which is go end of the following acceptance from will call for considerable coordination of organisation in effort purbos.

Me uncluring pregrammes that are currectly in Vogue in the country would need restructure g based or user experience and potentialities for further areas of application. The Computer Society of Edia should bring about the necessary user hadson and provide reedback into the maintaining area for improvement in systems.

In the field of education, there In the field of education, there has been much confusion, caused lately by the proliferation of organizations teaching programming, systems analysis, etc. while one cannot have any valid offering to any organization important training and getting paid of there are cases in which applies that make maked with opposite the maked with opposite of each of the property are misled with prospects of em-ployment with four figure salaries of the end of 23-month course. It is of the end of 2-month course. It is only an insignificant proportion of those that get impleyed and that too perhaps only because they were intready associated with an organization which had installed a computer. The majority of the students who had hopefully diverted themselves for a career as program mers from other opportunities cell distillusioned.

disillusioned The time is not yet tipe in the country for "Freelance programming", Whilst the elements of programming can be learnt. Excusing such courses, training to systems analysis cannot be easier out treat through casual courses. Systems analysis is an area where experiese has to be built up in overs orders reading them within to match up with its particular requirements

BROAD-BASED APPROACH ESSENTIAL

The adage "specialisation inde-to friviality" is true in computer sciences, in spite of the rapid ex-pansion of information growth in the various disciplines, interrelathe various disciplines, interrela-tion between these various disci

nimes has made a broad-based appines has made a broad-based approach very necessary. The Computer Society should create an atmosphere wherein all disciplines that form part of the computer cretices are brought together. In form a professional activity which may be termed Computer Engineer. by Based of the broad definition of Based of the broad definition of Frighteening as the application of science to increasing prosperity markind such an activity would reduce fields such as medicine, sychology, sociology economics. perchology, sociology econ education and management.

The Society should, therefore, strike to create this broad based a derstanding and also establish non-professional standards. Professional standards are not precise in infinished but there is no doubt that we should endeavour to build most the professional behaviour. up ethics, professional behaviour and metal responsibilities amongst the members in order to establish the CSL as the accepted profes-sional body in the computer field the country

There is no doubt that computing and information processing and information processing authority in 1 dia. The Society fould enarge its activities to into the antisynerity of Our obligatives purposefully. Our obligations as specialists and compete the processional personnel are very fiest.

The Computer So lety of India accomplete gratefully the co-operation of The divisor and the appealance in the production of Supplement

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A crivity started in Tata Institu Research (model gene was comple quently, a commission chine, nan operation t ly compute had their tomatic c RAC. The consciousn ch scientis ether insti

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Computer Centr Guindy Eng. Co

By Prof. K. S. Hegde specific College of Engineers

puter center at the offege of Engineering, Guindy, with an IRM 1620 marked the beginning of full-see digital computer

Since 1965, the College has been ofering courses in programming, unerical authories and computa-tional methods to engineering stutrend methods to engineering stituents and teochers at appropriate levels. The College has been the phoneer centre for three advanced submer Schools on computer prosummer schools on computer pro-comming and immerical analysis of all finite level store than chapter time is also available of this College, as well as other constituted and research institu-

Torough such courses and ex-terior of facilities and by its an direct mach ement, the Col-tical has stimulated considerable amount of computer-ories search and development.

My way of an administrative ap-plication, the centre has developed a computer programme for

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Computer Design And Development in India

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ACTIVITY in the area of elec-tronic computer development started in India in 1954 at the Tata Institute of Fundamental Research (TIFR), where a pilot model general purpose computer was completed in 1956. Subsequently, a fuil-scale version was commissioned in 1960. This machine, named HFRAC, was in operation till 1964 and many early computer users in the country had their first experience of an tomatic computing using TH-RAC The pioneering project TI-FRAC helped to spread computer consciousness among the resear th scientists of TIFR as well as other institutions

The TIFRAC project carried out in the first generation computer era, used the electronic hardware readily available at that time, readily available at that time, namely vacuum tubes semiconduc ramely, vacuum tuber, semiconductor diodes and the territe core memory. The design of TIFKAC was in pace with the state of the art of the time. But the specialists The fifth annual general conference of the Computer Society of India is being held in Madras for three days from to-day at the College of Engineering Guindy, Dr. B. D. Nag Chaudhuri, member, Planning Commission, will inaugurate the conference. Mr. P. Sivalingam, Director of Technical Education Tamil Nadu, will be in the chair of the inaugural session.

(Programme on Page IV)

far and rapid progress of the computer technology executes of the vent and pitchled puter technology executes had constitued at an obsidescent first generalized designs, but machine by the time it was completed, along with all other his solid attalog times of the period.

The first attempt in India to de rate area attempt in motor to de retop a general purpose second ge-reration computer was undertaken positly by the ludian Statistical Little (iSI) and the Jadwiper University in Calcutta in 1963

The newly formed department of Electronics and Tele common cation Engineering of Jacopur University welcomed the Mea of the Statistical Institute to take up programme jointly to develop analto-medium sized computer Juns project, while necessarily it mitted in scope because of considerations of cost, became operational in 1986 and was christened (SM) I after the names of the Iwo first Intions.

Both the TIPRAC and the Isl-Both the HILLIAN and HILLIAND JULI projects resulted in the grow-in of a nard-core of personnel in the country with professional computer teranology. The of computer technology. The ISIIU-I has been used in teaching programming and computer circuit design, as well as insolving research problems of moderate size. The limitations arise riskly from the limited memory-line. A rotable use of this computer has been in a tan project of industrial planning in South-hast

Both TIFRAC and ISLECT were noin THEAA and impact were built using imported electronic components and peripheral units. The semiconductor industry was started in finite in the early 50's primarily to need the needs of the entertainment industry. It is unly in the last 2 years or so that se-miconductor devices, stitutible for high-speed reliable computer applantions, have become mailable

The Computer, Division of the Electronic Group of the Trombey Alonic Energy Establishment, now known as the Bisshon Alonic Escargh Centra (BARC), developed ter in 1960 for handling engineer-

ing problem, primarily assert to connection with nuclear reactor section. Sub-equebtly from production and manufactured and sold attalog computers to scienti-no and tecching institutions. The in and teconing institutions. The Computer Group givestigated. The possible applications on real-time computions of the gossium applications of reactime computers in the sagnotices within the Department of Atomic Frency (DAE) and elsewhere in India and started a project in 1935 to develop such a computer. It has planted that the DAE's saily remain inhibit sector, in direction. that the DAE - coly public sector undertaked cornact -the Electronics Corporation of frame cECM rat Hyderabad, would later manufacture and self 11.014 these computers on a commercial

lical-time computers, as distin-tioned from general purpose computers, are used to a real the phant machinery of steet feum chemical and other nuclear reactors, etc. They are used in zirtraffic controls and

tellite tracking and communities.
Such computers supervise the computers supervise the computer by acquiring all cital data of operations in progress and data of operations in progress and data of operations in progress and after processing them, by sending back control signals to direct or guide the various equipment of the complex almost instantaneously.

The BARC resisting computer named TDC-12; became thened in 1969, and the group has already moved to ECIL to faunch their production programme. The 1DU-12 project has taken ioll advantage of locally available semi-conductor flevices and other electronic components. No more than 25 per cent of the direct cost of romponents and peripherals in producing these computers would bit in toreign exchange. The TDC-122 computer, apart from angesting the need in India tor read-time systhe need in India for read-time sys-terms would also be useful. The cording to the designers, for edu-cational and training purposes. The production programme of compu-ters at ECM marks an important stage in Indian industry, as nos-the country is ready for the ma-

numeture of computers completely nesitted in lindle.

The computer Group at the Tata institute of kundomental Kesearch turned its attention to the design of special purpose computers with Ladgebous electronic components after the installation there of CIR 3000 100A system in 1964 to function as a national computa-tional facility. To this effect, they also took up the problem of dearea took up the problem of the seming a real time data processor. OilhAP On line Data Processor, which has some similarities to the TLEC12 in its design appro-

Aport from the developmental entires we have been discussing so far liners have also been some operatived system and equipment activities in India that fall he the category of computer techniques. The most significant of these are the message switching electronic exchange now under development at the Telecommunication Research Centre of the Aport from the developmental munication Research Centre of the rest and relegraph bepartment in New Beint and data-logging sy-tems developed at the National Aeronautical Laboratory Banga fore. Derence, research inhoratories may also be developing special perpose systems.

FLECTRONIC DESK CALCELATOR

Special purpose computers for miciear research and multichannel diddyers have been developed New projects continue to be taken up in these areas at the Atomic backge. Department's Tresearch baers. Department s Tesearch centres, as well as at one or two Another aniversities. equipment

culture. It may be expected that this will be followed by the development of inidget computers. The properties that confront of specific in the area of sempeters in india at present the properties in india at present the peripheral non-availability. The types of basic hardware items required in computers cover a wide respective, semiconductor a wide range vir. semiconductor devices, discrete resistors, capacitors and pulse transformers, printed circuit boards, edge connector-and cable connectors to name some important one integrated Integrated ome important one integrated circuits and increase terrois packages were avoitable in the West in the earth 60% and in quantities, about 1965. The third generation computers were ushered in ground that time fulfill out of integrated and hybrid circuits.

H is unfortunated programme, laking such in one for the programme, laking such in one for the house of the non-availability, locally, of mi-

Continued on Page IV

er Centre at Eng. College

By Prof. K. S. Hegde

College of Englishers, Garagey

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conducted by the family and of Technical Educathan This programme has been it operation for the past few past few

Computing tachities have since Computing facilities have since been established at the Integral Coach Factory. Southern Raflavay, IBM, Binny's and the Physics Department of the University of States. The fact one is ensemble accorded to schemillar research, while the others are primarily concerned with management, proposed and communities. custom control and accounting.

hadre the thus recorded an all-round development in compater applications.

The College of Engineering Culady, deeps it as honour to have this apportunity to host the Lave this apportunity to host the fifth annual conference of the framework of the framework of the first that the deliberation of this Conference aparticum their technical contribution, will serve to add tonsiderably to the computer awareness among the students and the various projectional members in this region.

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