



The Doyen's Recollections

It's a pleasure to receive several contributions from Prof. V. Rajaraman for CSI Communications' special issue on IT History. Very recently Prof V. Rajaraman was honored with the award of D. Sc. (Honoris Causa) from IIT Kanpur on June 18th, 2014. A link to the video coverage of the award ceremony is available at iitk.vmukti.com. He has contributed five articles for this issue providing information on –First programming book in India, How CSI got its name, How MCA program started, Establishment of CDAC and Timeline of development of computing in India.

Prof. Dr. V Rajaraman: A brief biographical sketch

V. Rajaraman, PhD(Wisconsin) is Honorary Professor in the Supercomputer Education and Research Centre(SERC) at the Indian Institute of Science, Bangalore. He was previously TataChem Professor and Chairman of SERC, IISc (1982-1994), IBM Professor of IT at the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore (1994-2001), and Professor of Electrical Engineering and Computer Science at IIT,Kanpur (1966-1982). He was an Assistant Professor of Statistics at the University of Wisconsin, Madison (1961-62), a visiting Assistant Professor of Electrical Engineering and Computer Science at the University of California, Berkeley (1965-66), and an IBM Research Fellow at the IBM Systems Development Institute, Canberra, Australia (1973-74). He is an author of 23 widely used text books and numerous research papers in computer science and has guided 30 PhD students.



Prof. V.Rajaraman giving acceptance speech after receiving honorary D.Sc. of IIT,Kanpur on 18 June 2014

Prof. Rajaraman was awarded the Padma Bhushan by the President of India in 1998. He is a Fellow of the Computer Society of India, the Indian National Science Academy, the Indian Academy of Sciences, National Academy of Sciences, Indian National Academy of Engineering, and the Institution of Electronics and Telecommunication Engineers. Among the many honours and prizes that he has received are Shanti Swarup Bhatnagar Prize (1976), Homi Bhabha Prize (1984) by UGC, Indian Society of Technical Education award for excellence in Teaching (1988), Om Prakash Bhasin Prize (1992), Rustom Choksi Award (1993) by IISc, Zaheer Medal (1998) by the Indian National Science Academy, and the Life Time Contributions award by the Indian National Academy of Engineering, Dataquest, Computer Society of India, and the Systems Society of India. He was awarded an Honorary DSc (Engineering) by the Bengal Science and Engineering University, Sibpur in 2012, and an Honorary DSc by IIT/Kanpur in 2014. ■

The First Book on Programming in India

It all started with the arrival of an IBM 1620 mainframe computer at IIT/Kanpur in August 1963. This computer was the first one with a FORTRAN compiler to be installed in India. It was gifted to IIT/Kanpur by the Kanpur Indo American Programme (KIAP) funded by the United States Agency for International Development. KIAP was a consortium of nine top U.S. universities including MIT, CalTech, University of California, Berkeley, Princeton, and Purdue. The computer was installed by the engineers of IBM (India). KIAP had sent three Professors during 1963-64 to help in installing the software and teach how to program the computer. Professor Harry Huskey from the University of California, Berkeley was the head of the team. Prof. Huskey was a pioneer in computing, having been a member of the ENIAC team and also a member of the team which built the ACE computer at the National Physical Laboratories, U.K., under the leadership of Alan Turing. He was one of the early Presidents of the Association for Computing Machinery (ACM), U.S.A. The other members of the team were Prof. Forman Acton, a numerical analyst, and Prof. Irving Rabinowitz, a systems programmer both from Princeton University. As soon as the computer was installed, Prof. Huskey and his team planned a course in programming for IIT/Kanpur faculty and research students. He then took a pro-active step in spreading computer education not only to the IIT/Kanpur community but also to researchers in CSIR, DRDO, and other laboratories and Universities. Beginning in December 1963, IIT/Kanpur started 10 day intensive courses in computing which was continued and given thrice a year by the IIT/Kanpur faculty till 1972. Sixty participants were admitted to each course and it consisted of three lectures, one on programming using a load and go version of FORTRAN

called FORGO, one lecture on numerical methods and the third on computer logic. This was followed by 3 hour laboratory sessions on programming for batches of 20 participants. The batch size was limited to 20 as we had only 25 key punch machines using which participants in the course punched their programs on 80 column cards. Program decks of participants were submitted as a batch to computer operators who ran them.

As no inexpensive books were available to teach programming I was persuaded to write notes on programming. Originally they were distributed as cyclostyled notes to the participants. At the same time, IIT/Kanpur faculty decided to teach a course on computer programming as a compulsory course to all engineering students. Each batch had 300 students and the notes were used to teach the course beginning in 1964/65. The notes titled "Principles of Computer Programming" was printed in the graphic arts section of IIT/Kanpur and sold by the campus book store for Rs.5/-.

The book was bought not only by IIT/Kanpur students but also by outsiders who visited IIT/Kanpur.

I spent the year 1965-66 at the University of California, Berkeley, as a Visiting Assistant Professor and showed my programming notes to some colleagues there for their comments. They suggested small changes and I polished the notes. On return to India in August 1966, I got involved again in teaching the programming course to students as well as the participants of the intensive courses. I requested my colleague Prof. H N Mahabala to review my notes and he did a commendable job and gave numerous suggestions for improvement as he was also teaching the intensive course as well as the undergraduate course on computing. The thought then occurred, with persuasion by my wife Dharma, that I should try to get the

book published so that more persons can read it. I sent the book to several publishers but they were not interested in publishing it. They felt that there was no market in India for a book on computer programming. Only one publisher, Prentice-Hall of India, showed some interest. I insisted that the book should be priced below Rs.15 so that it will be affordable to students. Prentice-Hall of India Managing Director at that time Mr. Neville Gosling finally agreed in August 1967 to publish the book (after getting the book reviewed) with the stipulation that I give a "camera ready" copy by getting it typed using an IBM electric typewriter. It was done on A4 size paper with drawings drawn using India ink on tracing paper. The book titled "Principles of Computer Programming" was finally published in July 1969. The first print run was 3000 copies. Prentice-Hall of India had hoped that they will be able to sell the first print in three years. To their utter surprise and mine by December 1969, 2500 copies were sold and a second printing came out in May 1970. Even though there were not many computers in India there was tremendous curiosity and eagerness to learn about computers and programming. The book fulfilled that need.

This book was followed by a revised edition titled "Computer Programming in FORTRAN IV", and later as FORTRAN 77 (including an introduction to FORTRAN 90). The 51st printing of this book appeared in July 2013. Even today the latest version of the first programming book is being sold steadily, although not in large numbers, in spite of FORTRAN having been superseded by Pascal, C, C++, and Java. It is also gratifying that whenever I meet engineers/scientists in their 50s they remember that they learnt programming using the FORTRAN book describing its unusual A4 size and the colour of its cover which changed from silver grey to chocolate to yellow and finally blue. ■

How Computer Society of India got its Name

Indian Institute of Technology, Kanpur was the first educational institution in India to install a mainframe computer with a FORTRAN compiler in August 1963. It was

an IBM 1620 with 60K digit memory, three tapes, punched card I/O and an arithmetic unit which did arithmetic by table look up! The computer was installed by IBM

engineers in a large air conditioned room. IIT/Kanpur was assisted by a consortium of nine top Universities including MIT, CalTech, Princeton, University of

California, Berkeley, and Purdue University. Prof. Harry Huskey of the University of California, Berkeley, was the leader of an American faculty team who had come to help install the computer and to teach programming, numerical methods, and computer logic to the students and faculty at IIT/Kanpur. Prof. Huskey was a pioneer in computing, having worked with the ENIAC team and later with Alan Turing designing the ACE computer at the National Physical Laboratory, U.K. He was also a Past President of the Association for Computing Machinery (ACM), U.S.A. With his vast experience in managing computing facilities and influence with IBM he requested IBM to gather IBM computer users to exchange their experiences and to request IBM for some improved services. The group of 16 persons from seven IBM computer installations including representatives from IIT Kanpur, DRDO, PRL, and some other organizations first met at the IBM Education Centre at Faridabad on 6 June 1964. At the end of this meeting it was decided to form an All India Computer Users' Group (AICUG). In mid December 1964, Prof. Huskey

organized an International Conference on Computers at IIT/Kanpur, funded by the United States Agency for International Development and the Ford Foundation, with the primary goal of discussing the latest trends in computing. All speakers to this conference were invited speakers. Among the speakers were Prof. Maurice Wilkes of Cambridge University, Prof. John Bennet, of the University of Sydney, Australia, Prof. J Beltran from Mexico who was famous for spreading computer education in Mexico by transporting an IBM 1620 on an air conditioned truck to various universities there, Dr. S. Barton, a computer designer from CDC, besides Prof. Harry Huskey, Prof. Forman Acton, and Prof. Irving Rabinowitz (from Princeton). Almost 60 participants were invited from India among whom, I remember, were Major A Balasubramanian (DRDO), Dr. P P Gupta (CDC), Dr. S R Thakore (PRL), Dr. P V S Rao (TIFR), Dr. N Srinivasan (NAL), Prof. B Nag (Jadavpur University), Prof. J Roy (ISI), besides Prof. H K Kesavan and I from IIT/ Kanpur. At the end of the conference a meeting was held on

Friday, December 14, 1964 afternoon where a consensus was reached that the All India Computer Users' Group was not an appropriate forum for scholarly discussions and for presenting results of research in the area of computing. It was decided to form a professional society in computing. The question then arose about naming the society. Indian Computer Association, and Indian Computer Society, among other names were proposed. Indian Computer Society was rejected as the abbreviation ICS reminded everyone about our colonial past, and ICA was too close to the Institute of Chartered Accountants. Dr. P P Gupta, who was sitting next to me, then suggested the name Computer Society of India (CSI) and it was finally agreed as the appropriate name by all who were present. Major A. Balasubramanian, who was at that time in-charge of the IBM 1620 installation at DRDO, Hyderabad, volunteered to get the new society registered as soon as he returned to Hyderabad. (At that time all of us did not realize that CSI was used as an abbreviation by the Church of South India!). ■

How the MCA Programme Started

In 1979 the Electronic Commission of the Government of India, of which I was a member, felt that several computer based projects were not progressing fast enough due to the paucity of trained human resource. The then Chairman of the Electronics Commission Prof. Biswajit Nag set up a panel with me as its Chairman to project the demand for manpower and suggest appropriate educational programmes to meet the requirements of Human Resource. The other members of the panel were Prof. S Ghosh of Jadavpur University, Prof. K K Bhutani of J K Institute of Technology and Applied Physics, Allahabad, Prof. S K Lakshmana Rao of REC, Warrangal, Prof. M V Pitke of Bombay University, Prof. P C P Bhatt of IIT, Delhi (who was at that time the Director of Computer Division of the Department of Electronics), Dr. D Shankar Narayan of the University Grants Commission, Dr. S M Vaidya of the Regional Computer Centre, Pune University, Prof. P G Reddy of IIT, Delhi, Mr. S S Oberoi of DOE and Dr. Om Vikas of the Electronics Commission who was the member

convener of the panel.

The terms of reference given to the panel and the full report of the panel may be found in^[1]. The panel held nine meetings during January-July 1980. On 21 and 22 April 1980 it held a Computer Science and Engineering curriculum development seminar at IIT/Delhi. Opinions of CSI members were solicited at the Annual Convention of CSI held at Mumbai on February 9, 1980. The panel found that there was a scarcity of Computer Science professional all over the world. Further most predictions made of requirements of human resources in the area of computing all over the world were underestimates. While reviewing the situation it was found that very few institutions in India had a formal degree programs in Computer Science. M.Tech/ME programs were being offered by about a dozen institutions in India with an intake of 152 and B.Tech was offered only at seven institutions with an intake of 122. Further, B.Tech and M.Tech programmes were engineering oriented with emphasis on computer architecture, hardware, and systems software. These

programmes primarily emphasized the design of computers rather than their applications in industry and government. The committee felt that there was a need for a large number of systems analysts and application programmers particularly to fulfill the requirements of the data processing departments of companies which were primarily users of computers rather than designers of computers. A minicomputer policy which was in limbo for a long time was just about to be announced based on the Sondhi committee^[2] recommendations which was expected to allow many private companies to enter computer manufacture. There was no formal educational program to create a cadre of systems analysts and application programmers. Systems analysts are expected to have breadth of knowledge and maturity as their main job requirement is to interview personnel of various types of organizations and arrive at Systems Requirement Specification (SRS) before embarking on systems design and programming. Persons developing information systems for

organizations need not only knowledge of computers and computing but also business practices such as accountancy, stores, purchase, organizational structure and related organizational governance practices. The course was primarily meant to fulfill the needs of Management Information Systems departments of organizations^[3] and develop Information systems for the clients of software companies. The committee felt that a basic B.Sc/B.Com degree would give the students some breadth of knowledge and maturity. Further a large number of B.Sc/B.Com students did not have enough employment opportunities and a program to give them an orientation in a profession would make them employable in the nascent field of computer applications. This led to the idea of 3 year post graduate programme which the panel decided to name Master of Computer Applications (MCA). This course was of special relevance to conditions in India and did not mimic any course in the west. It

was the panel's conviction that the MCA course must have three components: strong mathematics base, broad general knowledge on the management structure of organizations including finance, and a strong grounding in computers as a tool in solving problems. The panel felt that the course must include programming, systems analysis and design, operating systems, and basic ideas on architecture of computers. The panel also felt strongly that at least six months of the course must be spent by the students in an organization understudying an experienced systems analyst. The approval of this course by UGC was expedited as Dr. Shankar Narayan who was an Additional Secretary of UGC was a member of the panel. The panel suggested that the MCA programme should be started at ten institutions with an intake of 30 each. The panel had hoped that among the ten would be the three IIMs. IIMs were not interested but many other colleges were. To kick start the programme it was suggested that

the ten institutions chosen should be fully funded for five years to create the infrastructure including hiring teachers and buying computers. Department of Electronics agreed to meet 90% of the funding requirement and 10% was to be funded by UGC/Ministry of HRD. These recommendations were presented to the Electronic Commission and the UGC and they approved the MCA program and the funding requested. Subsequently ten institutions submitted proposals, got the funding and the MCA course was started in 1982-83.

References

- [1] Report of the Panel on Computer Manpower Development, Electronic Information and Planning, IPAG, Electronics Commission, Vol.8, No.2, November 1980, pp.56-70.
- [2] Virendra Kumar, Committees and Commissions in India: 1978.
- [3] V.Rajaraman, "A Curriculum Proposal for a Degree Program in Information Systems Design", CSI Communications, Vol.5, No.4, Oct.1981.

History of the Establishment of the Centre for Development of Advanced Computing

Introduction

In 1983 the Indian Institute of Science, Bangalore, gave a proposal to the Department of Science and Technology, Government of India, to set up a supercomputer facility at the Institute. The contention of the Institute was that cutting edge research in science and engineering required such a machine at the Institute as modeling and simulation of complex systems depended heavily on a supercomputer. All major universities in the west had supercomputers. This was duly considered by the secretary, Department of S&T and as the financial outlay required was over Rs.25 crores he suggested that a committee of secretaries consisting of the secretaries of the then Department of Electronics, Ministry of Human Resource Development and S&T should consider the proposal. The proposal was approved in principle by this committee of secretaries. Then started a series of steps beginning with a visit by a group led by the Director of the Indian Institute of Science to some

leading supercomputer centres in U.K and U.S.A and the two major manufacturers of supercomputers, namely, Cray and Control Data Corporation(CDC) both located in Minnesota, U.S.A. A report was submitted to the Government by the Indian Institute of Science and final approval for buying a supercomputer with a budget allocation of Rs.60 crores including special building, technical staff, faculty etc., came in late 1985. The institute started the process of tendering etc. and soon found that the process of importing a supercomputer was tortuous. Getting an export clearance from the U.S. government was becoming difficult. Even when quoting for the computer Cray and CDC indicated the problems with export controls and wanted the Institute to sign an agreement which included surprise inspection of the use of the computer including the source codes of the programs being run, restriction on its use by organizations outside the Institute, restrictions on its use by visiting Professors from the then Soviet Union and its allies etc. Many

of these conditions were unacceptable to the Institute and the Government of India. After extensive negotiations on relaxing some of the conditions an order was placed for the purchase of a Cray-YMP computer with the condition that it should be installed within one year. Cray could not get an export clearance within the stipulated time and the order was cancelled. It was clear to the Institute and to the Government of India that unless we become self-reliant in building supercomputers, we will be forever at the mercy of the U.S. government. Prof. C N R Rao who was the then Director of the Indian Institute of Science and who was also the Chairman of the Science Advisory Council to the Prime Minister (SAC-PM) was convinced of the need for India to become self-reliant in building and using supercomputers. SAC-PM formed a committee with me as Chairman and Prof.P.C.P.Bhatt of IIT, Delhi, Dr. N Seshagiri of the Department of Electronics, and Dr.PNShankar of the National Aeronautical Laboratories, Bangalore, as members to

suggest ways and means of meeting this goal. The committee was set up some time in December 1986 and held several meetings. One of the meetings was held with Prof. Roddam Narasimha, a member of SAC-PM, in which he talked about the need of a high performance computer for solving complex computational fluid dynamics problems in aerospace and research in atmospheric sciences which had relevance to the important problem of monsoon prediction. He also mentioned the need of a high performance computer to solve problems in structural engineering, molecular biophysics etc. In the deliberations of the committee the need to emulate the successful mission

mode model and the flexibility in the management structure of CDOT in the new centre was emphasized. The need for collaboration between various scientific institutions and a distributed structure to expedite application developments on a parallel machine was also desired by the committee.

During the period 1984-86 technology was rapidly changing. Computer architects all over the World were looking for alternatives to vector supercomputers of the type manufactured by Cray and CDC in the U.S.A., and NEC and Fujitsu in Japan, which required special cooling, consumed enormous power and were

very expensive. Microcomputers were doubling their speed every 2 years and were inexpensive. Numerous start ups in U.S.A were exploring the possibility of building supercomputers using parallel processing and were building prototypes. The committee felt that it was easier to build parallel computers having a performance approaching the speed of supercomputers of the day at a fraction of the cost. Further, there were fortunately no embargos on buying microcomputers. The committee submitted a report in February 1987 to the SAC-PM entitled "Technology Mission to develop a Parallel Computer". The executive summary of the report is reproduced below:

TECHNOLOGY MISSION TO DEVELOP A PARALLEL COMPUTER SUMMARY

With the advent of inexpensive powerful microprocessors it has now become feasible to build a computer by interconnecting a large number of microprocessors. Such a computer, called a parallel computer, can be designed to solve problems requiring numerically intensive computing. There are a large number of applications critical to India's development, which requires sustained numerical speeds in the range of 10 to 100 million arithmetic operations per second. It is thus necessary to initiate a technology mission with a goal of building such parallel computers by 1990. The potential hardware speed of parallel computers cannot be utilized unless new algorithms tuned to the parallel structure of these computers are developed. Research in parallel algorithms is at its infancy and major effort can potentially

give us a leadership position in this area. It is thus proposed that commercially available parallel computers be distributed to fourteen organizations and individual goals be defined for each organization to develop parallel programs in their area of competence. These programs should be implemented on the prototype parallel computer developed by the mission. It is proposed that the mission be coordinated and executed under the umbrella of the Centre for Development of Advanced Computer Technology (CDACT) of the Department of Electronics and that it must have a separate identity and autonomy of operation. The proposed budget for the mission is Rs.32 crores of which USD 14.25 million will be in foreign exchange.

On March 31, 1987, I received a letter from the Secretary of SAC-PM which stated "It has been decided that SAC-PM's work on Parallel Computing be included as an item for discussion with the Prime Minister, in a meeting of SAC-PM members to be held with him on 21st April 1987 at 18.05 hours. SAC-PM has

tentatively suggested a discussion on this item for 30 minutes including a presentation of 10 minutes". I prepared 3 slides for presentation which are reproduced below. (An OHP was used for the presentation as the use of PPTs had not become common in 1987).

PRESENTATION TO PM ON 21.4.1987 ON PARALLEL COMPUTER MISSION

SLIDE 1

MISSION TO BUILD A PARALLEL COMPUTER

- ☛ BUILD PARALLEL COMPUTER WITH MINIMUM SUSTAINED SPEED OF 50M FLOPS

- ☛ DEVELOP PARALLEL ALGORITHMS AND SOFTWARE IN DIVERSE DISCIPLINES
- ☛ DEVELOP SOFTWARE TO RESTRUCTURE LARGE SERIAL PROGRAMS TO PARALLEL PROGRAMS FOR COMPUTER BEING DESIGNED

SLIDE 2

ISSUES IN PARALLEL COMPUTING

- ☛ PROCESSORS BECOMING FASTER AND CHEAPER
- ☛ OUR INDUSTRY ABLE TO USE THEM QUICKLY

HARDWARE ISSUES

- ☛ INTERCONNECTION STRATEGIES
- ☛ COMMUNICATION STRATEGIES

- ☛ HARDWARE SYSTEM DESIGN RELATIVELY EASY

CRUCIAL PROBLEMS ARE IN SOFTWARE

- ☛ MODELLING PROBLEMS
- ☛ RETHINKING SOLUTION
- ☛ PARTITIONING JOBS TO TASKS
- ☛ ASSIGNING TASKS
- ☛ COORDINATION OF TASKS
- ☛ PICKING RIGHT NOTATION

SLIDE 3

IMPLEMENTATION

- ☛ CREATE A CENTRE TO DESIGN DEVELOP AND FABRICATE A PROTOTYPE SYSTEM
- ☛ CENTRE SHOULD HAVE OPERATIONAL AUTONOMY INTERACT WITH IDENTIFIED MANUFACTURERS
- ☛ ASSIGN APPLICATION DEVELOPMENT TASKS TO R&D ORGANIZATIONS
- ☛ PROVIDE THEM WITH INFRASTRUCTURE TO ATTAIN

GOAL IN TIME

- ☛ INTERCONNECT ALL CENTRES BY A COMPUTER NETWORK WITH CONFERENCING FACILITY
 - TIME LINE IN REPORT
 - BUDGET \$7.25M + RS.935 LAKHS IMMEDIATELY
- ☛ TOTAL PROJECT COST \$14.25 MILLION +RS.12.85 CRORES = 32 CRORES
- ☛ 14 SOFTWARE DEVELOPMENT CENTRES SPREAD THROUGH INDIA

The report of the committee was accepted by the Prime Minister's office. Immediately steps were initiated by the Department of Electronics (DOE) whose secretary was Mr. K P P Nambiar and additional secretary Dr. N Seshagiri. DOE proceeded to form a registered society under its control. The name suggested by the working group "Centre for Development of Advanced Computer

Technology" was changed to the "Centre for Development of Advanced Computing" by DOE. As the working group had suggested that closely working with a University would be beneficial, CDAC was established at the campus of the University of Pune in mid April 1988.

Time-Line - Development of Computing in India (1955-2010)

This time line lists chronologically various developments which took place in computing in India. In developing this, I have used many sources including the books listed in the references. A complete list of references may be found in the monograph "History of Computing in India (1955-2010)" written by me on the invitation of IEEE Computer Society- History Committee whose URL is given in the References.

Year	Important Events
1955	<ul style="list-style-type: none">• HEC-2M arrives in India. 16 bit tube/drum machine designed by A D Booth at Birbek College, London, and ordered by ISI, Kolkata from the British Tabulating Machines.• Beginning of the design of TIFRAC prototype at the TIFR, Mumbai (R.Narasimhan leads the team).
1956	<ul style="list-style-type: none">• HEC-2M installed at the ISI and used to program statistical calculations in machine language.
1957	<ul style="list-style-type: none">• Design of a full-fledged computer similar to ILLIAC begins at the TIFR (R.Narasimhan's group).
1958	<ul style="list-style-type: none">• URAL-1 a Russian machine installed at the ISI, Kolkata. Has assembly language.
1959	<ul style="list-style-type: none">• TIFRAC fabrication completed.• IBM starts manufacturing key punch machines in India.
1960	<ul style="list-style-type: none">• TIFRAC starts working. Assembler developed for TIFRAC.
1961	<ul style="list-style-type: none">• ISIJU Project to make transistorized computer begins at ISI and Jadavpur University.• First IBM 1401 installed at the ESSO Standard Oil Co., Mumbai.
1962	<ul style="list-style-type: none">• TIFRAC dedicated to the nation by Jawaharlal Nehru the Prime Minister of India.• IBM 1401 refurbishing starts at Mumbai.
1963	<ul style="list-style-type: none">• IBM 1620 installed at the IIT at Kanpur. First computer with FORTRAN in India. Education using FORTRAN begins.• Bhabha committee set up to review electronics in India.
1964	<ul style="list-style-type: none">• IBM 1401 installed in ISI, Kolkata.• A large number of intensive courses on computing given at IIT/Kanpur.• CDC 160A-3600, a large mainframe computer, installed at the TIFR, Mumbai.• First International Conference on Computing held at IIT/Kanpur. Organized by Harry Huskey with financial support from the Ford Foundation. At the end of the conference decision taken to start Computer Society of India.
1965	<ul style="list-style-type: none">• 30 IBM 1401s and 12 ICL 1901s installed in India.• Computer Society of India registered in Hyderabad.

1966	<ul style="list-style-type: none"> Report of the Electronics Committee (Bhabha Committee) submitted (February). IBM 7044 installed at IIT/Kanpur. Rupee devalued from Rs.4.5 per USD to Rs.7.5 per USD. Windfall profit to IBM as rentals were quoted in dollars. ISIJU project complete. M.Tech program in computers in the Electrical Engineering Department started at IIT/Kanpur.
1967	<ul style="list-style-type: none"> ECIL established at Hyderabad by the Department of Atomic Energy to commercialize electronic instruments designed at the Atomic Research Centre at Mumbai. Dept. of Statistics, Government of India, installs 10 Honeywell computers.
1968	<ul style="list-style-type: none"> TCS established in Mumbai by Tata Sons with an IBM 1401. IBM 1401 installed as I/O computer for the IBM 7044 at IIT/Kanpur. Narasimhan committee report suggests self-reliant production of small and medium computers within 10 years. Opines no need for foreign collaboration in design and development.
1969	<ul style="list-style-type: none"> TDC 12 computer commissioned at the Bhabha Atomic Research Centre, Mumbai. A real-time data acquisition computer. Committee on Automation set up by the Ministry of Labour, Employment and Rehabilitation (called Dandekar Committee on Automation). HP Time sharing computers installed in IIM/Ahmedabad.
1970	<ul style="list-style-type: none"> Department of Electronics (DoE) established by the Government of India with M G K Menon as its Secretary. Foreign companies asked to dilute equity. IBM declines. ICL agrees and collaborates with the Bharat Electronics Ltd. (BEL) to manufacture ICL 1901A - 48 computers manufactured. National conference on Electronics under the Chairmanship of Vikram Sarabhai held at Mumbai to elicit comments on the development of electronics and computers. Self-reliant development of computers in India proposed.
1971	<ul style="list-style-type: none"> Electronics Commission established by the Government of India in Delhi as policy making body for electronics and computers with M G K Menon as its Chairman. IBM 1401 withdrawn in the USA. 14 IBM 1401s installed by the Indian Railways for accounting, freight etc. TDC 12 marketed by ECIL.
1972	<ul style="list-style-type: none"> DEC 1077 installed at NCSDCAT at TIFR with UNDP assistance. Groups in graphics, networks, databases, and compilers formed to do research in these areas. Panel on minicomputers constituted by the DoE to formulate a strategy for the development of small and medium computers by Indian companies. Separate Computer Science Programme starts at IIT/Kanpur. Masters and Phd degrees offered. First such programme in India.
1973	<ul style="list-style-type: none"> Report of the panel on minicomputers submitted. Opines that minicomputers can be made in India without any know-how being imported from abroad. No collaboration should be allowed. Demand for the period 1974-79 projected around 1400 minicomputers. Santacruz Electronic Export Promotion Zone (SEEPZ) established in Mumbai to promote export of electronic items and software. Foreign Exchange Regulation Act (FERA) passed. IBM asked to dilute equity again. Declines. Air Defence Ground Environment Systems (ADGES) design begins at TIFR. Plans to use ruggedized ECIL TDC 316 computers, display devices developed by Tata Electric Company, Radar from Electronics and Radar Development Establishment (LRDE) Bangalore with the user agency, namely, the Indian Air Force giving requirement specifications and test data. Entire system to be developed and fabricated with Indian engineers and Indian made subsystems. IIT/Madras installs IBM 370/155 with financial assistance from the Federal Republic of Germany. Fastest computer in south India.
1974	<ul style="list-style-type: none"> TDC 312 marketed by ECIL (uses imported ICs, local components locally made PCBs, and imported peripherals.) Regional Computer Centre (RCC) set up at Pune with an ICL mainframe. RCC to give low cost computer time to students and software exporters. ECIL imports IRIS 55 (from France), a 32 bit computer to expedite software development and reverse engineered to make TDC 332. Computer Imports for software export policy. TCS uses the scheme to import a Burroughs mainframe computer. Minicomputer policy not implemented - delayed due to indecision and foreign exchange problems.

1975	<ul style="list-style-type: none"> • Tata Burroughs established in SEEPZ. Burroughs B1728 and B6738 installed to export software. F C Kohli of TCS prime mover of the idea. • DoE issues guidelines for import of computers costing more than Rs. 500,000. Foreign exchange difficulties. • National Informatics Centre (NIC) established with UNDP assistance (USD 4.4 million). • TDC 316 produced and sold. • Engineers India installs Ryad 1040 from East Germany to export engineering design software to East European countries. • Ryad 1030, 1020 computers from the USSR also installed for software export to the USSR (Rupee trade with the USSR eases import of machines).
1976	<ul style="list-style-type: none"> • CMC established by the DoE. • CMS formed by some IBM employees to maintain IBM 1401 computers. • Report on the operation of IBM and ICL by the Public Accounts Committee of the Indian Parliament. Report criticizes companies. • Patni Computers collaborates with Data General Computers for software development. • DoE starts Appropriate Automation Promotion Program (AAPP), later renamed Industrial Electronics Promotion Programme (IEPP).
1977	<ul style="list-style-type: none"> • IBM announces intention of closing operations in India. • Regional Computer Centre, Calcutta, established with Burroughs B-6738 computer. • Minicomputer policy continues to be in limbo.
1978	<ul style="list-style-type: none"> • IBM closes operations in June. • CMC takes over maintenance of IBM computers. • IDM, a company formed by ex-IBM employees takes over IBM's data centres and card plant. • Biswajit Nag takes over as Secretary DoE from M G K Menon. • A S Rao retires from ECIL. • Minicomputer Policy announced opening the field of computer manufacture to private industry, breaking public sector (ECIL) monopoly. • IIT/Kanpur starts the first B.Tech programme in CSc at an IIT.
1979	<ul style="list-style-type: none"> • Sondhi Committee on Electronics report suggests liberalization of import of large computers and allowing private sector to enter computer and peripheral manufacture. • Bharat Electronics Ltd. (BEL - a public sector company specializing in defence electronics systems) decides to quit from computer and peripherals development. • 4 companies, ORG, DCM, HCL, and IDM, start manufacturing minicomputers. Adopt UNIX as O.S. • TCS opens Office in New York for software export. • Patni Computers develops comprehensive Apparel Development Software Package for Data General Computers. • Regional Computer Centre, Chandigarh established with DEC 2050 system.
1980	<ul style="list-style-type: none"> • Rajaraman's manpower committee report accepted by the Electronic Commission. A new programme called Master of Computer Applications to be started. Bachelor's programme in CSc to be expanded. • Software services export by a number of companies start primarily by sending software engineers to client sites (pejoratively called "body shopping"). • Tata Research Design and Development Centre (TRDDC) of Tata Sons established (mostly with funding by TCS). • TALLY, an accounting software product company established.
1981	<ul style="list-style-type: none"> • Rajaraman committee report on import of computers for software export. • P P Gupta takes over as DoE secretary from B Nag. • Decision to use computers in the organization of the Asian Games. Rajiv Gandhi takes this decision. • INFOSYS established. • Wipro markets 8086 based minicomputer (Wipro 86 series). • Reserve Bank of India computerizes clearing houses and ledger posting after agreement with the labour unions that not more than 10% of staff will be displaced. • NIIT starts private computer training school.
1982	<ul style="list-style-type: none"> • Asian Games held in New Delhi. Organizer Rajiv Gandhi decides to computerize games schedules, event records, result announcement etc. DCM computers used as terminals, networked with HP machines. Entire software developed locally by NIC engineers in 6 months. Seshagiri interacts with Rajiv Gandhi. • Import of Colour television tubes allowed; colour television arrives in India to telecast Asian Games.

	<ul style="list-style-type: none"> • NCST establishes VSAT network with 32 Kbps packet switching. • MASTEK starts software company in Mumbai. • Electronic voting machine using a microprocessor designed and developed in India used in a state election for the first time in the world. • UNDP funding (USD 653,200) for Appropriate Automation Promotion Programme (AAP) with centres at Delhi, Ahmedabad, Calcutta, and Trivandrum. Training in microprocessor use in automation.
1983	<ul style="list-style-type: none"> • NCSDCT hived off from TIFR to form NCST. • Bank Unions agree to limited computerization in public sector banks.
1984	<ul style="list-style-type: none"> • Indira Gandhi assassinated. Rajiv Gandhi becomes Prime Minister. Rajiv Gandhi is computer savvy. • Rajiv Gandhi initiates liberalization of computer industry with Seshagiri of the DoE as his informal adviser. • Trade unions observe 1984 as "anti computerization year". • Gateway Design automation starts software development work for export in Delhi • Citibank sets up software development unit in SEEPZ, Mumbai. • Inter-ministerial standing committee (IMSC) formed to regulate computer import and licensing industry. • Railway passenger reservation project given to CMC by the Railways. • Rangarajan Committee on bank computerization gives report. EDP cells in all banks recommended. • SOFTEK first company to develop compilers for COBOL, BASIC, and FORTRAN for locally made computers • CDOT set up to design electronic telephone exchanges by Indian engineers. • CAD Centres at IISc/Bangalore, IIT/Kanpur, IIT/Bombay and Jadavpur University at Kolkata. UNDP grant USD 1.5 million plus Rs.340 million grant from the DoE. • Computer Assisted Literacy And Study in Schools (CLASS) programme launched by the DoE to cover 250 schools all over India. Uses BBC Acorn microcomputers - 4 given per school. The UK government gives UK Pounds 1.3 Million for the project. • Government of India approves setting up of a National Supercomputer Centre at the Indian Institute of Science at Bangalore with a grant of Rs.500 million.
1985	<ul style="list-style-type: none"> • Department of Telecommunication (DoT) established. • Telephone services corporatized (earlier telephones were monopoly of a government department). • Software export USD 30 million (CMC, TCS, and TBL main contributors). • Texas Instruments facility at Bangalore established to export electronic CAD software using satellite communication with its Dallas Centre in the USA. • ERNET project starts with UNDP assistance. • Sampath committee on education - teacher training programme suggested. • KBCS project funded by UNDP and the DoE. USD 5.2 million + Rs.140 million grant from the DoE. IIT, Madras, IISc, Bangalore, ISI, Kolkata, NCST, Mumbai, TIFR, Mumbai and IIT, Bombay participated. • UNDP assisted Microprocessor Applications Engineering Program (USD 1.53 million) - 5 regional centres at Jabalpur, Bangalore, Ranchi, Pune and Delhi.
1986	<ul style="list-style-type: none"> • VSNL (Videsh Sanchar Nigam Ltd.) set up for overseas communication. • INDONET established by CMC. SNA network with IBM computers and leased lines from the DoT. • New policy on computer software export, software development and training. • Project to computerize reservation of tickets in the Indian Railways completed. Reservation office in New Delhi with 50 windows started. • NIC acquires SX1000 mainframe computers from Japan for software development for government departments. • NIIT starts franchising training centres. • Rajaraman committee submits report to the Science Advisory Committee to the Prime Minister to establish a centre for developing high performance parallel computers.
1987	<ul style="list-style-type: none"> • Sterling Computers sells PCs for Rs.29, 000. • TI's Satellite link to Dallas office starts the revolution of "off shore" software development. • Foreign collaboration for branded workstations begins in earnest. Hinditron-DEC, HCL-HP, and PSI-Honeywell Bull established. • NICNET established. • Indian Banks' Association agreement with Bank Unions on Computerization. Standardizes use of UNIX, Micro focus COBOL, and X .25 for networking. IBM PC clones in all banks. • Software India Conference in the USA to promote software companies.

1988	<ul style="list-style-type: none"> • National Association of Software and Service Companies (NASSCOM) established. • NIC hived off from the DoE and placed in the Planning Commission. • Excise duty exemption for software. • RCC Calcutta machine replaced with CDC 180/840A mainframe. • Cray XMP 14 installed in the Centre for Medium Range Weather Forecasting-number of conditions applies on usage. • Centre for Development of Advanced Computers (CDAC) established in Pune to design and fabricate parallel computers with 1Gflop speed.
1989	<ul style="list-style-type: none"> • Indian Administrative Service officer takes over from technocrats as DoE secretary. DoE becomes a "non-scientific" department. S Rajamani IAS takes over from technocrat K P P Nambiar when he retires. • VSNL sets up 64 Kbps link to the USA. • NCST connects ERNET to Internet via UUNET. • Electronics Commission abolished. • Datamatics, a software services company, uses satellite link to the USA to export software. • India's software services export reaches USD 100 Million.
1990	<ul style="list-style-type: none"> • N.Vittal, an Indian Administrative Service officer, takes over as the DoE Secretary. • Software Technology Parks set up by the DoE with shared satellite communication links to promote software export. • Companies established in STPs expected to export software each year equal to 4.5 times the salary paid to their employees. • MNCs enter India for offshore software development.
1991	<ul style="list-style-type: none"> • India nearly defaults in repaying loan. Forced by the International Monetary Fund (IMF) to liberalize. Rupee devalued and floated. • New industrial policy – Multi National Companies (MNCs) welcomed. • Reduced tariff, simplified procedures, and devalued Rupee attract MNCs. • NICNET used to disseminate results of general elections. • Export of software USD 164 million. • IIS is the first software services company to get ISO 9001 Quality Certification. • Software "development centres" set up for individual Fortune 500 companies by TCS (Each centre secure). • National Supercomputer Centre at the IISc, Bangalore starts functioning with a Cyber 992, 2 CDC4360, a VAX8810, 9 IBM6000/580s connected with a fibre optic net to work in parallel, 48 IBM RS6000/340, 24 Silicon graphics workstations, 25 Sun workstations, and a campus-wide fibre optics network. • CDAC completes design of PARAM parallel computer with 1 Gflop speed.
1992	<ul style="list-style-type: none"> • VSNL introduces 64 kbps leased line services. • Tata group and IBM form a 50:50 joint venture company. • Software product Flexcube for banks developed by Rajesh Hukku of IFlex.
1993	<ul style="list-style-type: none"> • EDI introduced by VSNL. • Private software companies allowed dedicated satellite links with customers in the USA. • Motorola India first company in the world to get CMM level 5 certification for software quality. • Import of software packages allowed on regular duty. Duplicating copies allowed. Duplicates permitted to be sold in the local market and royalty less than 30% of the local price allowed to be paid to the owner of the package. • INFOSYS becomes a publicly listed company • Indian Satellite Development Centre at Bangalore installs a distributed computer system with 9 IBM RS6000/530s, 9 RS6000/220s and 33 RS6000/220s.
1994	<ul style="list-style-type: none"> • Government monopoly in telecommunication ends. Private companies allowed starting mobile communication services. • American Express sets up Business Process Outsourcing Centre in Mumbai. • 200 satellite links installed by software companies to facilitate offshore software development. • Quality consciousness makes software companies obtain ISO/CMM certification. • Oracle sets up development centre in Bangalore. • Indian copyright act amended – stiffer penalties for infringement.

1995	<ul style="list-style-type: none"> • First commercial Internet service started by VSNL. • 100% tax holiday for software export earnings. • Private e-mail service introduced (non Internet). • DoE launches programme to accredit private computer training institutes due to proliferation of below par training institutes (named DOEACC scheme).
1996	<ul style="list-style-type: none"> • NASSCOM sets up Special Interest Group (SIG) to solve Y2K problem. Indian software companies advertised as Y2K solvers. • Indian software companies improve systems while fixing Y2K bug at little extra cost as strategy to get customers. • Rediff.com established - first e-commerce portal in India. • Software export reaches USD 1 Billion.
1997	<ul style="list-style-type: none"> • Digital Signal Processing chip "Ankur" designed by TI India centre at Bangalore. • Compaq and IBM overtake sales of PCs by local manufacturers. • 23% of INFOSYS revenue due to Y2K. • GE Capital International Services starts back-office services centre.
1998	<ul style="list-style-type: none"> • Prime Minister of India declares "IT India's Tomorrow". • IT task force set up by the government - comes up with 108 recommendations to promote IT among which is setting up of one Indian Institute of Information Technology in each state. • 109 companies receive ISO quality certification. • WIPRO the second IT company in India to get CMM level 5 quality certificate. • IIIT/Allahabad established. • VSNL establishes connection to Global One's 1400 points of presence worldwide. • Microsoft Software Development Centre started at Hyderabad. • Motorola Design Centre established in Delhi. • IBM Research Centre set up in New Delhi.
1999	<ul style="list-style-type: none"> • INFOSYS listed in NASDAQ. • IBM sets up fully owned subsidiary in India. Tata's stake in TATA- IBM bought by IBM. • 100% Foreign Direct Investment in IT allowed paving way for MNCs entry into India. • 6 out of 12 SEI CMM level 5 companies in India. • Nationwide linking of Railway Reservation System.
2000	<ul style="list-style-type: none"> • IT Act 2000 passed by Parliament to facilitate e-commerce. • Software export reaches USD 5 billion. • HP Global sets up BPO in Bangalore. • 12 Software Technology Parks host 1196 software companies. • Startup company Spectramind gets venture capital funding of Rs. 1 billion (USD 23 million) to set up back-office to process transactions of Internet portals worldwide. • Private companies allowed setting up international gateways.
2001	<ul style="list-style-type: none"> • Tata group takes over 51% of CMC Ltd. from the government. • Tata group takes over VSNL. • 10 companies obtain CMM level 5 certificates. 14 companies obtain CMM level 4 certificates. • Dell sets up R&D centre. • Simputer, a hand-held multilingual computer, designed by a group of IISc and Encore Software Ltd. engineers at Bangalore. Attracts worldwide attention. • Accenture starts centre in Mumbai.
2002	<ul style="list-style-type: none"> • Agrawal-Kayal-Saxena algorithm:"Primes in P" attracts worldwide attention. • National Institute for Smart Governance set up in Hyderabad (joint initiative of NASSCOM, Government of India and Government of Andhra Pradesh). • Internet based booking of tickets on the Indian Railways.
2003	<ul style="list-style-type: none"> • Bharati Airtel (largest mobile telephone provider in India) outsources all IT work to IBM India. • CDAC's PARAM PADMA ranks 171 in top 500 high performance computers. • High performance DSP chip designed at TI India at Bangalore. • Software Technology Parks India (STPI) centres across India reach 44. • Yahoo sets up R and D Centre at Bangalore (first outside the USA).

2004	<ul style="list-style-type: none"> • National E-Governance plan announced. • General Elections held using only Electronic Voting Machines (1,075,000 EVMs deployed all over India). • TCS, INFOSYS and WIPRO all cross USD 1 Billion revenue. • TCS becomes a publicly listed company. • Government of India announces Broadband Policy; fibre to home, DSL, cable to home etc. Targets 40 million Internet users and 40 million broadband users by 2010. • Google sets up first R&D Centre outside the USA in Bangalore. • IBM acquires Daksh, the largest Indian BPO company. • Number of employees in IT industry reaches 1 million. • State Wide Area Network for each state to be set up with minimum bandwidth of 2Mbps. • Mobilis, a low cost mobile tablet computer designed by Encore Software Ltd., Bangalore, attracts wide attention.
2005	<ul style="list-style-type: none"> • Oracle acquires IFlex an Indian Banking software product company. • Special Economic Zone (SEZ) Act passed. SEZ defined as “specifically demarked duty-free enclave deemed to be foreign territory (out of customs jurisdiction) for trade, duties and tariffs”.
2006	<ul style="list-style-type: none"> • CISCO establishes Globalization Centre East in Bangalore. • IBM announces plans to invest USD 5 billion in India. • SAP (German ERP major) announces USD 1 billion investment in India over next 5 years. • India’s software and services export revenue reaches USD 10 billion.
2007	<ul style="list-style-type: none"> • 257 IT companies set up in SEZ. • Special incentive package announced by the Department of Information Technology to encourage investments in semi-conductor fabrication industry. • EKA supercomputer fourth fastest in the world and fastest in Asia built by the Computational Research Laboratory of the Tata group.
2008	<ul style="list-style-type: none"> • TI (India) designs single-chip solution for ultra-low-cost mobile handset. • Accenture opens Technology lab in Bangalore (Fourth in the world after the USA and France). • 2G spectrum allocation on first come first served basis. • IT (amendment) Act passed by Parliament to strengthen IT Act 2000. • National Knowledge Network project started by the Government of India.
2009	<ul style="list-style-type: none"> • IBM has second largest workforce in India after the USA. Will invest USD 100 million for global mobile services research in India. • SAP’s third co-innovation lab in Bangalore (other labs in Palo Alto and Tokyo).
2010	<ul style="list-style-type: none"> • IT exports including software, services and BPO reaches USD 50 billion. • IT domestic revenue USD 24 billion. • 55% of the global outsourcing market sourced from India. • Indian IT companies present in 52 countries and have 400 of the Fortune 500 companies as clients. • Direct employment 2.4 million in IT and 8.2 million in support services. • 6.5% of GDP earned by IT industry. • Rs.600 billion allocated over a 10 year period for the National Knowledge Network.

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