CHAPTER – II
HISTORICAL PERSPECTIVE

1. HISTORY OF COMPUTER

The ABACUS which emerged about 5000 years ago in Asia Minor and is still in use today, may be considered as the first computer.\(^1\) They very first modern electronic computer became operational only in early 1940’s. In fact, it's only a little more than just five decades ago since the first modern electronic computer was brought into existence for the purpose of business data processing. Computers before that were only used in scientific and technological field.

Although the present modern electronic computers are very recent but the idea was conceived far back. The same could be seen by the advents of the history. In early days when our ancestors used to reside in caves the counting was a problem. Still it was easier as he could count on his fingers but gradually it started becoming difficult. As the belonging and possession increased, the need of more counting tools grew. It was not possible to have more fingers. The record keeping switched to number of stones and then to scribbling on the walls of their caves. But it was not possible to restrict oneself to stones and walls and they had to look out for some other counting devices. As the civilization grew in mid-seventh century, the adding tools and devices started developing across the world. Thus we can say that idea of computing is as old as the civilization itself. It is very important to learn how people attempted to create early computers as they played very important role in reaching this state.

When they started using stones to count their animals or the possessions, they never knew that this will lead to a computer of today. People started following a set of procedures to perform calculations with these stones, which later led to creation of a digital counting device, which was the predecessor of a computer.

1450 B.C. Abacus-China

The abacus is the first known calculating device. This illustrates how the ancient computers worked. It was invented by the Chinese and is still widely used in the far east for commercial calculations. In its primitive form, it consists of a wooden frame with a number of wires with beads strung through them. The beads are used for counting and calculations. To show a number, beads are pulled down so that each rod represents a digit.¹

1600 Napier Bones

Another counting device, “John Napier”, a Scottish mathematician, invented it. The “bones” were strips of ivory with numbers written in them. When the bones were arranged properly, the user could read the numbers in adjacent columns to get the answer of a multiplication operation.²

In 1621, an English mathematician and clergyman called William Oughtred used Napier’s Logarithms as the basis for the slide rule. However, although the slide rule was an exceptionally effective tool that remained in common use for over three hundred years, like the abacus it also does not qualify as a mechanical calculator.³

In 1623, Wilhelm Schickard built the first digital mechanical calculator and thus became the father of the computing era. Since his machine used techniques such as logs and gears first developed for clocks it was also called a “calculating clock.”⁴

Napier’s invention led directly to the slide rule, first built in England in 1632 and still is use in the 1960’s by NASA engineers of the Mercury, Gemini, and Apollo programs which landed men on the moon.⁵

³ http://www.maxmon.com/history.htm
⁵ http://computersciencelab.com/computerHistory/History.htm.
1642 A.D. Adding Machines – Blaise Pascal – France

The well known French Scientist and Mathematician, Blaise Pascal invented the first machine which could add, carry digits automatically. He was only nineteen years old at the time. His machine was so revolutionary that the principle behind it is still used in most of the mechanical counters being used today. He became European great philosopher and mathematician. His father was a tax commissioner and he used to accompany his father to his office. There he left the need of some calculating device, which could save people like his father from that boring and tedious job of doing sums over and again. He came out with a machine “Pascaline” that worked with clockwise hears and levers. The machine was basically developed to perform addition and subtraction operations. The machine rotated wheels to register values and lever was used to perform the carrying operations from one wheel to another. Although the machine was not accepted by the business but it initiated a series of inventions. To give honour to Pascal, a computer programming language was named after him. This language, Pascal, is generally used to teach programming to budding programmers.

1692 A.D. Multiplying Machine Gottfried Wilhelm Von Leibniz-Germany

Gottfried improved upon Pascal’s machine and introduced a mechanism to carry out automatic multiplication of numbers. Leibniz is best known for his work with Sir Isaac Newton in developing a branch of mathematics known as calculus. The calculator invented by him could add, subtract, multiply and divide accurately. It could even perform square root function, although not always accurately.

1813 A.D. Difference Engine – Charles Babbage-England

Since early 19th Century, Charles Babbage, an Englishman, had been working on the development of a machine, which could perform, complex calculations. In 1813 A.D., he invented the ‘Difference Engine’ which could perform complex calculations and print them out as well. This machine was a steam-powered machine. While Babbage was working on his doctorate, he had to

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solve many complex formulae and he found it difficult to cope up with them in the given time period.

**Early 1800’s Jacquard Loom – Joseph Marie Jacquard**

In the early nineteenth century, a French weaver Joseph Marie Jacquard developed a programmable loom, which used large cards and holes punched in them to control the pattern automatically\(^1\). The output was a thick rich cloth with repetitive floral or geometric patterns.

Jacquard patterns are still produced to this day. Others adapted the punched cards and used as the primary form of input. They were used till about 20-25 years ago. The Jacquard loom modernizes the textiles industry.\(^2\)

**1862 “Arithrometer” – Charles Xavier Thomas – France**

This was the first calculator with commercial prospects. Frenchman Charles Xavier Thomas (known as Charles of Colmar) developed it. He won a gold medal at the International Exhibition in London. The machine performed addition, subtraction, multiplication, division and square root functions accurately.

**1863 A.D. Analytic Engine – Charles Babbage – England**

Babbage had been working on a very elaborate machine all this time. By 1863 he had all the plans ready for the machine, which he named the Analytic Engine. He had conceived of a mechanism, which could carry out long sequence of complex calculations under automatic control. It would have the ability to store 1000,50-digit numbers in one second and multiply 20-digit numbers in three minutes.

Babbage used a form of punched cards for inputting the data. That would have been complete modern computer but technology at that time was not advanced enough to provide him with the hardware he required. He was thinking too far ahead of his time and his ideas could not be implemented. However, he was the first person to conceive of the “Stored Program Concept.”

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\(^1\) “Computer History”, [http://computersciencelab.com/ComputerHistory/HistoryPt.2.htm](http://computersciencelab.com/ComputerHistory/HistoryPt.2.htm).

Babbage worked on his plans for years. He was accompanied by Augusta Ada Byron (the daughter of famous poet Lord Byron), a brilliant mathematician whose contribution to Babbage’s work is tremendous. She is the first female computer scientist and a programmer. A computer programming language, Ada has also been named in her honour.

Charles Babbage is recognized as “the father of Computers”.¹ Although his plans could not be materialized and his analytical engine could not be completed in his life span but a working analytical engine was finally developed from his plans in year 1991 and is on the display at the Charles Babbage Institute at Minnesota.

1896 A.D. Punch Card Machine – Dr. Hermann Hallerith – USA

Dr. Hallerith is also a great figure in the history of computers. Dr. Hallerith used the idea of using cards and punching holes in them for speeding up the collation job of the American Census of 1880 (The US Constitution calls for the census of the population after every ten years so as to determine the representation in the US House of representatives). He devised a card in which holes would be punched to indicate the presence of a particular criteria in a respondent. Using wire brushes in his machine the hole punched earlier in a the card, enabled a wire to touch a metal plate which carried on electric charge. The charge was transmitted to respective electric counters which automatically incremented the numbers. After the census was completed, Hallerith perfected his punched card equipment and marketed it. He founded the Tabulating Machine Company in 1896 to continue his work. Although the machines were in great demand but then Hallerith was not happy as he could not pursue his research work. In 1911 the Tabulating Machine Company merged with other two companies to form Computing Tabulating Recording Company. Then Hallerith again started concentrating in inventing better equipment.

One of the partners, the marketing expert named Thomas Watson Sr. led the new company. Under his guidance, the company wrote a great success story.

¹ "The Computer History's Story", http://www.crews.org/curriculum/ex/compsci/articles/history.htm
Finally in 1924, management decided a new name for the company and then Computing-tabulating-Recording Company converted to International Business Machines Corporation (IBM).

His idea has been refined and improved and punch cards are still used for recording data items to be input to computers. During the Second World War, an acute need for fast calculating machines was felt to carryout complex defense calculations. The British and the American Government sponsored a number of projects in major Universities for the development of fast and accurate calculators and computers. This proved to be a boon for the industry which has never looked back since then.

**EARLY ELECTRONIC COMPUTERS**

**1930's Turing Machine Alan Turing**

In late 1930s the English mathematician wrote a paper describing the capabilities and limitations of a hypothetical general purpose computing machine “Turning Machine”. Turing also helped constructing Robinson, the British Computer used during the World War-II to decode German messages that were encrypted by the German Enigma machine. In 1950, Turing also published a book titled “Computer machinery and Intelligence”, in which he proposed the Turing test of Artificial Intelligence. That test is still used by scientists. Turing test basically explains that computer is capable of “interacting” with the user.¹

The Z1 originally created by Germany’s Konrad Zuse in his parents living room in 1936 to 1938 is considered to be the first electrical binary programmable computer.²

**1939 ABC (Atanasoff berry Computer) John Vincent Atanasoff**

Professor John Vincent Atansoff is remembered because of his contribution of some concepts, which led to the development of the electronic computer. He with a graduate student, Clifford Berry built an electronic calculating machine that

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could solve the problems of equations. ABC was first special purpose, electronic computer.  

1944 Mark I-Dr. Howard Aiken

Dr. Howard Aiken, who read the notes of Ada Byron was keenly interested in constructing an “Analytical Engine”. He approached IBM. In spite of doing very well with punched card equipments, IBM hired Aiken and allocated $1 million for the Research. Aiken, with his team members, came out with Mark I. Mark I was partly electronic and partly mechanical. It was bulky—8 feet high and 50 feet long. It took 3 to 5 seconds to perform a single multiplication operation.

1940s A.D. Mark I – University of Pennsylvania – USA

A group of scientists devised the Mark I, which were the first electromechanical calculators in the world. It utilized the punch-card concepts the Hallerith and powers, and it functioned by a series of electromagnetic relays and mechanical arithmetic counters.

During the World War II American Military asked Dr. John Mauchy of University of Pennsylvania to develop a machine which can quickly calculate the trajectories for missiles. A graduated student Presper Eckert helped him in building the device. This is another thing that the computer could not be completed until the two months after war ended.

1943 A.D. ENIAC-USA

The outbreak of World War II produced a desperate need for computing capability, especially for the military. New weapons systems were produced for which trajectory tables and other essential data were lacking. In 1942, John P. Eckert, John W. Mauchly, and their associates at the Moore School of Electrical Engineering of the University of Pennsylvania decided to build a high-

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1 John Atanasoff and Clifford Berry, "The first all electronic computer", http://inventors.about.com/library/weekly/aa050898.htm;
speed electronic computer to do the job. This machine became known as ENIAC, for Electronic Numerical Integrator and Computer (or Calculator). The size of its numerical word was 10 decimal digits, and it could multiply two such numbers at the rate of 300 products per second, by finding the value of each product from a multiplication table stored in its memory. ENIAC was thus about 1,000 times faster than the previous generation of relay computers. This was faster than Mark I but the major problem of using this computer was that the staff had to rewire the machine completely for carrying out the new instructions.

1947 A.D. EDSAC- Cambridge University – England

Electronic Delayed Storage and Calculation (EDSAC) was the name given to the first electronic computer in the world. It was the first one to implement the ‘stored program concepts’. Known later as the John Von Neumann concept, it proposed the use of binary numbers and the internal storage of instructions in digital form. Bell Telephone laboratories develop the transistor in 1947.

1951 A.D. UNIVAC – I – USA

By now numbers of commercial companies were working on the development of computing systems. Sperry Rand Corporation of USA introduced the first commercial computer to the world and named it UNIVAC-I (Universal Automatic Computer). Its introduction was followed by the entrance of IBM into the computer field with IBM-701 Computer.

Five Generations of Modern Computers

In recent years, the computer industry has grown at a phenomenal pace. In a short time of 35 years or so computers have improved tremendously. In the last
decade the speed of computer has increased 200 times. Not only has that reliability curve also taken a sharp increase. The cost per unit of calculating has gone down by 500 times. The storage capacity is increasing so fast that now it seems that nothing is impossible to store. Large data can be store in very small devices.

The term “generations” was initially introduced to distinguish between different hardware technologies. Gradually it shifted to both hardware and software as the total systems consists of both of them.

The computers can be divided in five past generations,¹ i.e., depending upon the technologies used. The five generations of computer are:

**First Generation Computers (1951-1958):-**

Until 1951, electronics computers were the exclusive possession of scientists and military. Till then nobody tried to use them of business purpose. The idea of marketing them was conceived by Mauchly and Eckert, creators of ENIAC’s. As US census bureau was already using IBCP cards, they were the pioneers in buying this computer for the first time in 1951. The company created by MUCHLY and ECKERT became UNIVAC division of Sperry and Corporation (later known as UNISYS).

The bringing of first UNIVAC (Universal Automatic Computers) general purpose electric digital computer, marks the beginning of the first generation of electronic computers.

These computers used valves and all the components were joined by copper wires. Due to large size of the components and due to the facts that the components had to be spaced apart as the valves dissipated a lot of heat, the computers were very bulky and required huge electric power, air conditioners, maintenance and space for their installation. Further, the speed of operation was very slow and had a very low reliability factor as vacuum tubes failed frequently. They were still given the name of “electronic brains” by the journalist. They also

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¹ The word 'generation' means a step in computer technology. Originally a change in the hardware technology was considered as a change in era or generation. But now-a-days it includes hardware and software both, Prof. S.R. Bhansali, "The Information Technology Act, 2000", University Book House Pvt. Ltd., Jaipur, Ed.2003, p.10.
said that these electronic brains will change the world one-day. Later IBM 650 and few other systems. These were called the first generation computers. The popular brand of first generation computer was IBM 650, which had a magnetic drum memory and utilized punch cards for input and output.\footnote{"IBM 650", \url{http://www.knowledgerush.com/kr/encyclopedia/IBM_650/}} This type of computer was of an intermediate size and was designed to meet the requirements of business and scientific applications. The available memories ranged from a few hundred thousand words of main storage. The cycle time was of the order of few milliseconds. It was only after 1957 that magnetic tapes were introduced as a faster and convenient storage medium. A single tape could hold approximately 1100 punch cards (i.e. about 2 pages of information).

IBM made 19 IBM 701 computers and at that time industry felt that these 19 computers are sufficient enough to take care of American business. These computer required special facilities and highly trained personnel.

The instructions given to FGC were in machine language (i.e. 0’s and 1’s). As the language was tough and understood by very few people. There were very few personnel available for it.

Computer\footnote{First Computer Came in India in 1956; \url{http://wiki.answers.com/Q/When_come_computer_in_India}} belonging to this generation had the following characteristics:

(i) Comparatively large in size as compared to present day computers.
(ii) Generated lot of heat, they were not consistent and reliable as the values tended to fail frequently.
(iii) Low capacity internal storage.
(iv) Individual, non-related models.
(v) Processors operated in the milliseconds speed range.
(vi) Internal storage consisted of magnetic drum and delay lines.

**Second Generation Computers (1959-1964)**

FGC were very unreliable, mainly because of vacuum tubes which kept on burning out. Users had to be prepared all the time with dozen of extra tubes to
replace them. The computers of this generation were characterized by the use of Solid State devices (transistors) instead of vacuum tubes. Transistorized circuits were smaller, generated little heat, were less expensive and consumed less power than vacuum tube circuits and were much greater in processing capacity. Since transistors had a faster switching action, this generation computers were significantly faster and smaller and were more reliable too than first generation computers. The use of magnetic cores as the primary internal storage medium and the introduction of removable magnetic disc pack were other major developments of the second generation. Although magnetic tapes were still used commonly. These computers had built in error detecting devices and more efficient means were developed to input retrieve from the computer. They were easier to work with. More efficient programming methods and higher level languages like FORTRAN and COBOL become available. It was easily understandable by people especially because no codes (like Assembly language) has to be remembered by the programmers. Moreover unlike Assembly language the high level language were not machine specific i.e. same set of programs could be used on computers produced by different manufactures. The instruction cycle time dropped from several hundred microsecond of the first generation in tens of microseconds of the second generation. The main memory in these systems could store several hundred thousand words.

This generation of computers could communicate with others using telephone lines. Transmission of data from one computer to another was possible in this generation of computers. Although the processing was very slow but the idea was convenient which was further developed in next generations. The problems which second generation computer faced was that input and output devices were too slow. The projects started in second generation to solve these problems. They used second generation technology but finally proposed results in third generation.

Dr. Daniel Slotnick worked out first solution. He was working with Burroughs Corporation, at that time. He designed a computer for the US department of Defence and tried to solve the problem of machines sitting idle
waiting for input and output. The computer known as ILLIAC IV was developed. It has 4 control units and thus was able to perform input/ output and processing (mathematical operation) at the same time. Slotnick was granted a patent for “Parallel Processing”. They were also called as first super computer. The second super computer was proposed by MIT (Massachusetts Institute of Technology) by a group of students and professors. The name of the project was MAC (Multiple Access Computer) and concept of multiprogramming was developed there. The system could process the programs concurrently which were run by different users.

Some of the popular models in this generation of computer systems, we IBM-1401, IBM-1620, BURROUGHS B-200 SERIES, HONEY-WELL H-400, NATIONAL CASH REGISTER NCR-315, 500 AND UNIVAC-1004. Many of these computers were used for business applications.

Computers of this generation had the following characteristics:

(i) Smaller in size compared to the first generation computers.
(ii) Generated a lower level of heat, as components were much smaller.
(iii) Greater degree of reliability because of solid state technology.
(iv) Higher capacity of internal storage.
(v) Use of core storage instead of magnetic drum and delay lines.
(vi) Related series of processors-the family concept.
(vii) Processor operated in the microsecond speed.
(viii) High cost direct accesses storage.

**Third Generation Computers (1965-1971)**

A revolution in the computer developments took place with the development of Integrated Circuits (IC) on a single silicon chip. In 1958, Jack St. Clair Kilby and Robert Noyce invented the first IC. IC incorporated number of transistors and electronic circuits on a single wafer or chip of silicon. IC is called chip because of the way they are made. They are also called as semi conductors as combining layers of materials that have varying capacity to conduct electricity.
form them.¹ This ushered in the third generation of computer systems in 1964. The integrated circuits enhanced considerably the processing capability and the speed of the computer. During the period 1964 to 1970, capability of placing 12 or more logic gates on a single chip was developed into a well-defined technology of small-scale integration (SSI). A logic gate is a circuit to perform arithmetic of addition, subtraction, multiplication or division. In 1970 this technology was redefined to a point where hundreds or more gates could be placed on a chip of silicon and incorporated as functional logic block in an overall system. This technology was termed as Middle Scale Integration (MSI). There was intense pressure on the semiconductor manufacturer to provide greater densities of gates on a single integrated circuit chip. Consequently more complex chips were developed with the ultimate goal of obtaining a central processor on a single physical circuit’s element. These circuits had higher reliability and lower power consumption and substantially reduced size. Component densities of 1,000 to 10,000 gates on a single silicon chip became possible. The technology consisting of 1,000 gates per chip, termed large scale integration (LSI), started to become commercially viable in 1975. The later technology consisting of more than 10,000 gates per chip is called very large scale integration (VLSI) or grand scale integration (GSI). This circuit became very useful in assembling computers. Some of the popular third generation computers are- IBM-360 series, IBM-370 series and ICL-2900 series. The large advanced computer systems are usually called ‘Main Frame’.

Integrated circuits technology is responsible for bringing in revolution in the computer industries. Scientists were aware that more powerful computers can be built by building more complex circuits, but as these circuits had to be wired by hand, these computers were too complex and expensive. IC solved this problem by introducing a computer that costed lower then first generation computer and offered more memory and faster processing.

In 1962, a new company built a plant in “Silicon Valley”, near Sanjose, California. Digital Equipment Corporation (DEC) revolutionized the total computer industry with this computer which used IC’s.

The first commercially available minicomputer was introduced in 1965. The PDP-8 (Programmed Data Processor) could fit easily in the corner of a room and did not require any attendant to it. The computer could be accessed by number of users from different locations of the building. (That was actually implementing time-sharing, which was developed in second generation). The price was one tenth of the traditional main frame, which made it possible for smaller companies to afford.

IBM was dominant in the market by releasing 360 series of computer. They were of different sizes of main frame computers. The main advantage of using this computer was use of same machine language compatibility thus making it easy and cost effective specially when upgraded.

By 1967, IBM decided to change its track as number of programming language came in the market. This was the beginning of software industry as the languages grew and people who had the skills to translate user requirement in these languages were high on demand now.

One more technology development which took place now was the launching of first telecommunications satellite. The communication stations on the earth were now in a position to send and receive data by means of satellite enabling communications between the computer systems around the world.

Admiral Grace Murray Hopper, also known as “the mother of COBOL” and “Amazing Grace” was sent to Harvard to work on the first large scale digital computer. She travelled to various computer conferences and gave lectures in various colleges about the data processing insights. She wrote more than 50 papers and articles on software and programming language.

Dr. Hopper tells about the origin of Bug and Debug in her book “understanding computers”. It was 1945, when students were working on Mark II

1 "PDP-8", http://www.knowledgerush.com/kr/encyclopedia/PDP-8/
and it stopped working. Programmers kept trying to figure out what’s wrong with the computer finally discovered that there was a moth caught in one of the relays causing the whole trouble. They removed it and the computer started working fine. There the terms “Bug” and “Debug” were introduced. The first bug can still be seen taped on a page in a logbook at the Naval Weapons Museum in Dahlgren, Virginia.

Computers of this generation have the following characteristics:
1. Smaller in size as compared to second generation computers.
2. Higher capacity internal storage.
3. Remote communication facilities.
4. Multiprogramming facilities.
5. Reduced cost of direct access storage.
6. Processors, which operate in nanosecond speed range.
7. Ranges of computers with a common architecture whereby models were upward compatible.
8. Use of high level languages such as COBOL.

Fourth Generation Computers (1971-Present)

The 1970’s marked the beginning of a new generation of computers, produced by computer giants like IBM, ICL, NCR and Burrought. From design viewpoint, the new generation provided increased input-output capability, longer component life as well as greater system reliability. From the functional viewpoint, new powerful language were developed to broaden the use of multiprogramming and multiprocessing and major shift from batch processing to on line, remote interactive processing.

The development of microprocessor chip, which contains an entire central processing unit (CPU) on a single silicon chip led to the mushroom growth of inexpensive computers. They are not computers by themselves but they can perform all the functions of arithmetic logic unit and control units of the CPU. When these microprocessors are connected with memory and input-output devices, they become microcomputers. The semiconductor memories are also very
small and very cheap. There are several types of memory chips. Three of the most commonly used are: (a) Random Access Memory (RAM) in which data can be read or written corresponding to the main memory of the conventional computer, (b) Read Only Memory (ROM) and (c) Programmable Read Only Memory (PROM). In the ROM chips, the data is ‘burnt’ into the chip at the manufacturing time. It cannot be changed. These chips are used in systems where the data need not to be changed. Even when power supply fails, the data remains in the memory. In case of PROM a user can program and even correct the data if necessary. The fourth generation of computers may be called microcomputer generation. The input-output devices used with the fourth generation computers are quite advanced. Among the advanced input-output devices employed in fourth generation computers are optical readers by which whole documents can be led into the computer, audio response terminals by which an operator can vocally introduce data or instructions and graphic display terminals by which an operator can feed pictures into the computer.

The use of very large integrated circuits (VLSI) has made the fourth generation (micro) computers very compact, much less expensive, faster, more reliable and of much greater data processing capacity than equalized third generation computers.

Some computers belonging to fourth generation are DEC-10, STAR-1000, PDP-11 and APPLE Series Personal Computers.¹

In 1975 Ed. Roberts coined the term personal computer when he introduced the Altair 8800.² Although the first personal computer is considered to the Kenback-I, which was first introduced for $ 750 in 1971.

The Micral is considered the be the first commercial non-assembly computer. The computer used the Intel 8008³ Processor and sold for $ 1750 in 1973.⁴

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³ The Intel Pentium 4 used in today's PCs is still compatible with the Intel 8008 used in IBM's first PC; http://www.computersciencelab.com/ComputerHistory/HistoryPt4.htm.
Fifth Generation Computers (Present and Beyond)

Till fourth generation of computers, the major stress was on improving the hardware from valves to transistors and then to integrated circuits, which resulted in miniaturization and fast speed of computers. However, the lack of thinking power has forced the scientists to work further for fifth generation computers. The concept of “Artificial Intelligence” is being used in these computers and Japanese call them “Knowledge Processors”. Automatic programming, computational logic, pattern recognition and control of robots, the processes and which need skill and intelligence are examples of Artificial Intelligence. These computers, when developed, will be able to execute billions of instructions per second and will have unimaginable storage capacities. The present day high level languages will become obsolete on these machines and new computer languages and related software will be needed.

The fifth generation gives the highest priority to making systems that are easy and natural to use. Its other objective relates to the types of technological support needed to support “problem solving systems” according to the fifth generation committee. “In these systems”, the Committee adds”, Intelligence will be greatly improved to approach that of a human being. When compared to conventional systems, the man-machine interface will be closer to that of human behavior”.¹

In 1987, IBM introduced its PS/2 machines, which made the 3½-inch floppy disk drive and video graphics assay standard for IBM computers. IBM released a new operating system, OS/2, at the same time, allowing the use of a mouse with IBMs for the first time.² The fifth generation has three functional requirements:

- easy to use computers with high intelligence and natural human input and output mechanism;
- reliable and efficient software development by new languages, new computer architectures and systems software which overcome previous problems and

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² http://www.computerhistory.org/timeline/?category=cmptr.
• improved overall functions and performance aimed at making computers smaller, lighter, faster, of greater capacity, more flexible and more reliable.

In 1970s, Alan Kay of the Xerox Palo Alto Research Center had a vision for a wireless portable computer roughly the size of a notebook. He called it the Dynabook. In 1979, William Moggridge of Grid Systems Corporation created the first laptop computer. The Grid Compass Computer 1109. Termed the on Grid Compass, the computer featured the clamshell design that is still used for most modern laptops and could be run on battery power. The next mobile computer produced was in 1983 by Gavilan Mobile Computers. It was peculiarly built and the screen folded over the keyboard when closed. It weighed 9 pounds. Gavilan later failed largely due to their computer being incompatible with other computers. Mainly because the Gavilan laptop used their own operating system. Many historians consider the Gavilan as the first fully functional laptop computers. Apple computers introduced the apple IIc model in 1984, but is wasn't all that much better than what Gavilan had produced a year earlier. Among the first commercial IBM-Compatible laptops were the IBM PC Convertible introduced in 1986.

2. HISTORY OF INTERNET

Wilhelm Eduard Weber who was the first to anticipate the Internet. He wrote in 1855: “When the globe is covered with a net of railroads and telegraph...
wires, this net will render services comparable to those of the nervous system in the human body, partly as a means of transport, partly as a means for the propagation of ideas and sensations with the speed of lightning.” Operating today at transmission rates of up to several gigabits/second, the Internet has proved every forecast of its limitations to be wrong so far, and it is likely that the entire communications infrastructure of the 21st century will be organized around the Internet or its successor.¹

The advanced research projects agency was formed with an emphasis towards research, and thus was not oriented only to a military product. The formation of this agency was part of the U.S. reaction to the then Soviet Union’s launch of Sputnik in 1957. (ARPA draft, III-6).²

Following the launch of Sputniks, the Advanced Research Projects Agency (ARPA) was founded essentially funded by the US Department of defense but also oriented towards academic research. In the climate of the cold war, a main concern was that a nuclear assault would reduce the ability of centers to communicate with each other. Johan Naughton has recently criticized the cliché that the Internet was simply the product of what Eisenhower called the military-industrial complex.³

J.C.R. Licklider of MIT, first proposed a global network of computers in 1962, and moved over to the Defense Advanced Research Projects Agency (DARPA) in late 1962 to head the work to develop it. Leonard Kleinrock of MIT and later UCLA developed the theory of packet switching, which was to form the basis of Internet connections. Lawrence Roberts of MIT connected a Massachusetts computer with a California computer in 1965 over dial-up telephone lines. It showed the feasibility of wide area networking, but also showed that the telephone line's circuit switching was inadequate. Kleinrock's packet switching theory was confirmed. Roberts moved over to DARPA in 1966 and developed his plan for ARPANET. These visionaries and many more left unnamed here are the real founders of the Internet.

³ "The History of ARPA Leading up to the ARPANET", http://www.dei.isep.ipp.pt/~acc/docs/arpa...1.html.
When Senator Ted Kennedy heard in 1968 that the pioneering Massachusetts Company Bold Beranek and Newman (BBN) had won the ARPA contract for an 'Interface Message Processor' (IMP), he sent a congratulatory telegram to BBN for their ecumenical spirit in winning the 'interfaith message processor' contract.

The Internet, then known as ARPANET, was brought online in 1969 under a contract let by the renamed Advanced Research Projects Agency (ARPA) which initially connected four major computers at universities in the southwestern US (UCLA, Stanford Research Institute, UCSB, and the University of Utah). The contract was carried out by BBN of Cambridge, MA under Bob Kahn and went online in December 1969. By June 1970, MIT, Harvard, BBN, and Systems Development Corp (SDC) in Santa Monica, Cal. were added. By January 1971 Stanford MIT’s Lincoln Labs Carnegie-Mellon and Case-Western Reserve U were added. In months to come, NASA/Ames, Mitre, Burroughs, RAND, and the U of Illinois plugged in. After that, there were far too many to keep listing here.

Charley Kline at UCLA sent the first packets on ARPANet as he tried to connect to Stanford Research Institute on Oct 29, 1969. The system crashed as he reached the G in LOGIN!

The Internet was designed in part to provide a communications network that would work even if some of the sites were destroyed by nuclear attack. If the most direct route was not available, routers would direct traffic around the network via alternate routes.

The early Internet was used by computer experts, engineers, scientists, and librarians. There was nothing friendly about it. There were no home or office personal computers in those days, and anyone who used it, whether a computer professional or an engineer or scientist or librarian, had to learn to use a very complex system.

According to a CNN transcript of an interview with Wolf Blitzer, Al Gore said, "During my service in the United States Congress, I took the initiative in
creating the Internet." Al Gore was not yet in Congress in 1969 when ARPANET started or in 1974 when the term Internet first came into use. Gore was elected to Congress in 1976. In fairness, Bob Kahn and Vint Cerf\(^1\) acknowledge in a paper titled Al Gore and the Internet that Gore has probably done more than any other elected official to support the growth and development of the Internet from the 1970's to the present.

E-mail was adapted for ARPANET by Ray Tomlinson of BBN in 1972. He picked the symbol from the available symbols on his teletype to link the username and address. The telnet protocol, enabling logging on to a remote computer, was published as a Request for Comments (RFC) in 1972. RFC's are a means of sharing developmental work throughout community. The ftp protocol, enabling file transfers between Internet sites, was published as an RFC in 1973, and from then on RFC's were available electronically to anyone who had use of the ftp protocol.

Libraries began automating and networking their catalogs in the late 1960s independent from ARPA. The visionary Frederick G. Kilgour of the Ohio College Library Centre (now OCLC, Inc.) led networking of Ohio libraries during the 60's and 70's. In the mid 1970's more regional consortia from New England, the Southwest states, and the Middle Atlantic states, etc., joined with Ohio to form a national, later international, network. Automated catalogs, not very user-friendly at first, became available to the world, first through telnet or the awkward IBM variant TN 3270 and only many years later, through the web.

Ethernet, a protocol for many local networks, appeared in 1974, an outgrowth of Harvard student Bob Metcalfe's dissertation on 'Packet Networks'. The dissertation was initially rejected by the University for not being analytical enough. It later won acceptance when he added some more equations to it.

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\(^1\) The Inter Networking Working Group is founded to govern the standards of the Internet. Vinton Cerf is the Chairman and is known as a "Father of the Internet", "A Brief History of Cybercrime", http://www.wavefrontcg.com/A_Brief_History_of_Cybercrime.html.
The Internet matured in the 70's as a result of the TCP/IP architecture first proposed by Bob Kahn at BBN and further developed by Kahn and Vint Cerf at Stanford and others throughout the 70's. It was adopted by the Defense Department in 1980 replacing the earlier Network Control Protocol (NCP) and universally adopted by 1983.\(^1\)

In 1976, the Queen of England Elizabeth goes on live with the first royal e-mail message.\(^2\)

The Unix to Unix Copy Protocol (UUCP) was invented in 1978 at Bell Labs. Usenet was started in 1979 based on UUCP. Newsgroups, which are discussion groups focusing on a topic, followed, providing a means of exchanging information throughout the world. While Usenet is not considered as part of the Internet, since it does not share the use of TCP/IP, it linked unix systems around the world, and many Internet sites took advantage of the availability of newsgroups. It was a significant part of the community building that took place on the networks.

Similarly, BITNET (Because It's Time Network) connected IBM mainframes around the educational community and the world to provide mail services beginning in 1981. Listserv software was developed for this network and later others. Gateways were developed to connect BITNET with the Internet and allowed exchange of e-mail, particularly for e-mail discussion lists. These listservs and other forms of e-mail discussion lists formed another major element in the community building that was taking place.\(^3\)

The ARPANET was divided into two networks: MILNET and ARPANET.MILNET was to serve the needs of the military and ARPANET to support the advanced research component, Department of Defense continued to

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support both networks.¹

In 1986, the National Science Foundation funded NSFNet as a cross country 56 Kbps backbone for the Internet. They maintained their sponsorship for nearly a decade, setting rules for its non-commercial government and research uses.

As the commands for e-mail, FTP, and telnet were standardized, it became a lot easier for non-technical people to learn to use the nets. It was not easy by today's standards by any means, but it did open up use of the Internet to many more people in universities in particular. Other departments besides the libraries, computer, physics, and engineering departments found ways to make good use of the nets—to communicate with colleagues around the world and to share files and resources.

While the number of sites on the Internet was small, it was fairly easy to keep track of the resources of interest that were available. But as more and more universities and organizations—and their libraries-connected, the Internet became harder and harder to track. There was more and more need for tools to index the resources that were available.

The first effort, other than library catalogs, to index the Internet was created in 1989, as Peter Deutsch and his crew at McGill University in Montreal, created an archiver for ftp sites, which they named Archie. This software would periodically reach out to all known openly available ftp sites, list their files, and build a searchable index of the software. The commands to search Archie were unix commands, and it took some knowledge of unix to use it to its full capability.

McGill University, which hosted the first Archie, found out one day that half the Internet traffic going into Canada from the United States was accessing Archie. Administrators were concerned that the University was subsidizing such a volume of traffic, and closed down Archie to outside access. Fortunately, by that

The early days of the web was a confused period as many developers tried to put their personal stamp on ways the web should develop. The web was threatened with becoming a mass of unrelated protocols that would require different software for different applications. The visionary Michael Dertouzos of MIT's Laboratory for Computer Sciences persuaded Tim Berners-Lee and others to form the World Wide Web Consortium in 1994 to promote and develop standards for the Web. Proprietary plug-ins still abound for the web, but the Consortium has ensured that there are common standards present in every browser.

Since the Internet was initially funded by the government, it was originally limited to research, education, and government uses. Commercial uses were prohibited unless they directly served the goals of research and education. This policy continued until the early 90's, when independent commercial networks began to grow. It then became possible to route traffic across the country from one commercial site to another without passing through the government funded NSFNet Internet backbone.

Delphi was the first national commercial online service to offer Internet access to its subscribers. It opened up an email connection in July 1992 and full Internet service in November 1992. All pretenses of limitations on commercial use disappeared in May 1995 when the National Science Foundation ended its sponsorship of the Internet backbone, and all traffic relied on commercial networks. AOL, Prodigy, and CompuServe came online. Since commercial usage was so widespread by this time and educational institutions had been paying their own way for some time, the loss of NSF funding had no appreciable effect on costs.

Today, NSF funding has moved beyond supporting the backbone and higher educational institutions to building the K-12 and local public library accesses on the one hand, and the research on the massive high volume connections on the other.
Microsoft's full scale entry into the browser, server, and Internet Service Provider market completed the major shift over to a commercially based Internet. The release of Windows 98 in June 1998 with the Microsoft browser well integrated into the desktop shows Bill Gates' determination to capitalize on the enormous growth of the Internet. Microsoft's success over the past few years has brought court challenges to their dominance—We'll leave it up to you whether you think these battles should be played out in the courts or the marketplace.

During this period of enormous growth, businesses entering the Internet arena scrambled to find economic models that work. Free services supported by advertising shifted some of the direct costs away from the consumer—temporarily. Services such as Delphi offered free web pages, chat rooms, and message boards for community building. Online sales have grown rapidly for such products as books and music CDs and computers, but the profit margins are slim when price comparisons are so easy, and public trust in online security is still shaky. Business models that have worked well are portal sites, that try to provide everything for everybody and live auctions. AOL's acquisition of Time Warner was the largest merger in history when it took place and shows the enormous growth of Internet business! The stock market has had a rocky ride, swooping up and down as the new technology companies, the dotcom's encountered good news and bad. The decline in advertising income spelled doom for many dotcoms, and a major shakeout and search for better business models took place by the survivors.

A current trend with major implications for the future is the growth of high speed connections. 56K modems and the providers who supported them spread widely for a while, but this is the low end now. 56K is not fast enough to carry multimedia, such as sound and video except in low quality. But new technologies many times faster, such as cable modems and digital subscriber lines (DSL) are predominant now.

Wireless has grown rapidly in the past few years, and travelers search for the Wi-Fi "hot spots" where they can connect while they are away from the home or office. Many airports, coffee bars, hotels and motels now routinely provide
these services, some for a fee and some for free.

The next big growth area is the surge towards universal wireless access, where almost everywhere is a "hot spot". Municipal Wi-Fi or city-wide access, wiMAX offering broader ranges than Wi-Fi, Verizon's EV-DO, and other formats will joust for dominance in the USA in the months ahead. The battle is both economic and political.

Another trend that is beginning to affect web designers is the growth of smaller devices to connect to the Internet. Small tablets, pocket PCs, smart phones, game machines, and even GPS devices are now capable of tapping into the web on the go and many web pages are not designed to work on that scale.

As Heraclitus said in the 4th century BC, "Nothing is permanent, but change!"1

3. HISTORY OF CYBER CRIME OR COMPUTER CRIME

The first recorded cyber crime took place in the year 1820! That is not surprising considering the fact that the abacus, which is thought to be the earliest form of a computer, has been around since 3500 B.C. in India, Japan and China. The era of modern computers, however, began with the analytical engine of Charles Babbage. In 1820, Joseph-Marie Jacquard, a textile manufacturer in France, produced the loom. This device allowed the repetition of a series of steps in the weaving of special fabrics. This resulted in a fear amongst Jacquard's employees that their traditional employment and livelihood were being threatened. They committed acts of sabotage to discourage Jacquard from further use of the new technology. This is the first recorded cyber crime.2

Computer abuse started with the emergence of computer technology in the late 1940's. As the number of people in the computer field began to increase, that facet of human nature that wants to harm society for personal gain or to assuage intense personal problems took hold; the problem of abuse became especially

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acute as computer technology proliferated into sensitive areas in society, such as military systems, and computer users were increasingly in positions of trust. The abuse then spread to engineering, to science, and in parallel to business and personal applications.

The first recorded computer abuse occurred in 1958 (Parker et al., 1973). The first federally prosecuted computer crime in the USA, identified as such, was the alteration of bank records by computer in Minneapolis in 1966.

No valid representative statistics on computer crime exist, even through many surveys have been conducted and well-known organizations and individuals have quoted various statistics. Frequency, losses per year, rate of increase or decrease, percentages of perpetrators within or outside of victimized organizations, and the number of cases discovered and prosecuted are not known. To protect themselves, many victims try to deny their loss. No methods have been devised to apply uniform definitions, identify authoritative sources or conduct surveys in any statistically valid way.1 For example, the American Bar Association Task force on computer crime. Section of Criminal Justice, reported the result of an informal questionnaire survey in a report on Computer Crime (40), but stated:

One cannot extrapolate from the results of this limited survey to derive a valid “total annual dollar loss” figure for computer crime, a figure which has been sought by many, but which is elusive and unattainable given the current state of record-keeping...

It is also noteworthy that many of the largest organizations responding to the survey (those with annual revenues/budgets over $1 billion) reported no available system to monitor or estimate value of losses...

As various commentators have pointed out, valid and reliable statistics on the actual incidence of computer crime and actual losses sustained on any comprehensive basis are simply not possible until better reporting systems are in place.

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Other statistical reports are “The Discovery and Prosecution of Computer abuse: Assessing Information Systems Managerial Responses” by Detmar W. Straub, Jr., University of Minnesota Graduate School of Business (June 1987) and “Computer Crime, The First Annual statistical Report,” prepared by the National Center for computer crime data, with Jay Bloombecker, editor (1986). As experience increases, valid statistics on rates of convictions among cases reported to the authorities should be obtainable, but only with respect to specific statutes.

Pursuit of the study of Computer Crime and Computer abuse has been controversial. In 1970 a number of researchers concluded that the problem was merely a small part of the effect of technology on society and not worthy of specific, explicit research. The increase in substantial losses associated with international acts involving computers proved the fallacy of this view. The explicit identification of computer crime as a subject for research and development of preventative measures in criminal justice suffered a similar fate in the mid-1970s. Researchers argued that computers should not be the focus in a study of various types of crime. They believed the involvement of computers should be subordinate to the study of each specific type of characteristics of computer crime across all the different types of crime was not considered sufficient to warrant explicit research.1

The formal study of computer abuse was started in 1971. The first US national conference on computer abuse and a comprehensive report were completed in 1973. Since then, many reports, papers, journal articles and books have been published describing the research.2

The internet of the criminal Justice community began in response to increasing number of cases and action by criminal justice organizations, including the FBI Academy, criminal justice conferences on white-collar and organized crime, National District Attorneys Association Economic crime project, postal

Inspection, Secret service, Securities and Exchange Commission, Internal Revenue service, state and local criminal justice agencies and the National College of District Attorneys. In 1976, the FBI established for its agents a 4-week training course in investigation of computer crime and another for other Agencies in 1978. The U.S. treasury, Federal law Enforcement Training center at Glynco, Georgia, is now the largest training Facilities for police officers that addresses computer crime.¹

In 1976, as a result of the increasing frequency of cases, Senator Abraham Ribicoff and his US Senate Government Affairs Committee became aware of computer crime and the inadequacy of federal criminal law to deal with it. The committee produced two reports on its research (US Senate, 1976, 1977), and Senator Ribicoff introduced the first Federal Systems protection Act Bill in June 1977. These legislative efforts evolved into House Bill 5616 in 1986, which resulted in the Computer Fraud and Abuse Act of 1987, established as Article 1030, Chapter 47 of Title 18 Criminal Code.

On the state level, Florida, Michigan, Colorado, Rhode Island and Arizona were the first to have computer crime law based on the first Ribicoff bill. Current legislation on computer crime exists in all US states and many other countries. The Computer Fraud and Abuse Act were modified in the early 1990s to make the creation and spreading of computer viruses a crime.

Computer crime has been portrayed fictionally in several novels, motion pictures and television dramas. The British Broadcasting Corporation dramatized the computer crime aspects of a massive insurance fraud. NBC TV News and the CBS show “60 Minutes” have had special segments. The motion pictures War Games and Sneakers were the first to portray computer hacking. Several nonfiction trade books have been published and articles have appeared in all major magazines and newspapers. Unfortunately, the public interest and sensationalism associated with computer crime. Particularly the malicious hacker (q.v.) cases that

peaked in 1982 and the 1988 computer virus cases have made folk heroes of the perpetrators and embarrassed the victims.

In the future, we may anticipate fully automated crime. For the first time in history, it will be possible to execute a computer crime in milliseconds without anyone knowing what computers were attacked, what crime was perpetrated, or who the victim was. To combat automated crime we will have to develop security that functions without human interventions.¹

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