

1. First Generation (1940 to 1956): Using Vacuum Tubes

Hardware Technology

The first generation of computers used vacuum tubes for circuitry and magnetic drums for memory. The input to the computer was through punched cards and paper tapes. The output was displayed as printouts.

Software Technology

The instructions were written in machine language, assembly language. Machine language uses 0s and 1s for coding of the instructions. The first generation computers could solve one problem at a time. In this generation mainly batch processing operating system were used. Stored program concept

Computing Characteristics

The computation time was in milliseconds.

Physical Appearance

These computers were enormous in size and required a large room for installation.

Application

They were used for scientific applications as they were the fastest computing device of their time.

Examples

UNIVAC-I, MARK -1, ENIAC, EDVAC, EDSAC, IBM-701, IBM-650

The main features of First Generation are Vacuum tube technology

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- 1) Unreliable
 - 2) Supported Machine language only
 - 3) Very costly
 - 4) Generate lot of heat
 - 5) Slow Input/output device
 - 6) Huge size
 - 7) Need of A.C.
 - 8) Non portable
 - 9) Consumed lot of electricity

Vacuum Tubes

In 904, John Ambrose Fleming invented the first practical electron tube called the 'Fleming Valve'. Feming invents the vacuum tube diode.

In 1906, Lee de Forest invented the 'audion' later called the triode, an improvement on the 'Fleming Valve' tube.

2. Second Generation (1956 to 1963): Using Transistors

Hardware Technology

Transistors replaced the vacuum tubes of the first generation of computers. The second generation computers used *magnetic core technology* for primary memory. They used magnetic tapes and magnetic disks for secondary storage. The input was still through punched cards and the output using printouts. They used the concept of a stored program, where instructions were stored in the memory of computer.

Software Technology

The instructions were written using the *assembly language*. Assembly language uses mnemonics like ADD for addition and SUB for subtraction for coding of the instructions. It is easier to write instructions in assembly language, as compared to writing instructions in machine language. High-level programming languages, such as early versions of COBOL, FORTRAN, BASIC. The first operating system developed in this generation. There were Batch processing and Multiprogramming Operating system used.

Computing Characteristics

The computation time was in microseconds.

Physical Appearance

Transistors are smaller in size compared to vacuum tubes, thus, the size of the computer was also reduced.

Application

The cost of commercial production of these computers was very high, though less than the first generation computers. The transistors had to be assembled manually in second generation computers Examples PDP-1, PDP-8, IBM 1401(used for business applications, this is the first computer to enter into Nepal as well. Nepal brought this computer for the census of 2028 BS), IBM-7000, IBM-7094, IBM-1620(used for scientific purpose), NCR-304, CDC 1604, CDC-3600(used for scientific purposes), UNIVAC 1108, Control Data 3600, UNIVAC LARC, Honeywell 400.

The main features of Second Generation are:

1. Use of transistors
2. Reliable as compared to First generation computers
3. Smaller size as compared to First generation computers
4. Generate less heat as compared to First generation computers
5. Consumed less electricity as compared to First generation computers
6. Faster than first generation computers
7. Still very costly
8. A.C. needed
9. Support machine and assembly languages

Transistors

In 1947 the three American physicists – John Bordin, William Shockley, and Walter Brattain – at Bell Telephone Laboratories invented transistors. They received the 1956 Nobel Prize jointly for this awesome invention. Transistors proved to be a much better alternative to the vacuum tubes. They were much smaller, produce low heat and were very reliable. This made it possible to develop computers smaller, efficient and more reliable.

CLARIFICATION: The stored program concept means the instructions to run a computer for a specific function (known as a program) were held inside the computer's memory, and could quickly be replaced by a different set of instructions for a different function.

3).Third Generation (1964 to 1971): Using Integrated Circuits

Hardware Technology

The third generation computers used the *Integrated Circuit (IC)* chips. User interface devices such as Keyboards & Monitors started from this generation. Similarly, GUI also was started from third generation. Instead of the punched card and printouts. Semi-conductor memory devices were used. Larger magnetic cores memory, larger capacity disks and magnetic tapes secondary storage

Software Technology

The keyboard and the monitor were interfaced through the *operating system*. Operating system allowed different applications to run at the same time. In this generation Remote processing, Time-sharing, Real-time, Multi-programming Operating System were used. Unbundling of software from hardware *High-level languages* (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC (**B**eginners **A**ll-**p**urpose **S**ymbolic **I**nstruction **C**ode), ALGOL-68 etc.) were used extensively for programming, instead of machine language and assembly language.

Computing Characteristics

The computation time was in nanoseconds.

Physical Appearance

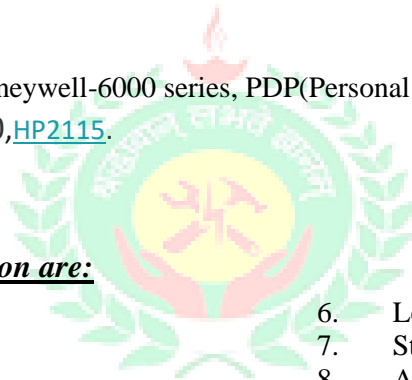
The size of these computers was quite small compared to the second generation computers. The mini computers were introduced in this generation.

Application

Computers became accessible to mass audience. Computers were produced commercially, and were smaller and cheaper than their predecessors.

Examples

IBM 360/370, PDP **II**, [PDP-8](#), series, Honeywell-6000 series, PDP(Personal Data Processor), TDC-316, ICL-1900/2900, VAX-750, CDC 1700/6600, [HP2115](#).



The main features of Third Generation are:

1. IC used
2. More reliable
3. Smaller size
4. Generate less heat
5. Faster
6. Lesser maintenance
7. Still costly
8. A.C needed
9. Consumed lesser electricity
10. Support high level language

Integrated Circuits

Integrated Circuit (IC) is a small electronic device made out of semiconductor material. The first integrated circuit was developed in the 1950s by Jack Kilby. So, after the invention of IC Chips, it is possible to integrate thousands of registers, diodes, capacitors and many other electronic components and circuitry in a tiny chip. In an IC chip, multiple transistors are placed on a silicon chip. Silicon is a type of semiconductor. The use of IC chip increased the speed and the efficiency of computer, manifold.

Integrated circuits are referred with different names like Chips, ICs, Microchips, and so on.

A tiny chip contains the whole electronic network that performs complex tasks.

Types of Integrated Circuits

- SSI (small-scale integration): - Up to 100 electronic components per chip
- MSI (medium-scale integration): From 100 to 3,000 electronic components per chip

- LSI (large-scale integration): From 3,000 to 100,000 electronic components per chip
- VLSI (very large-scale integration): From 100,000 to 1,000,000 electronic components per chip
- ULSI (ultra-large-scale integration): More than 1 million electronic components per chip

4) Fourth Generation (1971 to 1990): Using Microprocessors

▪ Hardware Technology

They use the *Large Scale Integration (LSI)* and the *Very Large Scale Integration (VLSI)* technology. It uses large scale Integrated Circuits (LSIC) built on a single silicon chip called microprocessors. Due to the development of microprocessor it is possible to place computer's central processing unit (CPU) on single chip. These computers are called microcomputers. Later very large scale Integrated Circuits (VLSIC) replaced LSICs. *Microprocessor* is a chip containing millions of transistors and components. This generation of computers gave rise to Personal Computer (PC). Semiconductor memory replaced the earlier magnetic core memory, resulting in fast random access to memory. Secondary storage device like magnetic disks became smaller in physical size and larger in capacity. Magnetic tapes and floppy disks as portable storage media. *The linking of computers* is another key development of this era. The computers were linked to form networks that led to the emergence of the Internet.

This generation also saw the development of pointing devices like mouse, keyboards, dot matrix printers and handheld devices.

Software Technology

Several new operating systems like the MS-DOS, **UNIX**, **Apple's Macintosh** and MS- Windows developed during this time. In this generation mini computers were built that had more user friendly software packages like word-processor and spreadsheet calculation. This generation of computers supported *Graphical User Interface (GUI)*. GUI is a user-friendly interface that allows user to interact with the computer via menus and icons. Users controlled the screen cursor using a mouse. In this generation Time sharing, Real time, Networks, Distributed Operating System. This led to the invention of networking. WAN, MAN, LAN and PAN networks came into existence.

High-level programming languages are used for the writing of programs like C and C++, DBASE, 4LG

Computing Characteristics

The computation time is in picoseconds.

Physical Appearance

They are smaller than the computers of the previous generation. Some can even fit into the palm of the hand.

Application

They became widely available for commercial purposes. Personal computers became available to the home user.

Examples.

In 1981, IBM introduced the first computer for home use. In 1984, Apple introduced the Macintosh. DEC 10, STAR 1000, PDP 11, CRAY-1(Super Computer), CRAY-X-MP (Super Computer), PRP11, APPLE 11, IBM 4341, TRS 80, VAX9000

The main features of Fourth Generation are:

1. VLSI technology used
2. Very cheap
3. Portable and reliable
4. Use of PC's

5. Very small size
6. Pipeline processing
7. No A.C. needed
8. Concept of internet was introduced
9. Great developments in the fields of networks

5) Fifth Generation (1990-onwards): Using Artificial Intelligence

Hardware Technology

The goal of fifth generation computing is to develop computers that are capable of learning and self-organization. The fifth generation computers use *Super Large Scale Integrated (SLSI)* chips. ULSI (Ultra Large Scale Integration) that are able to store millions of components on a single chip. 64 bit microprocessors have been developed during this period. Data flow & EPIC architecture of these processors have been developed. RISC & CISC, both types of designs are used in modern processors. These computers have large memory requirements. Memory chips and flash memory upto 1GB, hard disks up to 600GB & optical disks up to 50 GB have been developed. Optical disks as portable read-only storage media

This generation of computers uses *parallel processing hardware* that allows several instructions to be executed in parallel, instead of serial execution. Parallel processing results in faster processing speed. The Intel dual core microprocessor uses parallel processing.

Software Technology

The fifth generation computers are based on *Artificial Intelligence (AI)* software. They try to simulate the human way of thinking and reasoning. Artificial Intelligence includes areas like Expert System (ES), Natural Language Processing (NLP), speech recognition, voice recognition, robotics, etc.

[Quantum computation](#) and molecular and [nanotechnology](#) will radically change the face of computers in years to come.

All the Higher level languages like C and C++, Java, .Net etc. are used in this

Examples:

Desktop, Laptop, Notebook, Ultrabook. PIM/m, PIM/p, PIM/i, PIM/k, PIM/c, IBM notebooks, Pentium PCs, SUN Workstations, IBM SP/2, SGI Origin 2000
PARAM 10000.

The main features of Fifth Generation are:

1. ULSI technology
2. Development of true artificial intelligence
3. Development of Natural language processing
4. Advancement in Parallel Processing
5. Advancement in Superconductor technology
6. More user friendly interfaces with multimedia features