

**OUTPUT DEVICES**

An **output device** is any piece of computer hardware equipment used to communicate the results of data processing carried out by a computer system to the outside world.

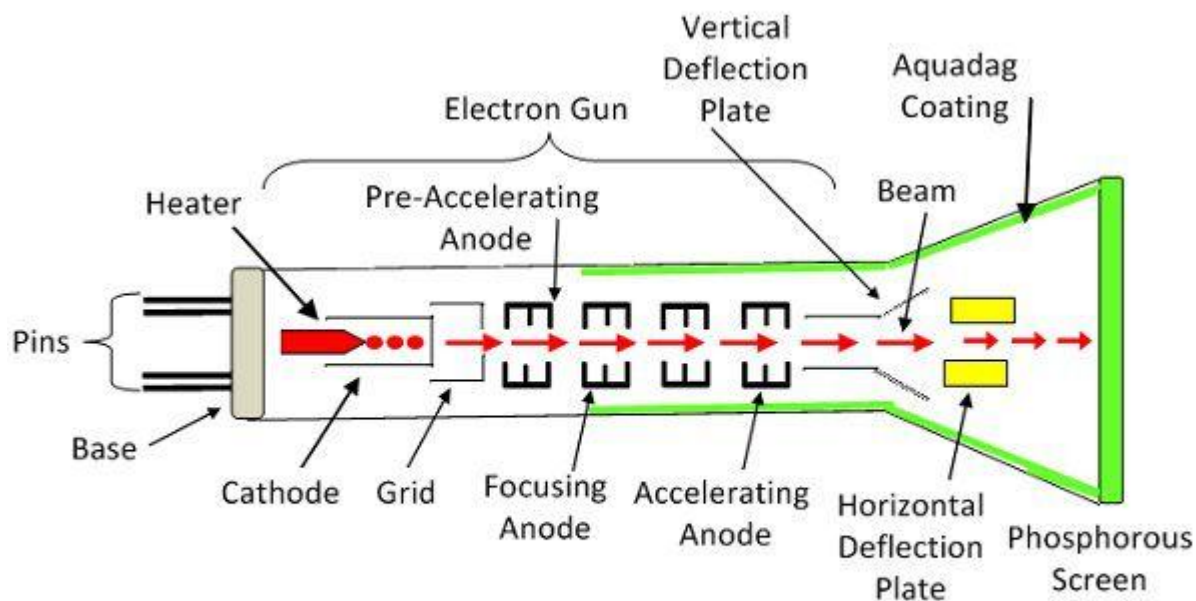
In computing, input/output, or I/O, refers to the communication between an information processing system (such as a computer), and the outside world. Inputs are the signals or data sent to the system, and outputs are the signals or data sent by the system to the outside.

Computer output devices deliver data that has been processed by the computer to the user. There are a variety of devices that produce data in different forms including audio, visual and hard copy. Computer output devices are types of peripheral hardware connected to a computer, using cables or over a wireless network.

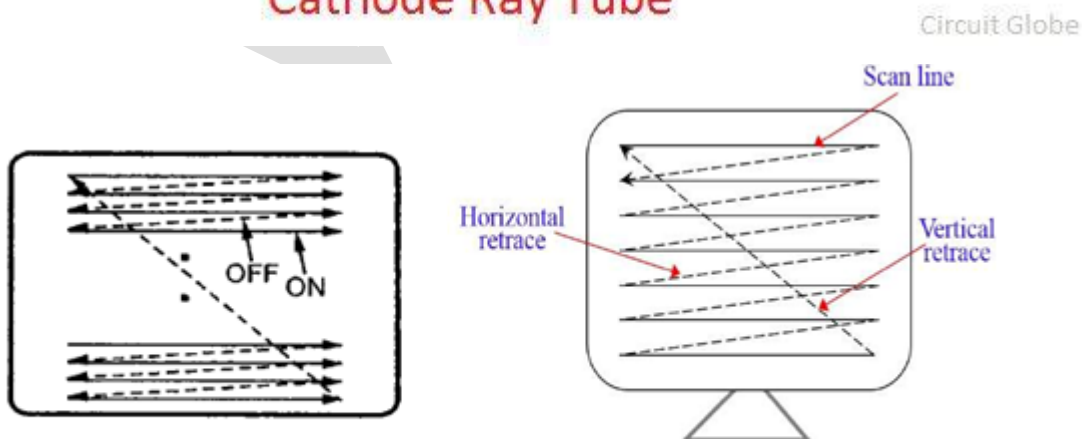
Examples of output devices:

- Monitors, Printer, Plotter, Speaker, scanner

**VDU (CRT monitor)**



**Cathode Ray Tube**



**fig. Raster Scan CRT**

- A monitor is a box containing a CRT (Cathode Ray Tube) and its power supplies. The CRT contains a gun that can shoot an electron beam against a phosphorescent screen near the front of the tube, (Color monitors have three electron guns, one each for red, green, and blue.) During the horizontal scan, the beam sweeps across the~ screen in about 50 usec, tracing out an almost horizontal line on the screen. Then it executes a horizontal retrace to get back to the left-hand edge in order to begin the next sweep. A device like this that produces an image line by line is called a raster scan device.
- Horizontal sweeping is controlled by a linearly increasing voltage applied to the horizontal deflection plates placed to the left and right of the electron gun. Vertical motion is controlled by a much more slowly linearly increasing voltage applied to the vertical deflection plates placed above and below the gun. After somewhere between 400 and 1000 sweeps, the voltages on the vertical and horizontal deflection plates are rapidly reversed together to put the beam back in the upper left-hand corner. A full-screen image is normally repainted between 30 and 60 times a second. Although we have described CRTs as using electric fields for sweeping the beam across the screen, many models use magnetic fields instead of electric ones, especially in high-end monitors. To produce a pattern of dots on the screen, a grid is present inside the CRT. When a positive voltage is applied to the grid, the electrons are accelerated, causing the beam to hit the screen and make it glow briefly. When a negative voltage is used, the electrons are repelled, so they do not pass through the grid and the screen does not glow. Thus the voltage applied to the grid causes the corresponding bit pattern to appear on the screen. This mechanism allows a binary electrical signal to be converted into a visual display consisting of bright and dark spots.

### **LCD Monitors**

LCD (Liquid Crystal Display) displays were used on laptop computers before the technology improved enough to make the jump to desktop monitors. An LCD monitor consists of five layers: a backlight, a sheet of polarized glass, a "mask" of colored pixels, a layer of liquid crystal solution responsive to a wired grid of x, y coordinates, and a second polarized sheet of glass. By manipulating the orientations of crystals through precise electrical charges of varying degrees and voltages, the crystals act like tiny shutters, opening or closing in response to the stimulus, thereby allowing degrees of light that have passed through specific colored pixels to illuminate the screen, creating a picture.

Flat panel monitors usually use LCD or plasma to create output. Light is passed through liquid crystals to create the pixels.

### **Advantages of LCDs**

- Light weight; can be about 15 lbs for a thin LCD.
- Smaller footprint on desk leaving, freeing up work area on the user's desk.
- Flicker free screen.
- More usable display area than on comparably sized CRTs.
- Low frequency radiation is practically eliminated.
- Easy adjustment, storage, and movement
- Energy efficient, using only 1/3 to 1/2 the electricity of CRTs, and they don't generate heat.
- Potentially less eyestrain due to reduced screen glare.
- Good for basic web surfing.
- Newest TFT liquid crystal technology has provided LCDs in competitive position with CRTs for image and color clarity.

- OLED, a new technology (Organic light-emitting diodes) in limited use presently in handheld personal video players, uses little power and provides a better image than present LCD technology; it thus holds the promise of making up for a significant weakness in LCD image quality.
- Plentiful mounting arm options available, enabling these light LCDs, whether computer or TV monitor to be ergonomically raised off the work surface.

### Disadvantages of LCD's

- Fragile screen; may result in both screen and backlight lamp damage if touched or handled. Thus, not recommended in environments where it may be handled roughly.
- Contrast ratio causes darkness to not be displayed true. Darkest areas may be viewed as dark gray rather than black.
- Designed only for one optimum resolution; can't adjust images.
- Best view of screen is straight-on, limiting clarity and colors of information for those viewing from an angle.
- The backlight is the potential weak link and its failure can be costly. Many warranties only cover it for 1 year.

### TFT Monitors

- A TFT monitor uses **Thin-Film Transistor** technology for the ultimate LCD display. LCD monitors, also called flat panel displays, are replacing the old style cathode ray tubes (CRTs) as the displays of choice. Nearly all LCD monitors today use TFT technology.
- The benefit of a TFT monitor is a separate, tiny transistor for each pixel on the display. Because each transistor is so small, the amount of charge needed to control it is also small. This allows for very fast re-drawing of the display, as the image is re-painted or refreshed several times per second
- Prior to TFT, *passive matrix* LCD displays could not keep up with fast moving images. A mouse dragged across the screen, for example, from point A to point B, would disappear between the two points. A TFT monitor can track the mouse, resulting in a display that can be used for video, gaming and all forms of multimedia.

### Printers

Printers are the most commonly used output devices used to prepare permanent documents on paper.

Printers are basically classified in two types

1. Impact Printer
2. Non-Impact Printer

**Impact Printer** uses some kind of impact (force) to achieve the effect of print on the paper. Some form of mechanism like print hammer or head is made to strike against the paper to create the impression on the paper.

#### Characteristics:-

- Use some force for printing
- Less costly
- These type of printers produce a noise and the printing quality is not that much good
- E.g. Dot matrix printer, Drum (line) printer

**Non-Impact Printer** uses some special chemical to make impression on the paper.

**Characteristics:-**

- Very costly
- Very high quality of output
- Produce no noise
- E.g. Laser printer, Inkjet printer

**Dot Matrix Printer**

- Dot matrix printer print only one character at a time. It prints any character or image as pattern of dots.
- Dot matrix printer has a print head, which can move horizontally (left to right and right to left) across the paper. The print head contains the array of pins. To print a character, the printer activates the appropriate set of pins as the print head moves horizontally.
- Dot matrix printer can print any shape of character as well as many special characters, graphics, charts etc. the speed of dot matrix printer is 30 to 600 characters per second. This printer is able to print multiple copies of a document in a single printing.
- The term dot matrix printer is specifically used for impact printers that use a matrix of small pins to create precise dots. The advantage of dot-matrix printers is that they can produce graphical images in addition to text; however the text is generally of poorer quality.
- Dot matrix printers were one of the more common types of printers used for general use, such as for home and small office use. Such printers would have either 9 or 24 pins on the print head. 24-pin print heads were able to print at a higher quality.

**Advantage:-**

- It is cheaper
- It is able to print multiple copies of a document in a single printing
- It is able to print any character, many special characters and graphics

**Disadvantages:-**

- It is noisy
- Printing quality is not that much good
- It is slow
- Not suitable for bulk printing

**Line (Drum) Printer**

- Line printer is an impact printer that prints one line at a time. It consists of solid, cylindrical drum with characters raised (embossed) on its surface.
- Each band consists of all the possible characters. The printer has a set of hammers mounted on the drum. The drum rotates at a high speed and a character is printed by activating the appropriate hammer, when the character embossed on the band passes below it.
- One revolution of the drum is required to print one line. This means that all characters on the line are not printed at exactly at the same time, but the time required to print the entire line is so fast that it appears as one line is printed at a time
- Typical speeds of line printers are in range of 300 to 2000 lines per minute.
- Its disadvantage is that it is noisy and do not have ability to print any shape of characters, different size of print and graphics.

### Laser Printer

- Laser printer is a non-impact printer. It is a page printer which prints one page at a time.
- The main components of laser printer are a laser beam, a multi sided mirror, a photoconductive drum and toner. To print a page, the laser beam is focused on the drum by the spinning multisided mirror. The mirror focuses the laser beam on the surface of the drum in a manner to create pattern of characters/images to be printed on the page.
- Speed of laser printer is 500 to 1000 pages per minute.
- Its advantages are that the quality of output is very high and is the fastest printer.
- Its disadvantage is that it is very expensive and its maintenance cost is high also it cannot produce multiple copies of a document in a single printing.

### Ink Jet Printer

- Ink-jet printer is a non-impact printer. It prints characters by spraying small drops of ink onto the paper to form graphics and characters. The printer consists of array of nozzles, from which the ink comes out. Ink is stored in the printer in a tank called ink cartridge. There are four cartridges – one for each cyan, magenta, yellow, black. This means that it's possible to have the colored printing.
- An inkjet printer is a type of computer printer that reproduces digital image by propelling variably-sized droplets of liquid material (ink) onto a page. Inkjet printers are the most common type of printer and range from small inexpensive consumer models to very large and expensive professional machines. A high-pressure pump directs liquid ink from a reservoir through a gun body and a microscopic nozzle, creating a continuous stream of ink droplets.
- The ink droplets are subjected to an electrostatic field created by a charging electrode as they form; the field varies according to the degree of drop deflection desired.
- Quality can be determined by its resolution. Printer resolution can be measured by measuring no. of dots per inch (dpi) a printer can print.
- Its produce very high-quality output because it forms characters by very high tiny ink dots
- The speed of ink-jet printer is 40 to 300 characters per seconds i.e., 12-36 ppm (no. of pages per minute) but print graphics and colors at a slower rate. It is faster than dot matrix printer but it is more expensive than dot matrix printer.
- The document printed may contain multiple characters styles and a verity of type sizes.
- It cannot produce multiple copies of a document in a single printing.

### Advantages

- Inkjets have the advantage of practically no warm up time and lower cost per page.
- They can print finer, smoother details through higher print head resolution.
- Lowest purchasing cost.

### Disadvantages

- The lifetime of inkjet prints produced by inkjets using aqueous inks is limited; they will eventually fade and the color balance may change.
- Because the ink used in most consumer inkjets is water-soluble, care must be taken with inkjet-printed documents to avoid even the smallest drop of water, which can cause severe "blurring" or "running." Similarly, water-based highlighter markers can blur inkjet-printed documents.
- The very narrow inkjet nozzles are prone to clogging with dried ink. The ink consumed cleaning them - either during cleaning invoked by the user, or in many cases.

## Input Device

Computer Devices that input information in the computer. Input basically means getting data into the computer to be processed.

**ex:**

Keyboard, Numeric Keypads, Mouse, Touchpad, remote control, joysticks, touch screen, magnetic strip readers, chip readers, scanners, digital cameras, microphones, sensors, barcode reader, webcam, video cameras etc.

## Key Board

- Keyboard of the computer is quite looking like similar to that of typewriter but it contains some addition keys then the normal typewriter.
- It is electromechanical devices & it connects through cable. One end of cabal is connected to the special input port of computer & another end is connected to the keyboard
- When a key pressed on a keyboard there is a matrix on which contact is done, at that time it generates the electronic signal which is detected by the electronic circuit called keyboard encoder. So, keyboard encoder is detecting the key which key pressed.
- Keyboards have keys that just make mechanical contact when depressed. Better ones have a sheet of elastomeric material (a kind of rubber) between the keys and the underlying printed circuit board. Under each key is a small dome that buckles when depressed far enough. A small spot of conductive material inside the dome closes the circuit. Some keyboards have a magnet under each key that passes through a coil when struck, thus inducing a current that can be detected. Various other methods, both mechanical and electromagnetic, are also in use.
- On personal computers, when a key is depressed, an interrupt is generated and the keyboard interrupt handler (a piece of software that is part of the operating system) is started. The interrupt handler reads a hardware register inside the keyboard controller to get the number of the key (1 through 102) that was just depressed. When a key is released, a second interrupt is caused. Thus if a user depresses the SHIFT key, then depresses and releases the M key, then releases the SHIFT key, the operating system can see that the user wants an uppercase "M" rather than a lowercase "m." Handling of multi key sequences involving SHIFT, CTRL, and AL T is done entirely in software (including the infamous CTRLALT-DEL key sequence that is used to reboot all IBM PCs and clones).

## Mouse

- A mouse is small hand-held box used to position the screen cursor. Wheels or rollers on the bottom of the mouse can be used to record the amount and direction of movement. A mouse can be picked up and put down at another point without change in cursor position. Two or three buttons are usually included on the top of the mouse for signaling the execution of some operation.
- A similar device called the Z Mouse includes three buttons, a thumbwheel on the side, a trackball on the top and the standard mouse ball under it. We can pick up an object, rotate it, and move it in any direction, and other three- dimensional application is possible using the Z mouse.

## Scanners

In computing, a scanner is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image. Common examples found in offices are variations of the *desktop (or flatbed) scanner* where the document is placed on a glass window for scanning. *Hand-held scanners*, where the device is moved by hand, have evolved from text scanning "wands" to

3D scanners used for industrial design, reverse engineering, test and measurement, gaming and other applications. Mechanically driven scanners that move the document are typically used for large-format documents, where a flatbed design would be impractical.

## **ADDRESSING Techniques**

Instructions can be classified according to the number of addresses they use. It should be kept in mind that a collection of numbered CPU registers, in effect, forms a high-speed memory and defines an address space. An instruction that adds register 1 to register 2 should be classified as having two addresses because the instruction must specify which registers are to be added, just as an instruction that adds two memory words must specify which words.

Instructions specifying one, two, and three addresses are all common. On many machines that do arithmetic with only one address, a special register called the accumulator provides one of the operands. On these machines, the address is usually the address of a memory word  $m$ , in which the operand is located. The instruction for addition specifying the address  $m$  has the effect

$$\text{accumulator} := \text{accumulator} + \text{memory}[m]$$

Two-address add instructions use one address as the source and the other as the destination. The source is then added to the destination:

$$\text{destination} := \text{destination} + \text{source}$$

Three-address instructions specify two sources and a destination. The two sources are added and stored at the destination.

### **Immediate Addressing:**

The simplest way for an instruction to specify an operand is for the address part of the instruction actually to contain the operand itself rather than an address or other information describing where the operand is. Such an operand is called an immediate operand because it is automatically fetched from memory at the same time the instruction itself is fetched; hence it is immediately available for use.

Immediate addressing has the virtue of not requiring an extra memory reference to fetch the operand. It has the disadvantage of restricting the operand to a number that can fit in an address field. In an instruction with a 3-bit address (e.g. register field), the operands would be restricted to 3 bits, which limits their usefulness.

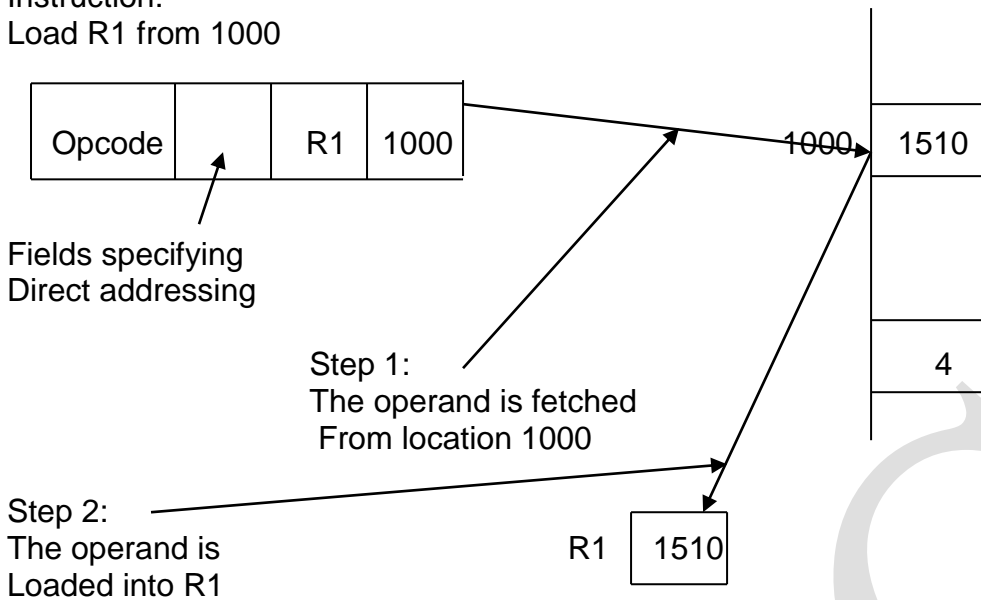
### **Direct Addressing:**

Another simple method for specifying an operand is to give the address of the memory word where the operand is contained. This form is called direct addressing. In general, there are two approaches: use different opcodes or use a special addressing mode for each kind of operand.

All the Intel CPUs have direct addressing. The 8088 and 80286 use 16-bit direct addresses. The 80386 uses 16-bit addresses in real and virtual modes, and 16-bit segments in protected mode. In 32-bit protected mode, the direct addresses are 32-bits. Note that in all cases the direct addresses are too short to cover the entire address space.

Instruction:

Load R1 from 1000



### Register Addressing:

Register addressing is conceptually the same as direct addressing. In this form of addressing, the address field contains the number of the register in which the operand is stored. A machine with 16 registers and 65,536 memory words really has two address spaces. One might think of an address on such a machine as having two parts: (a) one bit telling whether a register or a memory word is desired and (b) an address field telling which register or memory word is desired. Because there are fewer registers than memory words, a smaller address is needed, and thus different format instructions are often used for register operands and memory operands.

Machines are designed with registers for two reasons: (a) registers are faster than main memory and (b) because there are so few of them, only a few bits are needed to address them.

### Indirect Addressing:

Direct addressing is a scheme in which the address specifies which memory word or register contains the operand. Indirect addressing is a scheme in which the address specifies which memory word or register contains not the operand but the address of the operand. As shown in the fig. , consider an instruction to load a register (which we will call R1) indirectly from memory location 1000, where location 1000 contains 1510.

First, the contents of location 1000 are fetched into an internal CPU register. This 16-bit number (1510) is not put in R1. If it were, as in fig., we would have a direct address instruction. Instead, the contents of location 1510 are fetched and put into R1. The number at location 1000 is not the operand but instead it “points to” the operand. For this reason, it is called a pointer.

The Intel processors all have indirect addressing via a register. Some machines, although neither of our two examples, allow multiple-level indirect addressing. In this addressing mode, a pointer is used to locate a memory word that itself points to another memory word, and so on.

Immediate, direct, indirect and multiple level indirect addressing exhibit a certain progression. Immediate addressing requires zero memory references, because the operand was fetched along with the instruction, which we will not count here. Direct addressing requires one memory reference, to fetch the operand. Indirect addressing requires two memory references, one for the

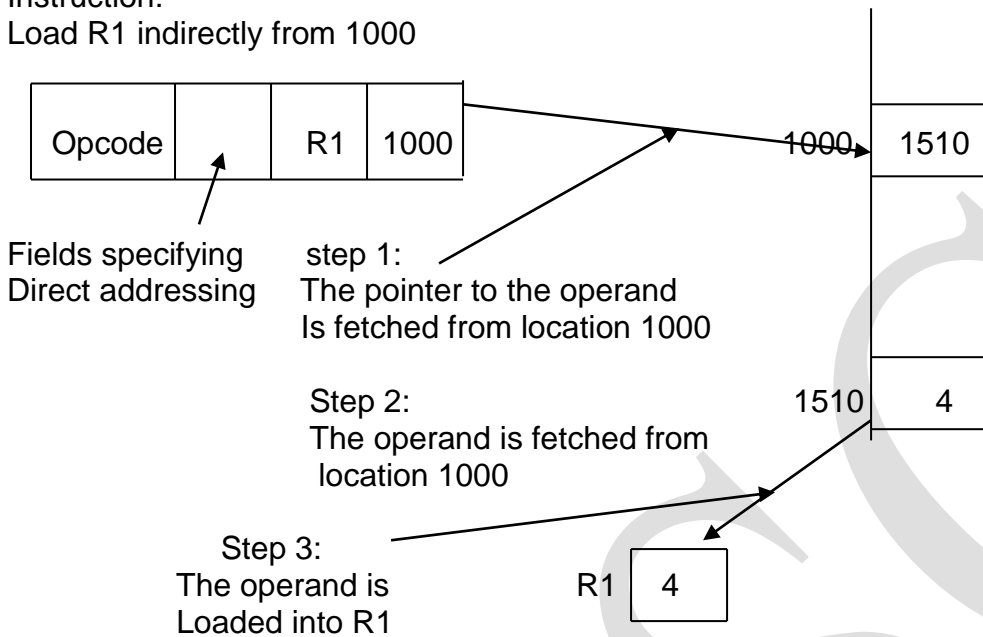
Payal Sheth



pointer and one for the operand. Multiple-level indirect addressing requires at least three memory references, two or more for pointers and one for the operand. Memory references in this context include register references.

Instruction:

Load R1 indirectly from 1000



**Indexing:**

Many algorithms require performing some operation on a sequence of data structures stored in consecutive memory locations. For example, consider a block of n machine words occupying locations

$$A, A+1, A+2, \dots, A+n-1$$

which must be moved to locations

$$B, B+1, B+2, \dots, B+n-1$$

Assuming that the machine has an instruction **MOVE A, B**

that moves the contents of location A to location B, one could execute this instruction, modify the instruction itself to read **MOVE A+1, B+1**

Execute it again, then modify it again and repeat the cycle until all n words had been copied.

Although programs that modify themselves were once popular, they are now considered bad programming practice. They are difficult to debug and they make sharing of a program among several users of a time-sharing system difficult.

The copying problem can also be solved by indirect addressing. One register or memory word is loaded with the address A; a second one is loaded with B. The MOVE instruction uses these two as pointer. After each word has been copied, the pointers are each increased by one. The pointers are part of the data, not part of the program, of course, and are not shared by simultaneous users.

Another solution is to have one or more registers, called index registers, which work as follows. Addresses have two parts, the number of an index register and a constant. The address of the operand is the sum of the constant and the contents of the index register. In the above example, if both addresses are indexed using an index register containing the integer  $k$ , the instruction MOVE A, B will move the contents of memory location  $A+k$  to  $B+k$ . By initializing the index register to 0 and incrementing it by the word size after each word is copied, only one register is needed for the copy loop. Furthermore, incrementing a register is faster than incrementing a memory location.

In the above example given above it was necessary to explicitly increment the index register by the word size after each use of it. The need to increment or decrement an index register just before or after it is used is so common that some computers provide special instructions or addressing modes, or even special index registers that automatically increment or decrement themselves. Automatic modification of an index register is called autoindexing.

### **Stack Addressing:**

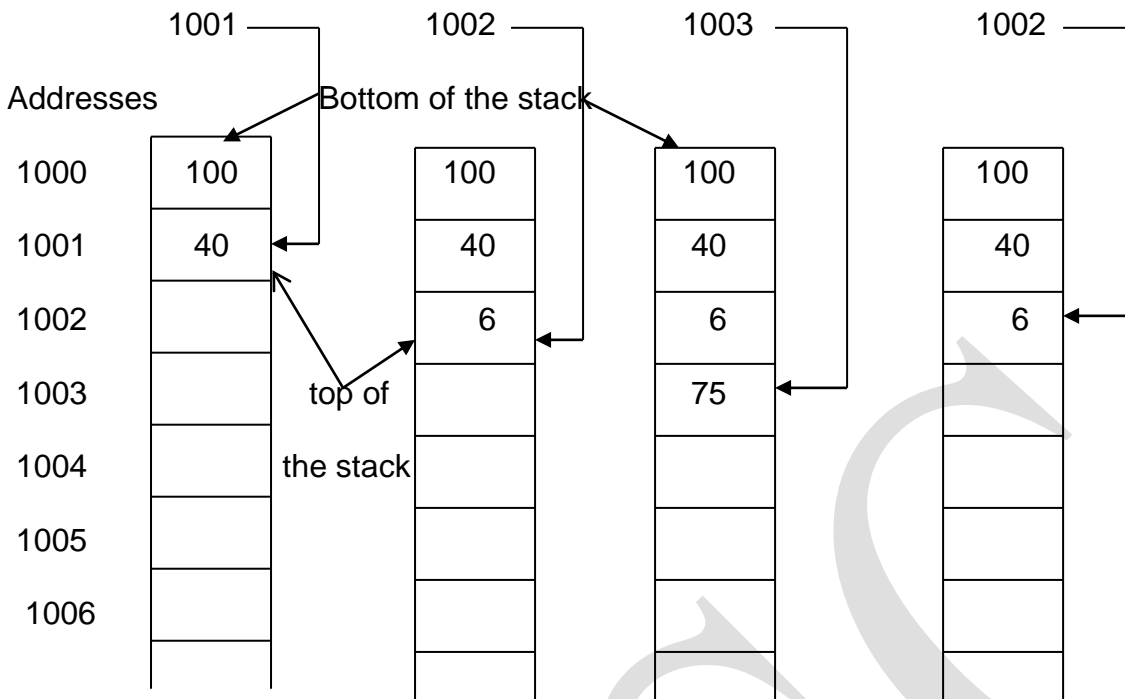
Making machine instructions as short as possible is highly desirable for saving both CPU time and memory. The ultimate limit in reducing address lengths would be to have instructions with no addresses at all, just opcodes. Surprisingly enough, this situation is possible. It is accomplished by organizing the machine around a data structure called a stack.

A stack consists of data items (words, characters, bits, etc.) stored in consecutive order in the memory. The first item pushed onto the stack is said to be at the bottom of the stack. The item most recently pushed onto the stack is said to be on the top of the stack. Associated with each stack is a register or memory word that contains the address of the top of the stack. It is called the stack pointer.

Computers that are stack-oriented have an instruction to push the contents of a memory location or a register onto the stack. Such an instruction must both copy the item and increment the stack pointer. Similarly, an instruction to pop the top of the stack into a register or memory location must make a new copy in the proper place and decrement the stack pointer. Some computers have their stacks upside down, with new items being pushed into consecutively lower numbered memory locations rather than consecutively higher numbered locations.

Instructions with no addresses are used in conjunction with a stack. This form of addressing specifies that the two operands are to be popped off the stack, one after another, the operations performed (e.g. multiplication or AND) and the result pushed back onto the stack.

Stack Pointer:



**Que: Differences between Dot-matrix printer and Inkjet printer.**

**Solution:**

**Dot-matrix Printer**

- 1 Produce image when the tiny wire pins on a print head mechanism strike an inked ribbon. The ribbon then pressed and it creates dots on a paper that form characters and graphics.
- 2 Their speed can measure in cps (characters per second)
- 3 Speed of 375-1100 characters per second which also depends on the desired print quality.
- 4 It has average resolution. So, low print quality.
- 5 Dot matrix use continuous feed of paper, making it easier to print multiple pages of documents.
- 6 Cheaper to purchase.
- 7 Noisy printer while printing on paper.

**Inkjet Printer**

- 1 Produce image when head mechanism contained ink-filled cartridges sprays tiny drops of liquid ink onto a piece of paper to form graphics and characters.
- 2 Speed can measure in ppm (no. of pages per minute)
- 3 Speed of 12-36 ppm but they print graphics and colors at a slower rate.
- 4 It has good resolution about 1200-4800 dpi (no. of dots per inch). High print quality.
- 5 Inkjet printers pick papers individually.
- 6 Costly to purchase compare to dot-matrix.
- 7 Produce no noise while printing on paper.

**Que: Differences between Laser printer and Inkjet printer.**

**Solution:**

**Inkjet Printer**

- 1 Inkjet print images as a series of tiny points.
- 2 Depending on the paper used, inkjet images have a possibility of appearing blurry due to absorption into the paper.
- 3 Inkjet prints are very economical to

**Laser Printer**

- 1 Lasers print images as a geometric shape through mathematical values.
- 2 Laser images do not have this risk, because the toner is fused with head into the fibers of the paper.
- 3 Laser printers generally require a large

purchase, but the ink can be costly.

investment upfront, but the toner cartridges need replacing less often and have a more rapid print speed.

**Que: Differences between Line printer and Inkjet printer.**

**Solution:**

Inkjet Printer	Line Printer
1 Inkjet print images as a series of tiny points.	1 Line printer print entire line at a time.
2 Speed can be measured by the ppm (no. of pages per minute)	2 Speed can be measured by the number of lines (lpm).
3 Inkjet printers pick papers individually.	3 Line matrix use continuous feed of paper, making it easier to print multiple pages of documents.

**Que: Differences between Impact and Non-Impact Printer.**

**Solution:**

Impact Printer	Non-Impact Printer
1 It produces print on paper by striking mechanism.	1 It produces print on paper with a non-striking mechanism.
2 It uses pins, hammers or wheel to strike against an inked ribbon to print on a paper.	2 It uses laser, spray of special ink, or heat and pressure to print on paper.
3 Normally impact printers use continuous paper sheet.	3 Non-Impact printers normally use individual paper sheets.
4 Impact printers are normally less expensive.	4 Non-Impact printers are more expensive.
5 Print quality of impact printers is lower than those of non-impact printers.	5 Print quality of Non-Impact printers is higher than those of impact printers.
6 Impact printers use special inked ribbons to produce print on paper when print head strikes.	6 Non-Impact printers use toner or cartridge for printing on paper.
7 Impact printers are low speed printers. They consume a lot of time to print a document.	7 Non-Impact printers are very fast, they can print many pages per minute.
8 Impact printers are very noisy because they strike print head.	8 Non-Impact printers do not make a noise because they do not use striking mechanism in which print head strikes on ribbon and paper etc.
9 Examples of Impact printers are Dot matrix and daisy wheel printers.	9 Examples of Non-Impact printers are laser printers and inkjet printers.
10 Impact printers use old printing technologies.	10 Non-impact printers use latest printing technologies.

**Question Bank Solution****Unit-1****Que: Explain first generation of computer.**

The first computer systems used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. These computers were very expensive to operate and in addition to using a great deal of electricity, the first computers generated a lot of heat, which was often the cause of malfunctions.

First generation computers relied on machine language, the lowest-level programming language understood by computers, to perform operations, and they could only solve one problem at a time. It would take operators days or even weeks to set-up a new problem. Input was based on punched cards and paper tape, and output was displayed on printouts.

The UNIVAC and ENIAC computers are examples of first-generation computing devices. The UNIVAC was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951.

**Advantages:**

- They were capable of making arithmetic and logical operations.
- They used the electronic values in place of the key punch machines or the unit record machines.

**Disadvantages:**

- They were too big in size, very slow, low level of accuracy and reliability.
- They consumed lot of electricity, generated a lot of heat and break down frequently.

**Que: Explain second generation of computer.**

The transistor was invented at Bell Labs in 1947 but did not see widespread use in computers until the late 1950s.

The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output.

Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN. These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology.

The first computers of this generation were developed for the atomic energy industry.

**Advantages:**

- They required very small space, were very fast and reliable and dependable.
- They used less power and dissipated less heat and had large storage capacity.
- They used better peripheral devices like card readers and printer etc.

**Disadvantages:**

- They did not have any operating system and used assembly languages.
- They lacked in intelligence and decision making and needed constant upkeep and maintenance.

**Que: Explain Third generation of computer.**

Third generation computers use integrated circuits. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers.

Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

**Advantages:**

- The size was very small in comparison less costly and built with thousands of transistors which were very cheap.
- They used faster better device for storage, called auxiliary backing or secondary storage.
- They used operating system for better resource management and used the concept of time sharing and multiple programming.

**Disadvantages:**

- They created lot of problems to the manufacturers at their initial stages.
- They could not provide any insight into their internal working.

**Que: Explain Fourth generation of computer.**

The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip. What in the first generation filled an entire room could now fit in the palm of the hand. The Intel 4004 chip, developed in 1971, located all the components of the computer—from the central processing unit and memory to input/output controls—on a single chip.

In 1981 IBM introduced its first computer for the home user, and in 1984 Apple introduced the Macintosh. Microprocessors also moved out of the realm of desktop computers and into many areas of life as more and more everyday products began to use microprocessors.

As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of GUIs, the mouse and handheld devices.

**Advantages:**

- They were very small in size, and cost of operation was very less.
- They were very compact faster and reliable as they used very large-scale integrated circuits.
- They were capable of facilitating the interactive on line remote programming by which one sitting at the distant place can get his programs executed by centrally located computer.

**Disadvantages:**

- They are less powerful and had less speed than the main frame computers.

- They lacked thinking power and decision-making ability.
- They had less storage capacity and needed further improvement.

**Que: Explain Fifth generation of computer.**

Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today. The use of parallel processing and superconductors is helping to make artificial intelligence a reality.

Quantum computation and molecular and nanotechnology will radically change the face of computers in years to come. The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization.

**Advantages:**

- They are oriented towards integrated data base development to provide decision models.
- They faster very cheap and have the highest possible storage capacity.
- They have thinking power and decision-making capability and thereby they will be able to aid the executives in the management.

**Disadvantages:**

- They need very low-level languages; they may replace the human force and cause grievous unemployment problems.
- They may make the human brains dull and doomed.