GALGOTIAS UNIVERSITY

School of Computing Science and Engineering

Program: B.C.A.

Course Code: BCAS3003

Course Name: Computer Graphics

Course Prerequisites

- Knowledge of Mathematics
- Fundamental knowledge of Computer

Recommended Books

Text books

- D. Hearn, P. Baker, "Computer Graphics - C Version", 2nd Edition, Pearson Education, 1997

Reference Book

- Heam Donald, Pauline Baker M: "Computer Graphics", PHI 2nd Edn. 1995.
- Harrington S: "Computer Graphics - A Programming Approach", 2nd Edn. Mc GrawHill.
- Shalini Govil-Pai, Principles of Computer Graphics, Springer, 2004

Additional online materials

- Coursera - https://www.coursera.org/learn/fundamentals-of-graphic-design
- https://www.youtube.com/watch?v=fwzYuhduME4&list=PLE4D97E3B8DB8A590
- NPTEL - https://nptel.ac.in/courses/106/106/106106090/
- https://www.coursera.org/learn/research-methods
- https://www.coursera.org/browse/physical-science-and-engineering/research-methods

Graphic Monitors

- The name itself giving some idea that, Monitor which is capable of displaying “Graphics”. Most graphics monitors today operate as raster scan displays.
- So Monitors which are capable of showing and supporting Graphics mode along with the Text modes.
- A high-definition graphics monitor used in applications such as air traffic control, medical imaging, and CAD.

Graphic Monitors

- Graphic monitors who can display pictures on its screen, of course it acts like an output device.
- The monitors which support the following Graphic applications are said to be Graphic Monitors:
- The Graphics Applications include-
  - Animation Software's
  - CAD Software's
  - Drawing programs
  - Paint Application programs
  - Presentation Graphics Software’s (Excel likewise, creating pie and bar charts)
  - Desktop publishing (MS Office, Share points, Document managements)

Workstations

- Workstation is also a computer which varies generally with other General Computers.
- A workstation is a special computer designed for technical or scientific applications.
- Intended primarily to be used by one person at a time, they are commonly connected to a local area network and run multi-user operating systems.
- Workstations were optimized for the visualization and manipulation of different types of complex data such as 3D mechanical design, engineering simulation , animation and rendering of images.
- Because these Workstations need good operating power of computer . They must be able to support high power i.e. it must sustain good graphic capabilities.

Workstations

- These kind of computers comes with the following specifications. Unlike normal general computers they consists of:
  - Minimum of 64 Megabytes of RAM & high processor
  - Very good Resolution Graphics screen
  - High and Large Screen
  - GUI Graphical User Interface
  - Mass storage Device like Disk Drive(optional)
  - Built-in Network Support and many factors

Workstations

Workstations

- We may also notice that, some of the workstations do not have any disk drives in it. So these kind of disk drives are called as Diskless workstation.
- Workstations took place of and they lie between Personal computer and minicomputers as far as Computing power is concerned.
- These can be used as both types such as stand system (which only consists of one) and Local area network. So basically in this LAN kind, workstations are typically connected together one and other.
- Many graphics workstations are configured with two monitors. One monitor can be used to show all features of an object or scene, while the second monitor displays the detail in some part of the picture. Another use for dual-monitor systems is to view a picture on one monitor and display graphics options (menus) for manipulating the picture components on the other monitor.

Workstations

Input Devices

- The Input Devices are the hardware that is used to transfer transfers input to the computer. The data can be in the form of text, graphics, sound, and text. Output device display data from the memory of the computer. Output can be text, numeric data, line, polygon, and other objects.
- These Devices includes Keyboard, Mouse, Trackball, Spaceball, Joystick, Light Pen, Digitizer, Touch Panels, Voice Recognition, Image Scanner

Keyboards

- The most commonly used input device is a keyboard. The data is entered by pressing the set of keys. All keys are labeled. A keyboard with 101 keys is called a QWERTY keyboard.
- The keyboard has alphabetic as well as numeric keys.
- Alphanumeric Keyboards are used in CAD. (Computer Aided Designing)
- Keyboards are available with special features line screen co-ordinates entry, Menu selection or graphics functions, etc.
- Special purpose keyboards are available having buttons, dials, and switches. Dials are used to enter scalar values. Dials also enter real numbers. Buttons and switches are used to enter predefined function values.

Input Devices

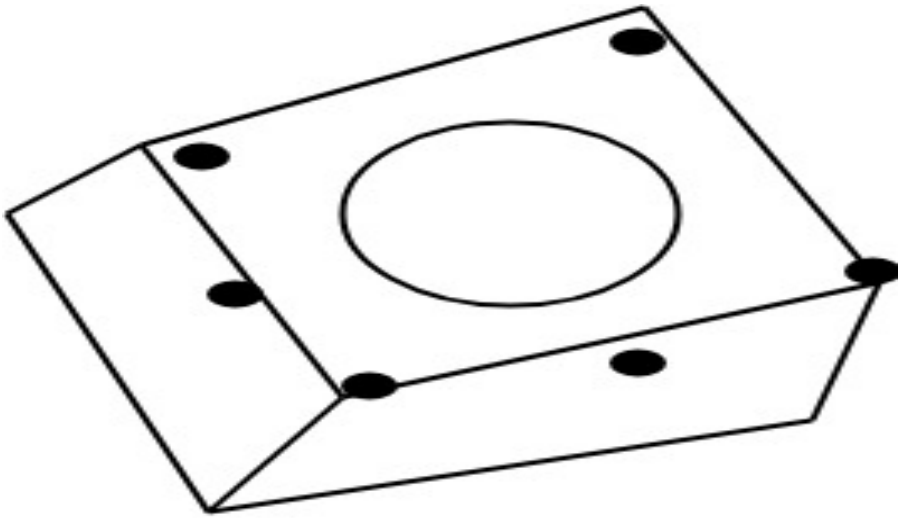
Mouse

- A Mouse is a pointing device and used to position the pointer on the screen.
- It is a small palm size box. There are two or three depression switches on the top. The movement of the mouse along the x-axis helps in the horizontal movement of the cursor and the movement along the y-axis helps in the vertical movement of the cursor on the screen.
- The mouse cannot be used to enter text. Therefore, they are used in conjunction with a keyboard.
- Nowadays, more advanced mouse is available which are very useful in graphics application for example Z mouse.

Input Devices

Trackball

- It is a pointing device. It is similar to a mouse. This is mainly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted, and by changing fingers on the ball, the pointer can be moved.



TrackBall

Input Devices

Spaceball

- It is similar to trackball, but it can move in three directions where trackball can move in two directions only.
- The movement is recorded by the strain gauge. Strain gauge is applied with pressure. It can be pushed and pulled in various directions.
- The ball has a diameter around 7.5 cm. The ball is mounted in the base using rollers. One-third of the ball is an inside box, the rest is outside.
- It is used in the area of simulation and modeling, CAD, animation.

Input Devices

Joystick

- A Joystick is also a pointing device which is used to change cursor position on a monitor screen.
- Joystick is a stick having a spherical ball as its both lower and upper ends as shown in figure below. The lower spherical ball moves in a socket.
- The joystick can be changed in all four directions. The function of a joystick is similar to that of the mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games.

Input Devices

Lightpen

- Light Pen (similar to the pen) is a pointing device which is used to select a displayed menu item or draw pictures on the monitor screen.
- It consists of a photocell and an optical system placed in a small tube. When its tip is moved over the monitor screen, and pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signals to the CPU.
- Light Pens can be used as input

coordinate positions by providing necessary arrangements.

Light Pen

Input Devices

Digitizers:

- The digitizer is an operator input device, which contains a large, smooth board (the appearance is similar to the mechanical drawing board) & an electronic tracking device, which can be changed over the surface to follow existing lines.
- The electronic tracking device contains a switch for the user to record the desire x & y coordinate positions. The coordinates can be entered into the computer memory or stored or an off-line storage medium such as magnetic tape.
- It is costly.
- It provides the capability of interactive graphics.
- Suitable only for applications which require high-resolution graphics.

Digitizer

Input Devices

Touch Panels:

- Touch Panels is a type of display screen that has a touch-sensitive transparent panel covering the screen. A touch screen registers input when a finger or other object comes in contact with the screen.
- When the wave signals are interrupted by some contact with the screen, that located is recorded. Touch screens have long been used in military applications.

Input Devices

Voice Systems (Voice Recognition):

- Voice Recognition is one of the newest, most complex input techniques used to interact with the computer. The user inputs data by speaking into a microphone. The simplest form of voice recognition is a one-word command spoken by one person. Each command is isolated with pauses between the words.
- Voice Recognition is used in some graphics workstations as input devices to accept voice commands. The voice-system input can be used to initiate graphics operations or to enter data. These systems operate by matching an input against a predefined dictionary of words and phrases.

Input Devices

Image Scanner

- It is an input device. The data or text is written on paper. The paper is feeded to scanner. The paper written information is converted into electronic format; this format is stored in the computer. The input documents can contain text, handwritten material, picture extra.
- By storing the document in a computer document became safe for longer period of time. The document will be permanently stored for the future. We can change the document when we need. The document can be printed when needed.
- Scanning can be of the black and white or colored picture. On stored picture 2D or 3D rotations, scaling and other operations can be applied.

Hard Copy Devices

- All the output devices can be categorized into two categories such as Hard Copy Devices and Soft Copy Devices.
- Hard copy devices are those that give the output in the tangible form. Printers and Plotters are two common hard copy devices.
- Soft copy devices give output in the intangible form or the virtual form, e.g. something displayed on a screen. All the computer monitors are covered under this category.

Printers

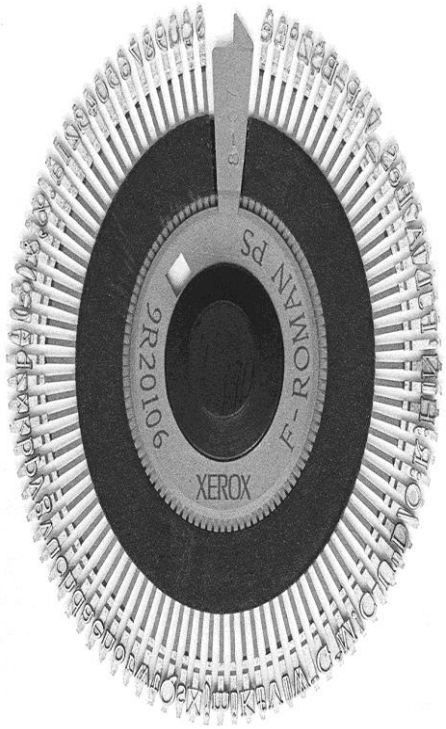
- All the printers irrespective of the technology used can be categorized as Impact Printers and Non Impact Printers.
- **Impact printers** are those printers in which there is a direct contact between the printing head and the paper on which the print is produced.
  - They work by striking a head or a needle against an inked ribbon which leaves a mark on the paper.
  - These printers produce a lot of noise when printing, because of the head striking the paper.
  - Examples are Dot Matrix, Daisy Wheel and Line printers.
- In the case of **non-impact printers,** the printing head never comes in direct contact with the paper.
  - These printers work by spraying ink on the paper.
  - Electrostatic or electromagnetic charge is used in these printers.
  - Examples are Ink-Jet and Laser printers.

Dot-Matrix Printers

- Dot Matrix is an impact printer.
- These printer forms characters from individual dots.
- These printers have a print head which runs back and forth on a paper.
- The print head has a two-dimensional array of pins called dot matrix. There may be 9 to 24 pins in the dot matrix.
- From this array of pins some pins are drawn out (or driven forward) to form the shape of a character.
- The drawn out pins strike an ink soaked cloth ribbon against a paper. This forms that particular character on the paper.
- Thus dot matrix printers can be used to print different fonts of characters.
- Since mechanical force is used, carbon copies of documents can be taken.
- 40 to 250 characters can be printed per second.

Daisy Wheel Printers

- This printer contains a daisy wheel. Daisy wheel is made of plastic or metal. This holds an entire character set as raised characters molded on each "petal".
- A motor rotates the daisy wheel to position the required character between the hammer and the ribbon.
- A small hammer then strikes the petal, which in turn strikes the inked ribbon to leave the character mark on the paper.
- The daisy wheel and hammer are mounted on a sliding carriage similar to that used by dot matrix printers.
- Different fonts cannot be printed using this technology.



Line Printers

- The line printer is a high speed impact printer in which one line is printed at a time.
- 600-1200 lines can be printed per minute.
- Drum printer is an example of line printers.
- These printers are very expensive.
- These kind of printers were popular in the early days of computers, but the technology is still in use.

Ink-Jet Printers

- Inkjet printer is a non impact printer, Core of an inkjet printer is the print head.
- The print head contains an ink cartridge which has a series of nozzles that are used to spray tiny drops of ink on to the paper.
- Ink cartridges come in various combinations, such as separate black and colour cartridges, colour and black in a single cartridge or even a cartridge for each ink colour.
- A motor moves the print head back and forth across the paper.

Laser Printers

- A laser printer is a non impact printer, which produces a page of text at a time.
- Laser printer uses the principle of Static Electricity to print.
- This printer has revolving cylinder called Drum. Drum is given a positive charge.
- A Laser beam is used to draw the image to be printed, on the drum with negative charge. This discharges some portion of the charge on the drum. This creates electrostatic image of the print on the drum with no charge, and the background is left positively charged.
- The drum is then exposed to toner from which positively charged toner particles mixed with carbon black are released. Since positive charge repels positive charge, the toner particles settles on the discharged areas of the drum, this is exactly the image to be printed.
- The paper is then pressed against the drum, this transfers the toner particles on to the paper.

Plotters

- Another hard copy output device is plotter. Plotter is a printing device which can draw continuous lines. This is useful to print vector graphics rather than raster graphics unlike normal printers. Plotters are widely used in applications like CAD.
- Plotters print by moving one or more pen across the surface of a piece of paper. This means that plotters are restricted to line art, rather than raster graphics as with other printers.
- Pen plotters can draw complex line art, including text, but do so slowly because of the mechanical movement of the pens. They are often incapable of efficiently creating a solid region of colour, but can draw an area by drawing a number of close, regular lines.
- Plotters offered the fastest way to efficiently produce very large drawings or colour high-resolution vector-based artwork when computer memory was very expensive and processor power was very limited.
- There are a number of different types of plotters: drum plotter, flatbed plotter.
- They are most frequently used for CAE (computer-aided engineering) applications, such as CAD (computer-aided design) and CAM (computer-aided manufacturing).

Graphics Software

- There are two types of Graphics Software.

1. General Purpose Packages

- Basic Functions in a general package include those for generating picture components (straight lines, polygons, circles and other figures), setting color and intensity values, selecting views, and applying transformations.
- Example of general purpose package is the GL (Graphics Library), GKS, PHIGS, PHIGS+ etc.

2. Special Purpose Packages

- These packages are designed for non programmers, so that these users can use the graphics packages, without knowing the inner details.
- Example of special purpose package is
- Painting programs, Package used for business purpose
- Package used for medical systems.
- CAD packages


Thank You