Computer Graphics

22318

Syllabus

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Computer Graphics	06	04	04	-	08
II	Raster Scan Graphics	12	02	06	10	18
III	Overview of Transformations	12	02	06	10	18
IV	Windowing and clipping	10	-	06	08	14
V	Introduction to Curves	08	-	04	08	12
Total		**48**	**8**	**26**	**36**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*
This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

Course Outcomes

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Manipulate visual and geometric information of images.
b. Implement standard algorithms to draw various graphics objects using C program.
c. Develop programs for 2-D and 3-D Transformations.
d. Use projections to visualize objects on view plane.
e. Implement various clipping algorithms.
f. Develop programs to create curves using algorithms.

Practical Outcomes

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Write Programs to draw following graphics object using built-in "C" functions. i) Pixel ii) Lines iii) Circles iv) Rectangle v) Ellipse	I	02*
2	Implement following algorithms to draw line. i) DDA algorithm	II	02*
3	ii) Bresennham's algorithm	II	02
4	Implement Bresennham's algorithm to draw a circle.	II	02
5	Write a program to fill Polygon using following methods: i) Flood fill	II	02
6	ii) Boundary fill	II	02
7	Write a program for two-dimensional transformation i) Translation ii) Scaling	III	02*
8	iii) Rotation	III	02
9	iv) Reflection v) Shearing	III	02
10	Write a program for three-dimensional transformation i) Translation ii) Scaling	III	02
11	iii) Rotation	III	02
12	Write a program to clip line using following algorithms. Cohen- Sutherland algorithm	IV	02*
13	Write a program to clip line using following algorithms. Cohen Midpoint subdivision algorithm	IV	02
14	Write a program to clip polygon using Sutherland -Hodgeman. Algorithm.	IV	02
15	Write a program to draw (any one) following type of curves. i) Hilbert's Curve	V	02*
16	Write a program to draw (any one) following type of curves. i) Koch curve ii) Bezier curves	V	02*

Unit-1

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of Computer Graphics	1a. Differentiate attributes of the given mode. 1b. Compare features of the given Scan Display. 1c. Write a program to draw the given type of primitives using "C". 1d. Describe application of the given display device. 1e. Convert the given 2D co-ordinates to physical device co-ordinates.	1.1 Image and Objects, pixel and resolution, Text mode, Graphics mode, Basic Graphics Pipeline, Bitmap and Vector Based Graphics, Applications of Computer Graphics. 1.2 Display Devices: Raster-Scan Display, Random-Scan Display, Flat Panel Display, LED, LCD display, Plasma, Touch screen. 1.3 Output primitives: line, polygon, marker, text. 1.4 Graphics functions and standards. 1.5 Latest trends in Computer Graphics: Virtual reality, Augmented reality.

Basics Of Computer Graphics

- **Introduction to CG**

  What is Computer Graphics
- **Application of CG**

  Where it is used
- **What is Pixel**
- **What is Frame Buffer**
- **Bitmap Graphics and Vector based Graphics**

Application of CG

- Engineering/ Scientific software
- For making Animated movies and pictures
- In medical
- In TV Channels
- Making Charts, Image Processing
- CAD/CAM
- Visual effects in movies and computer games
- Office automation
- PCB designing
- Map Preparation
- User Interface

Pixel

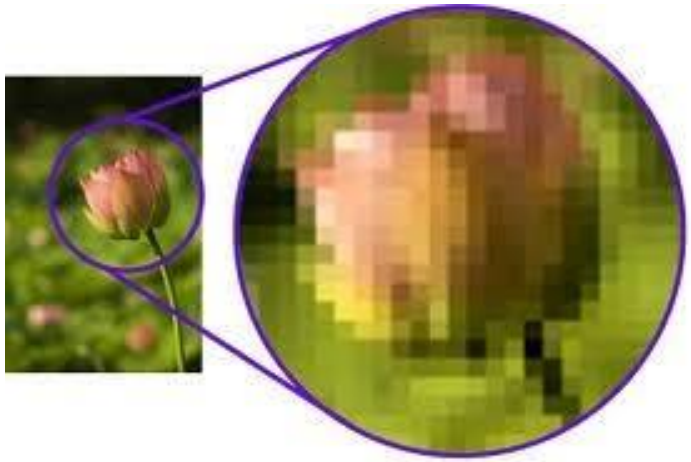
- Smallest addressable unit on computer screen
- Each pixel has its name and unique address or location
- CG images and videos are made by using setting the intensity and color to pixel
- Greater the number of pixels/point, the higher is the resolution.

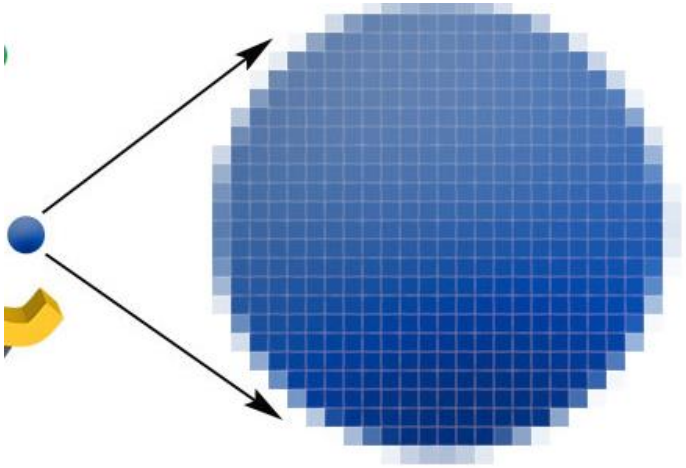
Frame buffer

- It is an array of computer memory
- Before image can be displayed on screen it must be created by computer program in a special part of memory called as frame buffer
- Frame buffer is a portion of graphics memory that hold the scene data. This buffer contains details such as width and height of the surface (in pixels), color of each pixel, and depth

Bitmap and Vector based graphics

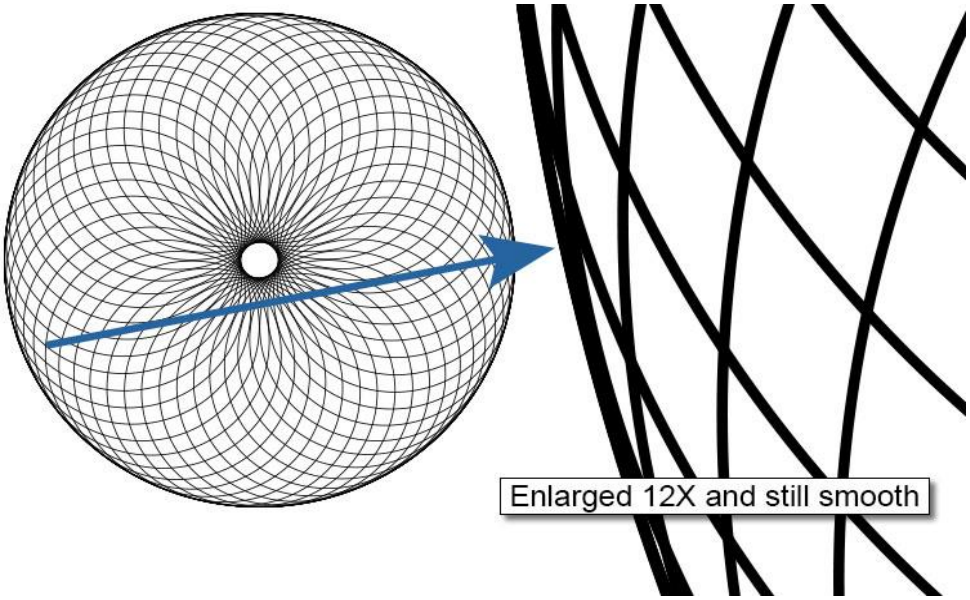
- Bitmap Image/Graphics:





1. **Collection of bits in memory location corresponding to pixels on the screen**
2. **It consist of array of bits called pixel**
3. **Affects resolution**
4. **Larger in size than vector image**
5. **Modification is difficult**
6. **Eg. .JPEG, .GIF, .BMP**

Vector based Graphics



Raster
.jpeg .gif .png

Vector
.svg

1. Use Mathematical formulas to draw vector images
2. Image Consist of lines instead of pixel
3. Resolution does not affect
4. Smaller in size
5. Modification is easy
6. Eg. Postscripts, .svg

Difference between Bitmap & Vector Graphics

No	Bitmap Graphics	Vector based Graphics
1	Pixels are used to form bitmap images	Mathematical formulas are used to form vector based images
2	It is made up from pixels	It is made up from lines
3	Larger in size than vector image	Smaller in size
4	Affected by resolution	Does affect by resolution
5	Modification is more difficult	Modification is easy
6	Conversion of bitmap graphics to vector graphics is more difficult	Vector graphics can be Converted into bitmap graphics easily
7	More suitable for complex images	Not appropriate for complex images
8	Example: .GIF, .JPEG, .BMP, .PNG	Example: .svg, postscripts

Display Adapters/Video Adapter

- It is an integrated circuit card in a computer which provide digital to analog convertor.

Characteristics:

1. **Resolution**: Number of dots present on the screen horizontally and vertically. Common resolutions are, 640x480, 800x600, 1024x768, 1280x1024, 1368*768

2. **Color Depth:** Determines no. Of bits assigned to hold color value.

   1 Bit : 2 Colors, 4 Bits : 16 Colors 8 Bits : 256 Colors
   16 Bits : 32 thousand Colors 24 Bits : 16 Million 32 Bits : Latest

   If System using n-bit per pixel then it can support 2^n number of colors

3. **Refresh Rate:** Nothing but the speed at which a particular dot on the screen is getting printed

4. **Accelerator:** It is an IC chip existing on display adapter. It is used to draw ready made shapes like lines, rectangles, circle etc.

   CPU has to send only command to the accelerator rest will be done by accelerator.

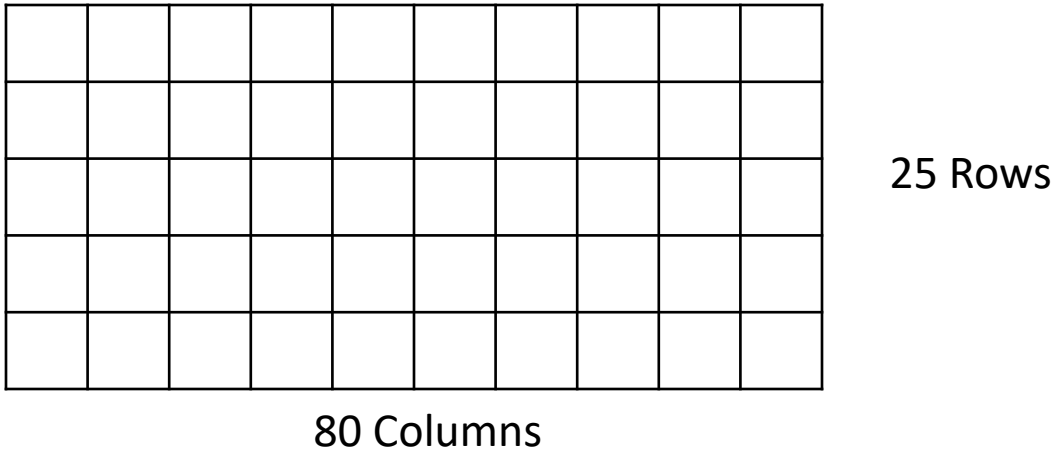
   Eg. Drawing a line by passing coordinates of two end points.

Display Modes

Two types of modes:

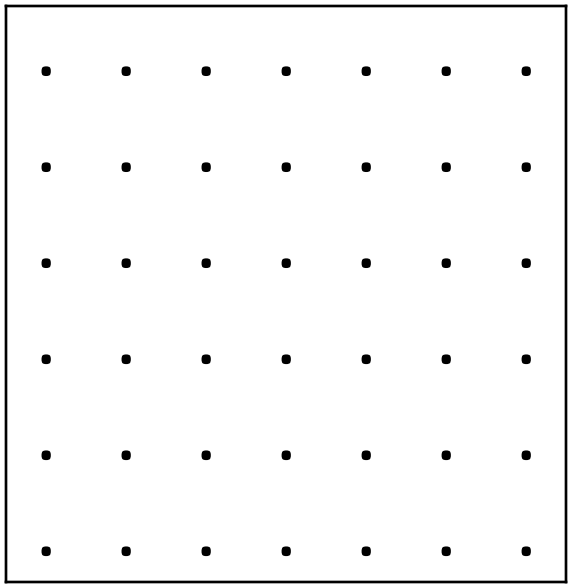
1. **Text Mode/ Character Mode:**

- In this type the screen is divided into array of blocks.
- In this mode screen is divided into number of square boxes (i.e in number of rows and columns).
- All standard display adapters support this mode.
- In this mode screen is divided into 25 rows and 80 columns. Where each block stores a single ASCII character.
- Many limitations while displaying different shapes. We can't increase the font



2. Graphics Mode:

- In this mode display screen is divided into number of pixels instead of block.
- Pixel is a smallest addressable unit element having its name an own address so that we can uniquely identify each pixel.
- The output in graphics mode is look like more clear and we can display variety of shapes in this mode.



Graphics Function

- **initgraph()** : To initialize graphics mode and graphics driver.

  Syntax: Initgraph(&gd, &gm, ”C:/tc/bgi”);
- **Path:** (c:/tc/bgi)

  To find graphics driver in BGI directory
- **Line() :**
- **Closegraph():**

Problems on Refresh Rate & Frame Buffer

1. **How Long it would take to load a 1280 x 1024 frame buffer with 12 bits per Pixel if transfer rate is 1MBPS.**

   Time required to load= $\frac{\text{total number of pixels}}{\text{Transfer rate}}$

2. If transfer rate of system is 104 bits/second what amount of time is required to load frame buffer of size 400x300 which supports 256 colors

2. **How Long it would take to load a 640 x 400 frame buffer with 12 bits per Pixel if 10^6 bits can be transfer per second.**

2. **How Long it would take to load a 640 x 480 frame buffer with 12 bits per Pixel if transfer rate is 1MBPS. What is the size of frame buffer and how many colors it support.**

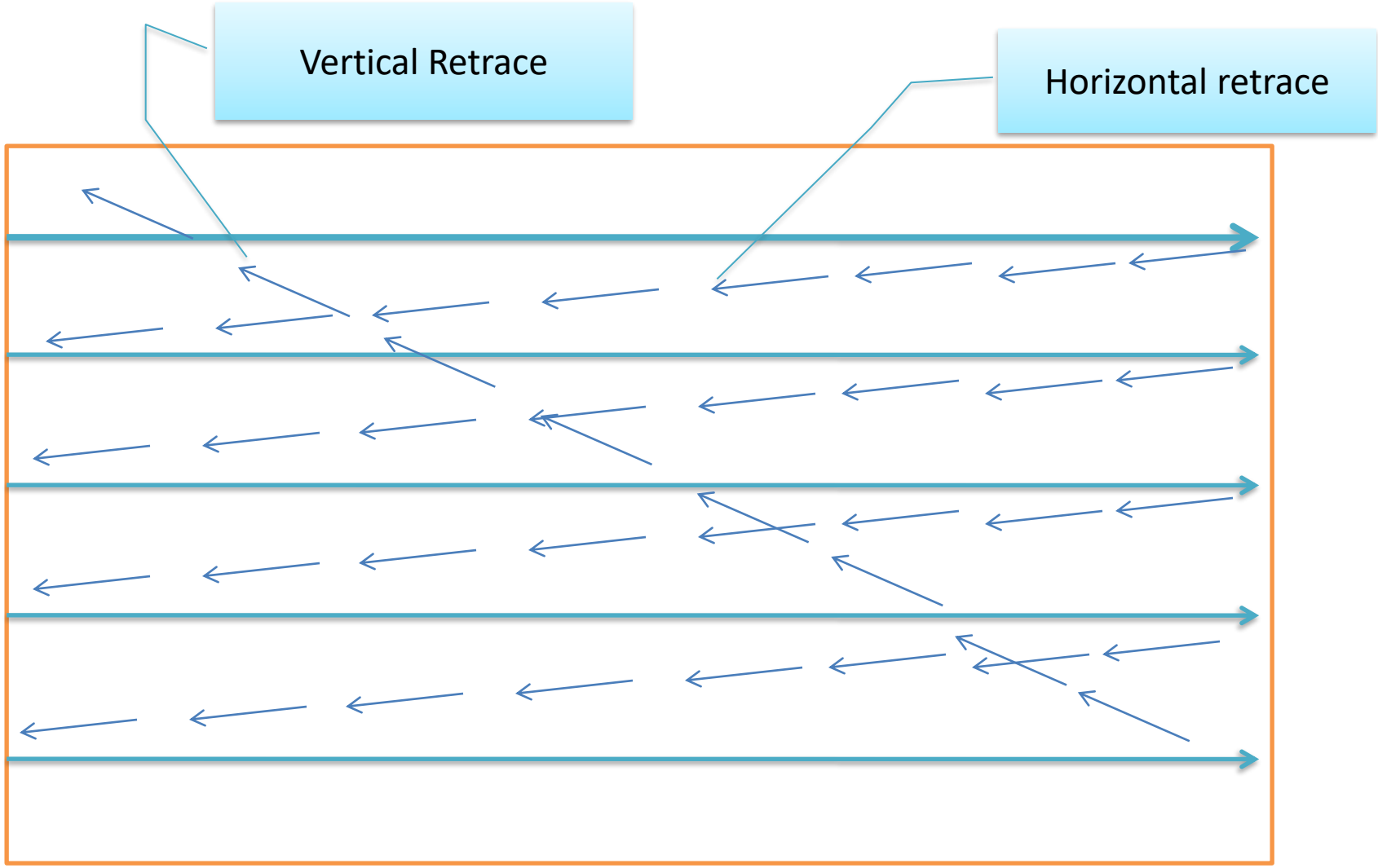
Graphics Devices

- **Interactive Devices**
    1. Mouse
    2. Trackball
    3. Joystick
    4. Touch Panel
- **Data Generating Devices**
    1. Scanners
    2. Digitizes
- **Display Devices**
    1. Video Display Devices
    2. Raster Graphics Display/ Raster Scan Display
    3. Random Scan display /Vector scan display
    4. Plotters

Raster Scan Display

- In Raster scan display while scanning any image/object electron beams follows a fixed path.
- The electron beams starts scanning from top left corner of the screen and move horizontally to the right.
- During this scan the electron beams get modulated according to the pattern of the desired image.
- At the right corner of the screen the beam becomes off and moved back to the left edge of the screen at the starting point on the straight line. This is shown as dotted line called as **horizontal retrace.**
- This way is continued till the bottom right corner is reached. At this pint one scan is completed.
- The beam is then repositioned at the top left corner of the screen for starting another scan.
- This movement of beam from bottom right corner to top left corner is called as **vertical retrace.**

Raster Scan Display



Vector /Random Scan Display

- In random scan electron beams scan to only those part of the screen where the picture is to be drawn.
- Creation of diagrams using vector scan is more easier.

Difference in between Raster scan display v/s Random scan display

Sr. No	Raster Scan	Random Scan
1	The electron beams start scanning from top left corner of the screen and move to the right	The electron beams start scanning only those part of the screen where the picture is to be drawn
2	Creation of diagram using raster scan is difficult	Creation of diagram using random scan is easier
3	Used in animation	Used in engineering and scientific drawings
4	Cost of device used for raster scan is much cheaper	Cost of device used for random scan is much higher
5	Require More Memory	Require less Memory
6	No such intelligent electron beams are required	Require intelligent electron beams
7	CRT are used	Pen plotters and direct view storage tubes are used

Output Primitive Operations

- **Line-abs();**

  To draw a line from current position

- **Line-rel();**

  To draw a line from finding its horizontal and vertical distance

  Dx-Horizonatal X axis

  Dy-

Display File and its structure

- **Opcode**

  It is a command

Eg. Move(), line();

Commnad (Opcode)	X-operand	Y-Operand
Move(1)	x1	y1
Line(2)	x2	y2

- **Operand**

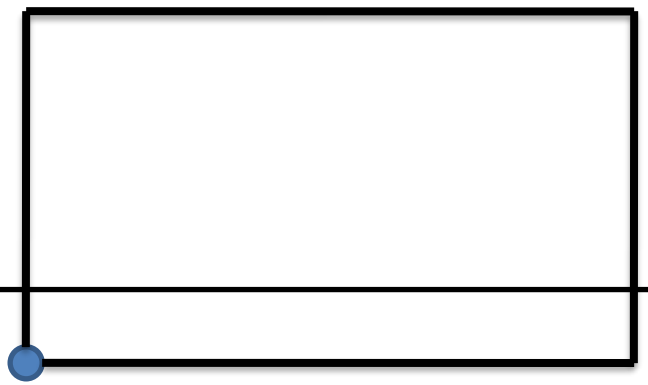
  Its is divided into two parts

  x-op and y-op

Primitive Operation on display file

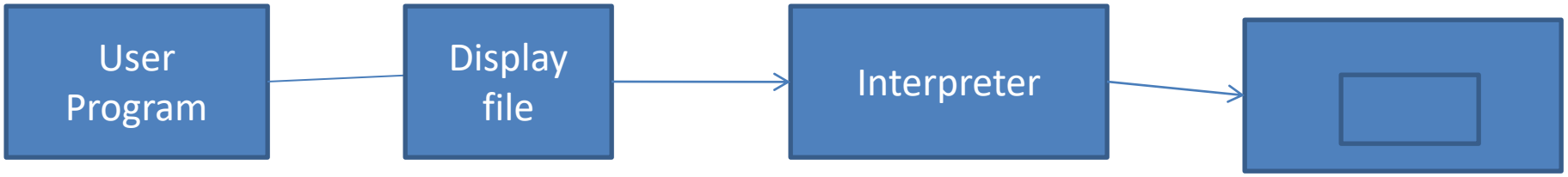
1. Move(x1,y1) ------→ (1,x1,y1)
2. Line(x2,y2)-------→ (2,x2,y2)
3. Line(x3,y3)--------→ (2,x3,y3)
4. Line(x4,y4)--------→ (2,x4,y4)
5. Line(x1,y1)--------→ (2,x1,y1)

Opcode	X-Operand	Y-
1	x1	y1
2	x2	y2
2	x3	Y3
2	x4	y4
2	x1	y1



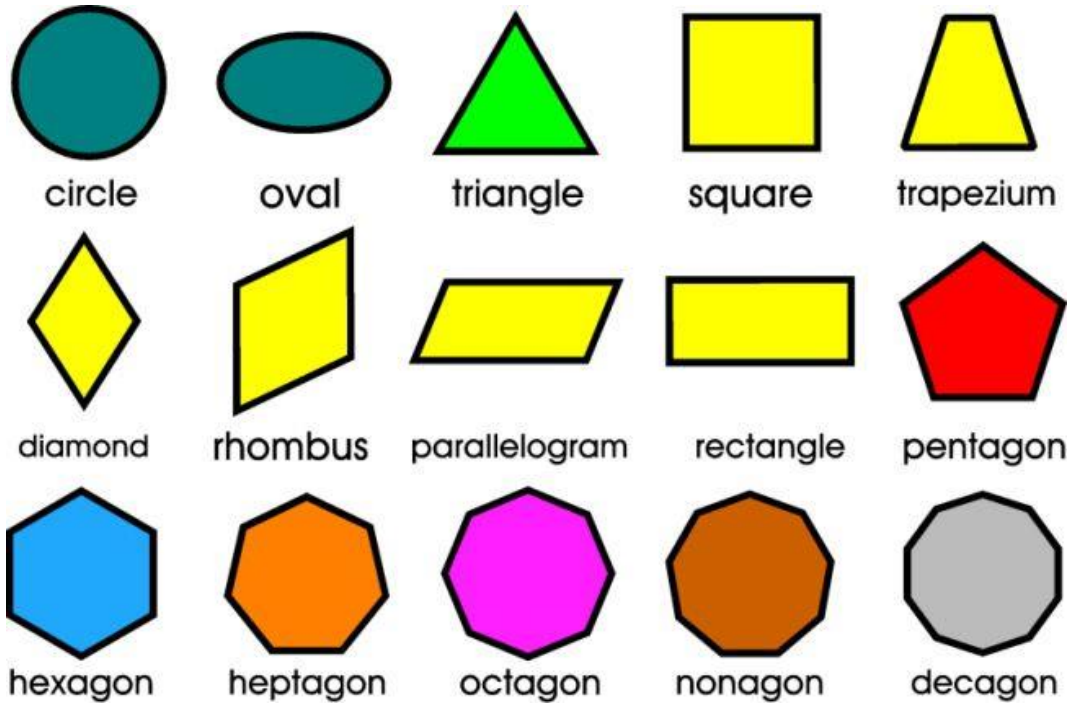
Display File Interpreter

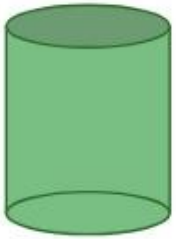
- Display File contains information necessary to construct different shapes and images
- Each command having a instructions to draw shape
- But we need something to construct images using command



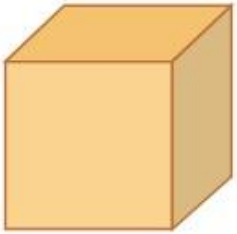
Co- Ordinate System

- Two Dimensions
- Three Dimensions



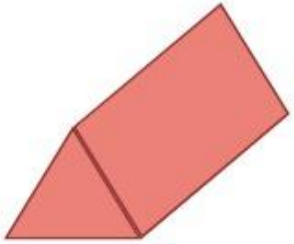


Cylinder



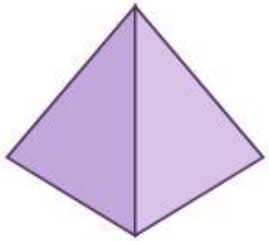
Cube

Rectangular Prism



Triangular Prism

Sphere



Pyramid

Cone

Virtual Reality

- Means Computer Generated Environment
- Creation of Simulated environment by using computer technology
- So that we can feel we are also part of such environment.
- You feel that you are physically present in that environment you can view in all direction.
- Wee can experience such environment using some VR devices.
- Example. 3D movies,

Augmented Reality

- In AR user can see and interact with real world while digital contents are added to it.
- It is a enhanced version of reality which is created by the use of technology to add digital information on an images
- It create totally an Artificial environment .


Transit
1:30min 120m
Hotel
40m
Grocery Store
30m
Restaurant
25m


07:44
Pikachu
CP ???