# HEMVATI NANDAN BAHUGUNA GARHWAL UNIVERSITY

# (SRINAGAR,UTTARKHAND)

## M.C.A. IV sem

## Batch (2018-2021)

## SUBJECT:- COMPUTER GRAPHICS


**Submitted to**

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# ASSIGNMENT 01

**Q1. Explain the role of pixel and frame buffer in graphics devices.**

**Ans.** A **pixel** (short for picture element, using the common abbreviation "pix" for "picture") is one of the many tiny dots that make up the representation of a picture in a computer's memory. Each such information element is not really a dot, nor a square, but an abstract sample.

Short for **Pic**ture Element, a pixel is a single point in a graphic image. Graphics monitors display pictures by dividing the display screen into thousands (or millions) of pixels, arranged in rows and columns. The pixels are so close together that they appear connected.

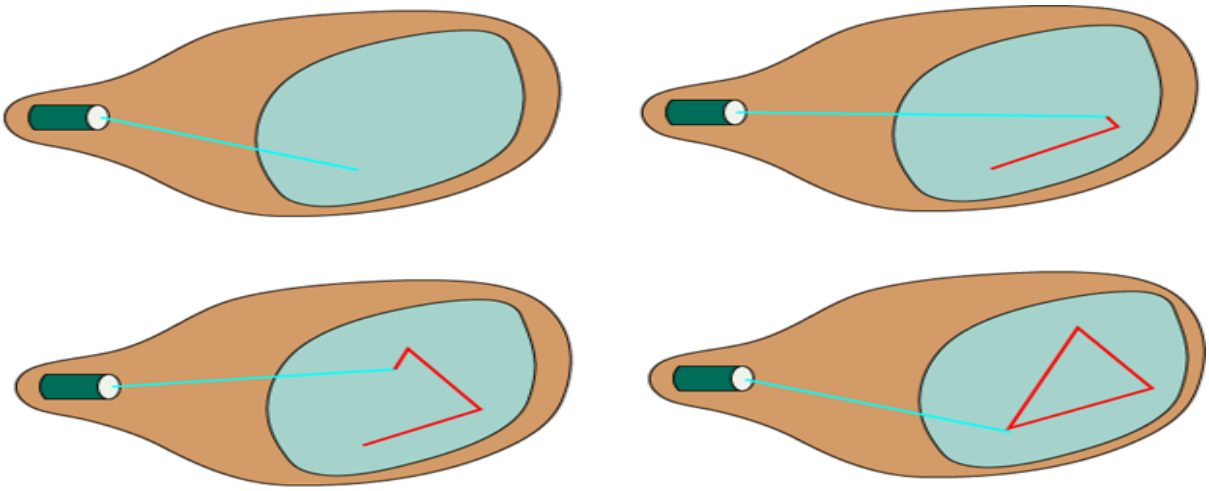
The number of bits used to represent each pixel determines how many colors or shades of gray can be displayed. For example, in 8-bit color mode, the color monitor uses 8 bits for each pixel, making it possible to display 2 to the 8th power (256) different colors or shades of gray

A **frame buffer** is a large, contiguous piece of computer memory. At a minimum there is one memory bit for each pixel in the rater; this amount of memory is called a bit plane. The picture is built up in the frame buffer one bit at a time. Or a framebuffer or frame buffer is a part of the RAM of a system that is used to store a bitmap file that is responsible for displaying a video. In other words, this is a memory buffer that accommodates a full data framework.

**Q2. Distinguish between random and raster scan display.**

**Ans. <u>Random Scan Display:</u>**

Random Scan System uses an electron beam which operates like a pencil to create a line image on the CRT screen. The picture is constructed out of a sequence of straight-line segments. Each line segment is drawn on the screen by directing the beam to move from one point on the screen to the next, where its x & y coordinates define each point. After drawing the picture. The system cycles back to the first line and design all the lines of the image 30 to 60 time each second. The process is shown in fig:



Random-scan monitors are also known as vector displays or stroke-writing displays or calligraphic displays.

**Advantages:**

1. A CRT has the electron beam directed only to the parts of the screen where an image is to be drawn.
2. Produce smooth line drawings.
3. High Resolution

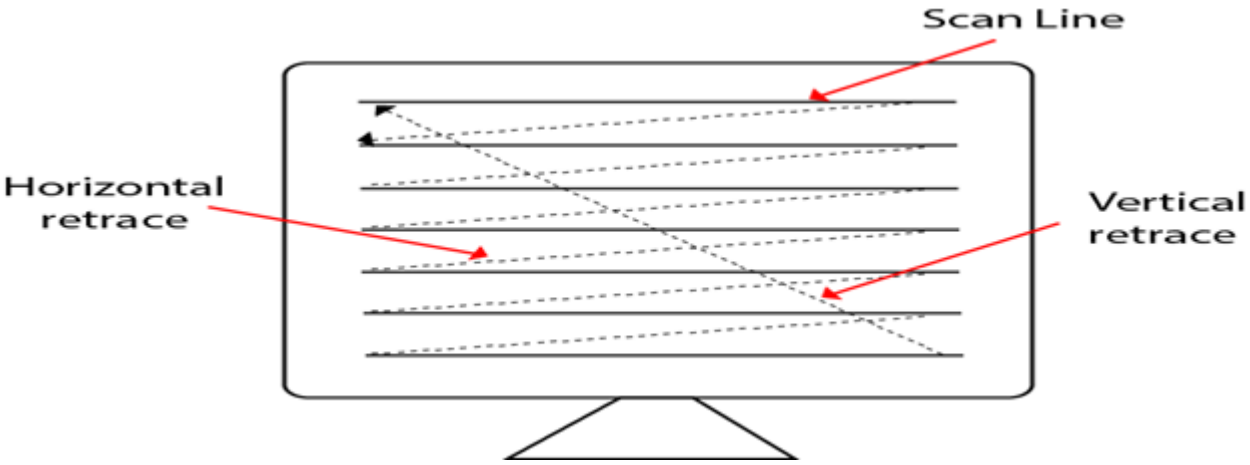
**Disadvantages:**

1. Random-Scan monitors cannot display realistic shades scenes.

## Raster Scan Display:

A Raster Scan Display is based on intensity control of pixels in the form of a rectangular box called Raster on the screen. Information of on and off pixels is stored in refresh buffer or Frame buffer. Televisions in our house are based on Raster Scan Method. The raster scan system can store information of each pixel position, so it is suitable for realistic display of objects. Raster Scan provides a refresh rate of 60 to 80 frames per second.

Frame Buffer is also known as Raster or bit map. In Frame Buffer the positions are called picture elements or pixels. Beam refreshing is of two types. First is horizontal retracing and second is vertical retracing. When the beam starts from the top left corner and reaches the bottom right scale, it will again return to the top left side called at vertical retrace. Then it will again more horizontally from top to bottom call as horizontal retracing shown in fig:




### Types of Scanning or travelling of beam in Raster Scan

1. Interlaced Scanning
2. Non-Interlaced Scanning

In Interlaced scanning, each horizontal line of the screen is traced from top to bottom. Due to which fading of display of object may occur. This problem can be solved by Non-Interlaced scanning. In this

first of all odd numbered lines are traced or visited by an electron beam, then in the next circle, even number of lines are located.

For non-interlaced display refresh rate of 30 frames per second used. But it gives flickers. For interlaced display refresh rate of 60 frames per second is used.

Advantages:

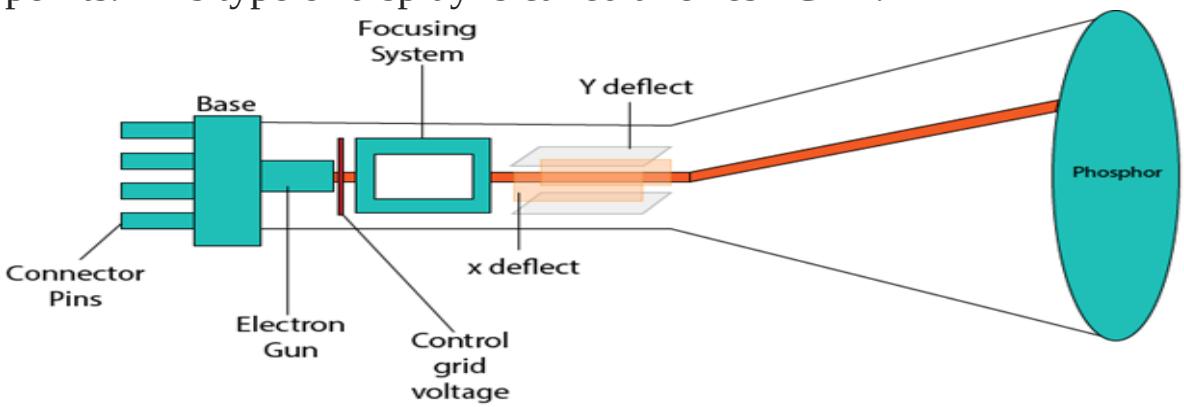
1. Realistic image
2. Million Different colors to be generated
3. Shadow Scenes are possible.

Disadvantages:

1. Low Resolution
2. Expensive

**Q3.Explain working of Refresh cathode ray tube with diagaram.**

- **Ans.** A beam of electrons (cathode rays), emitted by an electron gun, passes through focusing and deflection systems that direct the beam towards specified position on the phosphor-coated screen.
- The phosphor then emits a small spot of light at each position contacted by the electron beam.
- One way to keep the phosphor glowing is to redraw the picture repeatedly by quickly directing the electron beam back over the same points. This type of display is called a refresh CRT.



Cathode Ray Tube

**Electron Gun**

- The primary components of an electron gun in a CRT are the heated metal cathode and a control grid.
- The cathode is heated by an electric current passed through a coil of wire called the filament.
- In the vacuum inside the CRT envelope, negatively charged electrons are then accelerated toward the phosphor coating by a high positive voltage.

**Control Grid :**

- Control grid is used to surround the cathode. Grid is cylindrical in shape. It is made up of metal.
- Grid has hole at one end, through which electrons get escaped.
- The control grid is kept at lower potential as compared to cathode, so that a electrostatic field can be created.
- It will direct that electrons through point source, so process of focusing will be simplified.

**Focusing System**

- The focusing system is to create a clear picture by focusing the electrons into a narrow beam. Otherwise, electrons would repel each other and beam would spread out as it reaches the screen.
- Focusing is accomplished with either electric or magnetic fields.

**Deflection System**

- Deflection of the electron beam can be controlled by either electric fields or magnetic fields.
- In case of magnetic field, two pairs of coils are used, one for horizontal deflection and other for vertical deflection.
- In case of electric field, two pairs of parallel plates are used, one for horizontal deflection and second for vertical deflection as shown in figure above.

**CRT Screen**

- The inside of the large end of a CRT is coated with a fluorescent material that gives off light when struck by electrons.
- When the electrons in the beam is collides with phosphor coating screen, they stopped and their kinetic energy is absorbed by the phosphor.
- Then a part of beam energy is converted into heat energy and the remainder part causes the electrons in the phosphor atom to move up to higher energy levels.

**Persistence**

- It is defined as the time they continue to emit light after the CRT beam is removed.
- Persistence is defined as the time it takes the emitted light from the screen to decay to one-tenth of its original intensity.
- Lower-persistence phosphors require higher refresh rates to maintain a picture on the screen without flicker.
- A phosphor with low persistence is useful for animation; a high-persistence phosphor is useful for displaying highly complex, static pictures.

**Resolution**

- The number of points per centimeter that can be used be plotted horizontally and vertically. Or Total number of points in each direction.
- The resolution of a CRT is depend on
- type of phosphor
- intensity to be displayed

**Aspect Ratio**

- It is ratio of horizontal to vertical points.
- Example: An aspect ratio of 3/4 means that a vertical line plotted with three points has same length as horizontal line plotted with four points.

**Q4. Write various applications of Computer Graphics.**

**Ans.**

**1. Education and Training:** Computer-generated model of the physical, financial and economic system is often used as educational aids. Model of physical systems, physiological system, population trends or equipment can help trainees to understand the operation of the system.

For some training applications, particular systems are designed. For example Flight Simulator.

**Flight Simulator:** It helps in giving training to the pilots of airplanes. These pilots spend much of their training not in a real aircraft but on the ground at the controls of a Flight Simulator.

Advantages:

1. Fuel Saving
2. Safety
3. Ability to familiarize the training with a large number of the world's airports.

**2. Use in Biology:** Molecular biologist can display a picture of molecules and gain insight into their structure with the help of computer graphics.

**3. Computer-Generated Maps:** Town planners and transportation engineers can use computer-generated maps which display data useful to them in their planning work.

**4. Architect:** Architect can explore an alternative solution to design problems at an interactive graphics terminal. In this way, they can test many more solutions that would not be possible without the computer.

**5. Presentation Graphics:** Example of presentation Graphics are bar charts, line graphs, pie charts and other displays showing relationships between multiple parameters. Presentation Graphics is commonly used to summarize

- Financial Reports
- Statistical Reports
- Mathematical Reports
- Scientific Reports
- Economic Data for research reports
- Managerial Reports
- Consumer Information Bulletins
- And other types of reports

**6. Computer Art:** Computer Graphics are also used in the field of commercial arts. It is used to generate television and advertising commercial.

**7. Entertainment:** Computer Graphics are now commonly used in making motion pictures, music videos and television shows.

**8. Visualization:** It is used for visualization of scientists, engineers, medical personnel, business analysts for the study of a large amount of information.

**9. Educational Software:** Computer Graphics is used in the development of educational software for making computer-aided instruction.

**10. Printing Technology:** Computer Graphics is used for printing technology and textile design.

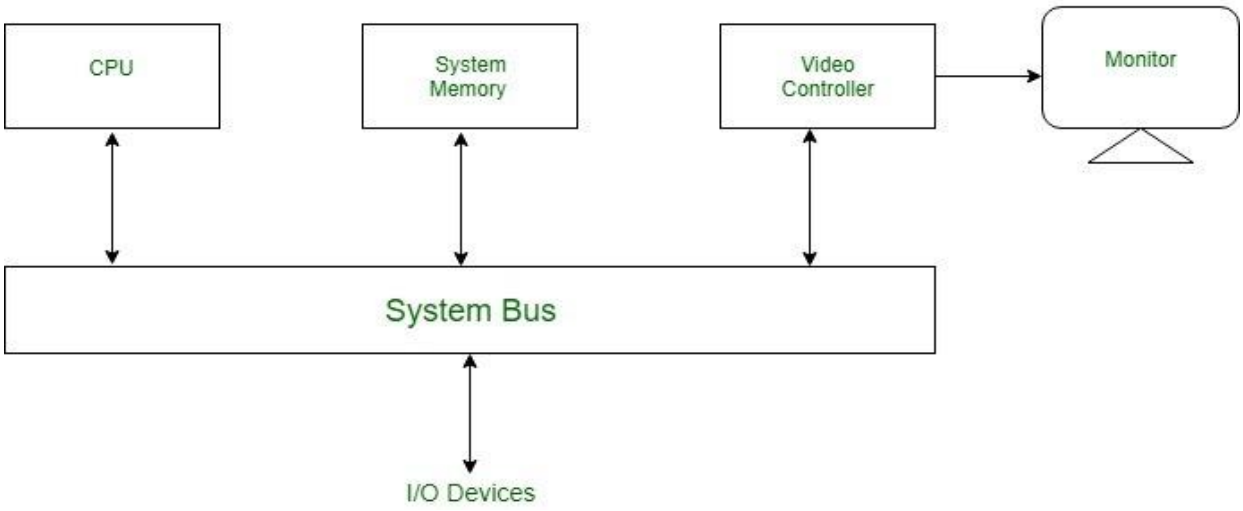
**Q5. Explain Raster Scan Display architecture with diagram.**

**Ans. Raster Scan Displays** are most common type of graphics monitor which employs CRT. It is based on television technology. In raster scan system electron beam sweeps across the screen, from top to bottom covering one row at a time.A pattern of illuminated pattern of spots is created by turning beam intensity on and off as it moves across each row. A memory area called refresh buffer or frame buffer stores picture definition. This memory area holds intensity values for all screen points. Stored intensity values are restored from frame buffer and painted on screen taking one row at a time.Each screen point is referred to as pixels.

In raster scan systems refreshing is done at done at a rate of 60-80 frames per second. Refresh rates are also sometimes described in units of cycles per second / Hertz (Hz). At the end of each scan line, electron beam begins to display next scan line after returning to left side of screen. The return to the left of screen after refresh of each scan line is known as horizontal retrace of electron beam. At the end of each frame electron beam returns to top left corner and begins the next frame.

**Raster-Scan Display Processor:**
An important function of display process is to digitize a picture definition given in an application program into a set of pixel-intensity values for storage in refresh buffer. This process is referred to as **scan conversion**. The purpose of display processors is to relieve the CPU from graphics jobs.

Display processors can perform various other tasks like: creating different line styles, displaying color areas, etc. Typically display processors are utilized to interface input devices, such as mouse, joysticks.



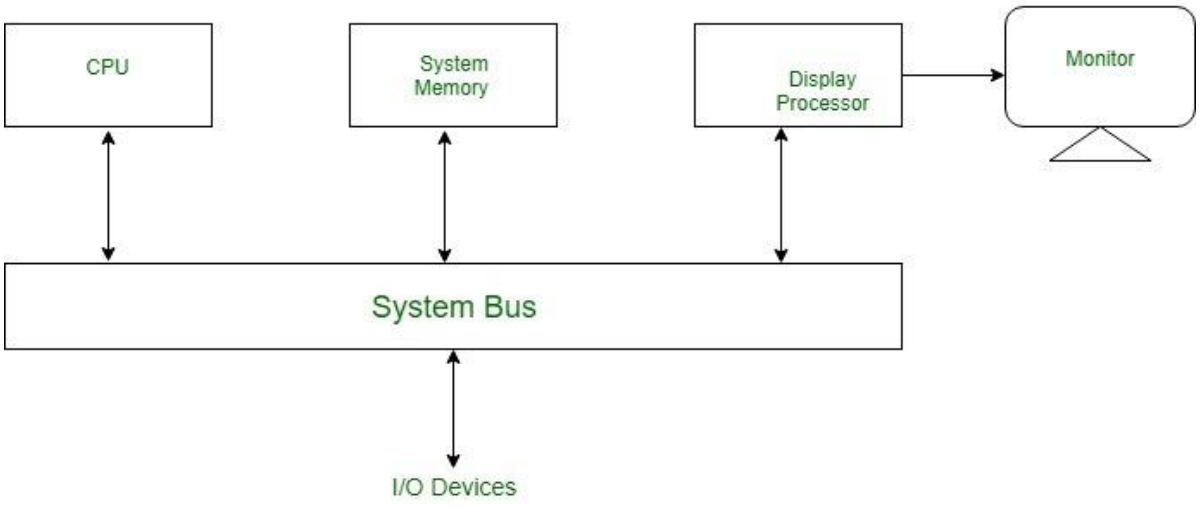

**Q6. Explain Vector Scan Display architecture with diagram.**

**Ans.** In **Random-Scan Display** electron beam is directed only to the ares of screen where a picture has to be drawn. It is also called vector displays, as it draws picture one line at time. It can draw and refresh component lines of a picture in any specified sequence. Pen plotter is an example of random-scan displays.

The number of lines regulates refresh rate on random-scan displays. An area of memory called refresh display files stores picture definition as a set of line drawing commands. The system returns back to first line command in the list, after all the drawing commands have been processed. High-quality vector systems can handle around 100, 00 short lines at this refresh rate. Faster refreshing can burn the phosphor. To avoid this every refresh cycle is delayed to prevent refresh rate greater than 60 frames per second.

**Random-Scan Display Processors:**
Input in the form of an application program is stored in the system memory along with graphics package. Graphics package translates the graphic commands in application program into a display file stored in

system memory. This display file is then accessed by the display processor to refresh the screen. The display processor cycles through each command in the display file program. Sometimes the display processor in a random-scan is referred as Display Processing Unit / Graphics Controller.




**Q7. Discuss DDA Algorithm for line drawing and its disadvantage over Bresenham's Algotithm.**

**Ans. <u>DDA Algorithm-</u>**

DDA Algorithm is the simplest line drawing algorithm.

Given the starting and ending coordinates of a line,

DDA Algorithm attempts to generate the points between the starting and ending coordinates.

**Procedure-**

Given-

Starting coordinates = $(X_0, Y_0)$

Ending coordinates = $(X_n, Y_n)$

The points generation using DDA Algorithm involves the following steps-

**Step-01:**

Calculate ΔX, ΔY and M from the given input.

These parameters are calculated as-

$\Delta X = X_n - X_0$

$\Delta Y = Y_n - Y_0$

$M = \Delta Y / \Delta X$

**Step-02:**

Find the number of steps or points in between the starting and ending coordinates.

if (absolute (ΔX) > absolute (ΔY))

Steps = absolute (ΔX);

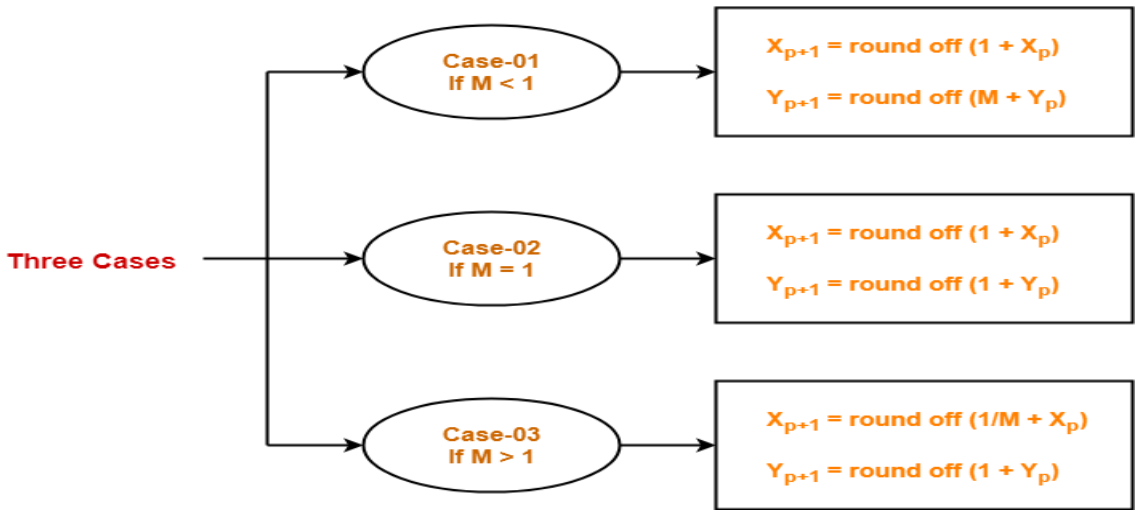
else

Steps = absolute (ΔY);

**Step-03:**

Suppose the current point is $(X_p, Y_p)$ and the next point is $(X_{p+1}, Y_{p+1})$.

Find the next point by following the below three cases-




**Step-04:**

Keep repeating Step-03 until the end point is reached or the number of generated new points (including the starting and ending points) equals to the steps count.

**Disadvantage of DDA:**

The accumulation of round of error is successive addition of the floating point increments is used to find the pixel position but it take

lot of time to compute the pixel position.

**Advantages of bresenham's line drawing algorithm..**

The Bresenham line algorithm has the following advantages:
– An fast incremental algorithm
– Uses only integer calculations
The Bresenham algorithm is another incremental scan conversion algorithm
The big advantage of this algorithm is that it uses only integer calculations such as addition/subtraction and bit shifting.
The main advantage of Bresenham's algorithm is speed.

**Q8. Plot a line between (2,2) and (9,2) using DDA Algorithm.**

**Ans.**

$X_1=2$ $X_2=9$

$Y_1=2$ $Y_2=2$

$dX= X_2-X_1 = 9-2 = 7$

$dY= Y_2-Y_1 = 2-2 = 0$

abs(dx)=7, abs(dy)=0

abs(dx) > abs(dy)

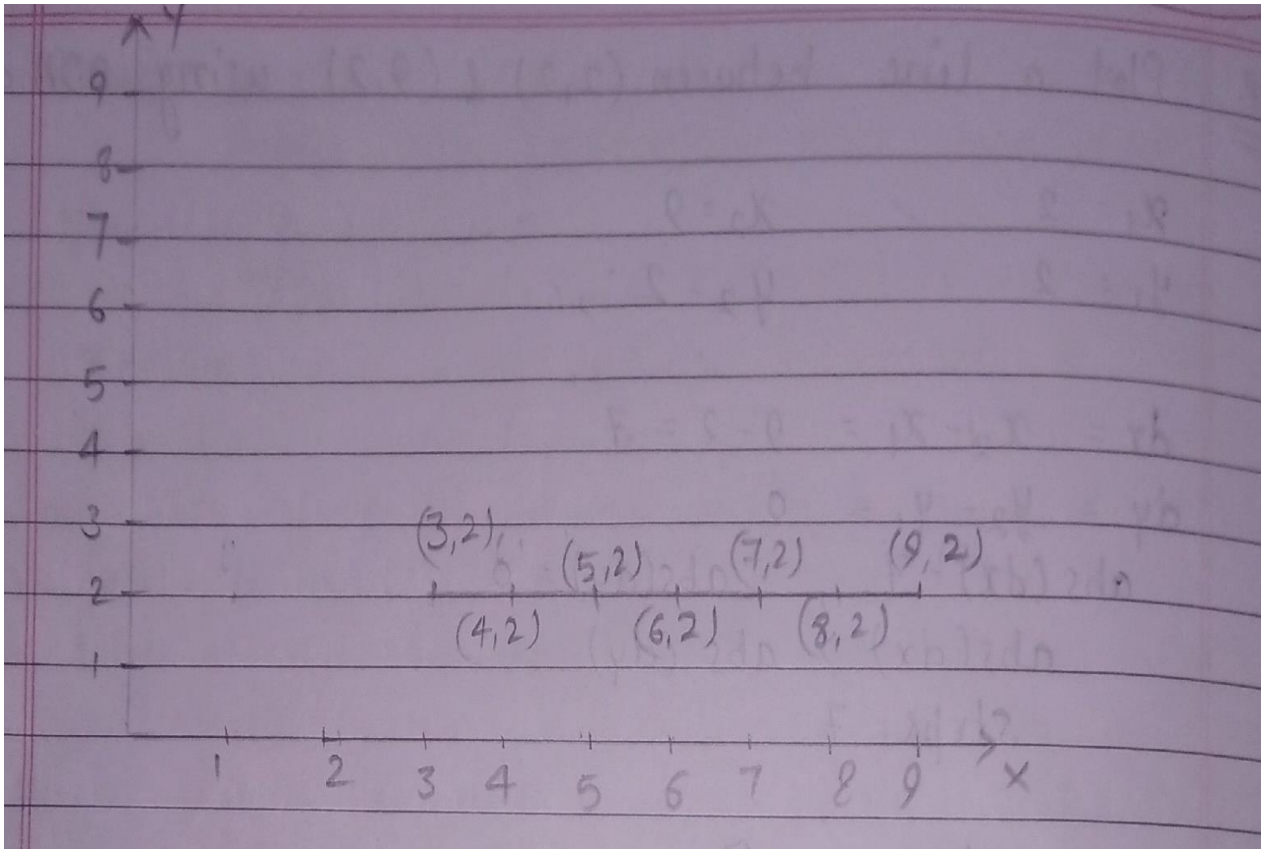
steps = 7

$x_{inc}$ = dx/steps = 7/7 =1

$y_{inc}$ = dy/steps = 0/7= 0

Tabulating the result of each itration

| i | x | y | Plot(x,y) |
|---|---|---|---|
| 1 | 3 | 2 | (3,2) |
| 2 | 4 | 2 | (4,2) |
| 3 | 5 | 2 | (5,2) |
| 4 | 6 | 2 | (6,2) |
| 5 | 7 | 2 | (7,2) |
| 6 | 8 | 2 | (8,2) |
| 7 | 9 | 2 | (9,2) |



**Q9. Explain an inside test.**

**Ans.** This method is also known as counting number method.while filling an object we often need to identify whether particular point is inside the object or outside it.there are two methods by which we can identify whether particular point is inside an object or outside.

**Odd- even rule:** In this algorithm we draw a line from any position p to a distant point outside the coordinate extents of the object and counting the number of edge crossing along the line. If the number of polygon edges crossed by this line is odd, then p is an interior point, otherwise p is an exterior point. To obtain an accurate edge count, we must be sure that the line path we choose does not intersect any polygon vertices.

**Non zero winding number rule:** In this algorithm count the number of times the polygon edges wind around a particular point in the counter clockwise direction. This count s called the winding number and the interior points of a two dimensional object are defined to be those that have a non zero value for the winding number. We apply the non zero winding number rule to polygons by initializing the winding number to 0 and again imagining a kine drawn from any position p to a distant point beyond the coordinates extents of the object. The line we choose must not pass through any vertices. As we move along the line from position p to the distant point. We count the number of edges that crosses the line in each direction we add 1 to the winding number every time we intersect a polygon edge that crosses the line from right to lift, and we subtract 1 every line we intersect an edge that crosses from left to right. The final value of the winding number, after all edge crossing have been counted, determines the relative position of p. If the ending number is non zero p is taken to be an exterior point. Recursive boundary fill algorithms may not fill regions correctly if some interior pixels are already displayed in the fill color. This occurs because the algorithm checks next pixels both

for boundary color and for fill color. Encountering a pixel with the fill color can cause a recursive branch to terminate leaving other interior pixels unfilled. To avoid this we can first change the color of and interior pixels unfilled. To avoid this we can first change the color of any interior pixels that are initially set to the fill color before applying the boundary fill procedure.  Also since this procedure requires considerable stacking of neighboring points more efficient methods are generally employed. These methods fill horizontal pixel spans across scan lines instead of proceeding to 4 commented or 8 commented neighboring points. Then we need only stack a beginning position for each horizontal pixel span instead of stacking all unprocessed neighboring positions around the current position. Starting from the initial interior point with this method we first fill in the contiguous span of pixels on this starting scan line.