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Group A

1) List the operating characteristics for the following display technologies: raster refresh systems, vector refresh systems, plasma panels, and LCDs.

→ The operating characteristics for the following display technologies are:

a) Raster Refresh Systems

- Resolution: Limited by the number of pixels in the display
- Refresh Rate: Typically 60-120Hz for most consumer displays
- Color Depth: Supports a wide range of colors depending on the bit depth
- Brightness and Contrast: Can vary widely; typically good but can be affected by the backlight quality and screen technology
- Power Consumption: Generally moderate, higher than LCDs but lower than CRTs
- Response Time: Depends on the display tech. used.
- Viewing Angle: Varies by tech.
- Applications: Used in televisions, computer monitors, and mobile devices

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b) Vector Refresh Systems.
- Resolution: Not limited by pixels; defined by the precision of the beam control
- Refresh Rate: Can be lower than raster systems as only the required lines are drawn
- Color Depth: Traditionally limited but can be enhanced with modern tech.
- Brightness and Contrast: Can be very high, especially in systems like CRTs
- Power Consumption: Typically high, especially for older tech. like CRTs
- Response Time: Typically very fast as the electron beam can move quickly
- Viewing Angle: Generally very good
- Applications: Used in older radar displays and some specialized applications

c) Plasma Panels
- Resolution: Typically high, suitable for large screen sizes
- Refresh Rate: Typically 60-600 Hz, often with sub-field drives to reduce motion blur
- Color Depth: Excellent, often supporting deep blacks and a wide color ~~gamut~~. range

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- Brightness and Contrast: Very high contrast ratios and good brightness levels
- Power Consumption: Generally high, especially compared to LCDs.
- Response Time: Very fast, reducing motion blur
- Viewing Angle: Excellent, maintaining color and contrast at wide angles
- Applications: Used in large televisions and some high end displays

d) Liquid Crystal Displays (LCDs):
- Resolution: Very high, limited by the manufacturing process and display size
- Refresh Rate: Typically 60-144 Hz, with higher rates available in gaming monitors
- Color Depth: Good to excellent, depending on the panel type
- Brightness and Contrast: Good brightness levels; contrast can vary but generally lower than OLED
- Power Consumption: Generally low, especially with LED backlighting
- Response Time: Can vary
- Viewing Angle: Good
- Applications: Used in wide range of devices including monitors, TVs, laptops, smartphones, and tablets

3) Consider three diff. raster systems with resolutions of 640 by 400, 1280 by 1024, and 2560 by 2048. What size frame buffer (in byte) is needed for each of these systems to store 12 bits per pixel? How much storage is required for each system if 24 bits per pixel are to be stored?

→ If 12 bits per pixel stored:

a) 640×400:

Size of frame buffer = Resolution × pixel depth

$= 640 \times 400 \times 12$ bits

$= \left(\frac{640 \times 400 \times 12}{8}\right)$ bytes

$= 384000$ bytes

b) 1280×1024:

Size of frame buffer = Resolution × pixel depth

$= 1280 \times 1024 \times 12$ bits

$= \left(\frac{1280 \times 1024 \times 12}{8}\right)$ bytes

$= 1966080$ bytes

c) 2560×2048:

Size of frame buffer = Resolution × pixel depth

$= 2560 \times 2048 \times 12$ bits

$= \left(\frac{2560 \times 2048 \times 12}{8}\right)$ bytes

$= 7864320$ bytes

If 24 bits per pixel stored;

a) 640 × 400:

Size of frame buffer = Resolution × pixel depth

$$= \left(\frac{640 \times 400 \times 24}{8}\right) \text{ bytes}$$

$$= 768000 \text{ bytes}$$

b) 1280 × 1024:

Size of frame buffer = Resolution × pixel depth

$$= \left(\frac{1280 \times 1024 \times 24}{8}\right) \text{ bytes}$$

$$= 3932160 \text{ bytes}$$

c) 2560 × 2048 :

Size of frame buffer = Resolution × pixel depth

$$= \left(\frac{2560 \times 2048 \times 24}{8}\right) \text{ bytes}$$

$$= 15728640 \text{ bytes}$$

4) Suppose an RGB raster system is to be ~~dis~~ designed using an 8-inch by 10-inch screen with a resolution of 100 pixels per inch in each direction. If we want to store 9 bits per pixel in the frame buffer, how much storage (in bytes) do we need for the frame buffer?

→ Sol-n,

~~Resolution = (8 × 10) inch~~
Resolution = (8 × 10) inch

~~Since~~ Here,
Resolution in pixel = 8×100 by 10×100
$= 800 \times 1000$ pixel

Since 1 pixel can store 9 bits,
Size of frame buffer = Resolution × pixel depth
$= 800 \times 1000 \times 9$ bits
$= \left(\frac{800 \times 1000 \times 9}{8}\right)$ bytes
$= 900000$ bytes

∴ Hence, frame buffer requires 900000 bytes of storage.

5) How long would it take to load a 640 by 480 frame buffer with 12 bits per pixel, if 10^5 bits can be transferred per second? How long would it take to load a 24-bit per pixel frame buffer with a resolution of 1280 by 1024 using this same transfer rate?

→ Soln,
Transfer Speed: 10^5 bits

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For 640 × 480

12 bits can be stored per pixel

Size of frame buffer = Resolution × pixel depth

$= 640 \times 480 \times 12$ bits

$\therefore$ Time required $= \frac{640 \times 480 \times 12}{10^5}$ sec

$= 36.864$ sec

For 1280 × 1024

24 bits can be stored per pixel

Size of frame buffer = Resolution × pixel depth

$= 1280 \times 1024 \times 24$ bits

$\therefore$ Time required $= \frac{1280 \times 1024 \times 24}{10^5}$ sec

$= 314.57$ sec

6) Consider two raster systems with resolutions of 640 by 480 and 1280 by 1024. How many pixels could be accessed per second in each of these systems by a display controller that refreshes the screen at a rate of 60 ~~frames~~ frames per second? What is the access time per pixel in each system?

→ Sol^n,

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For 640×480

Refresh Rate = 60 frames per second

In 1 sec, 60 frames could be accessed

In 1 sec, 60×480 rows could be accessed

In 1 sec, $60 \times 480 \times 640$ pixels could be accessed

= 18432000 pixels ~~per~~

The access time per pixel = $\frac{1}{18432000}$ sec/pixels

∴ 18432000 pixels could be accessed per second.

∴ The access time per pixel is

$\frac{1}{18432000}$ sec/pixels.

For 1280×1024

Refresh Rate = 60 frames per second

In 1 sec, 60 frames could be accessed.

In 1 sec, 60×1024 rows could be accessed.

In 1 sec, $60 \times 1024 \times 1280$ pixels could be accessed

= 78643200 pixels

The access time per pixel = $\frac{1}{78643200}$ sec/pixels

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∴ 78643200 pixels could be accessed per second.

∴ The access time per pixel is $\frac{1}{78643200}$ sec / pixels.

7) A raster system can produce a total number of 1024 different levels of intensities from a single pixel composed of red, green and blue phosphor dots. If the total resolution of the screen is 1280 x 1024, what will be required size of frame buffer for the display purpose?

→ Sol^{-n},

1024 diff levels of intensities is produced which can be represented by $\log_2 1024$ = 10 bits

Resolution = 1280 x 1024 pixels

Size of frame buffer = Resolution x pixel depth

$$= \left(\frac{1280 \times 1024 \times 10}{8 \times 1024}\right) KB$$

$$= 1600 \text{ KB}$$

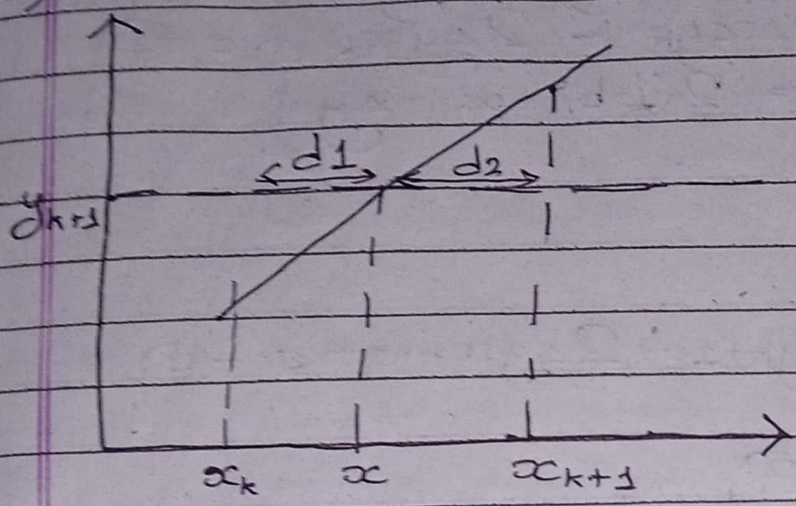
8) Differentiate bet^{-n} Sonic touch panel and Sonic tablet.

→ Difference:

Sonic Touch Panel	Sonic Tablet
a) It is a type of touch - sensitive display technology that uses ultrasonic waves to detect touch input.	It is a tablet device that uses ultrasonic ~~techot~~ technology for certain functionalities.
b) It is used for direct touch interactions on display surfaces.	It is used for stylus-based input on flexible or irregular surfaces.
c) It is less advantageous for scenarios requiring digitization on unconventional surfaces.	It is advantageous for scenarios requiring digitization or unconventional surfaces.
d) It requires a flat, designed touch area.	It can adapt to various surfaces due to their microphone placement flexibility
e) E.g.: interior, kiosks, retail displays, digital signage, etc. uses it.	E.g.: digital art & design, medical imaging, architectural drafting uses it.

Q) Derive Bresenham's line drawing algorithm for slope $|m| > 1$.

→



Case : $|m| > 1$

Let (x_k, y_k) be the pixel position determined then the next pixel to be plotted is either (x_{k+1}, y_{k+1}) or (x_k, y_{k+1}).

Let d1 and d2 be the seperation of the pixel positions (x_k, y_{k+1}) and (x_{k+1}, y_{k+1}) for the actual line path.

$$y = mx + b$$

The actual value of x is given by,

$$x = \frac{y - b}{m}$$

Sampling position at y_{k+1} ; $x = \frac{y_{k+1} - b}{m}$

From figure,

$$d1 = x - x_k$$

$$d2 = x_{k+1} - x$$

Defining decision parameter,

$$P_k = \Delta y (d1 - d2)$$

$$= \cancel{\Delta\, 2\Delta x y_k - 2\Delta y x_k + c}$$

$$= 2\Delta x y_k - 2\Delta y x_k + c \quad (1)$$

(where, constant $= 2(1-b)\Delta x - \Delta y$)

For next step,

$$P_{k+1} = 2\Delta x y_{k+1} - 2\Delta y x_{k+1} + c \quad (2)$$

From (1) and (2),

$$P_{k+1} - P_k = 2\Delta x (y_{k+1} - y_k) - 2\Delta y (x_{k+1} - x_k)$$

$$P_{k+1} = P_k + 2\Delta x (y_{k+1} - y_k) - 2\Delta y (x_{k+1} - x_k)$$

$\cancel{x_{k+1} - x_k = 1}$

Where, $x_{k+1} - x_k =$ '0' or '1'

If $P_k \geq 0$, $P_{k+1} = P_k + 2\Delta x - 2\Delta y$

we plot, $x_{k+1} = x_k + 1$, $y_{k+1} = y_k + 1$

If $P_k < 0$, $P_{k+1} = P_k + 2\Delta x$

we plot, $x_{k+1} = x_k$, $y_{k+1} = y_k + 1$

For Recursive calculation, initially

$$P_k = 2\Delta x - \Delta y$$

∴ Substitute, $b = y_0 - m x_0$ and $m = \Delta y / \Delta x$ - in eq^n (1)

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10) Write ~~about~~ short notes on Refresh rate, Aspect Ratio, Resolution, Persistence.

→ Refresh Rate:
The refresh rate of a display refers to how many times per second the screen updates its image. It is measured in Hertz (Hz). For example, a refresh rate of 60 Hz means the screen refreshes 60 times per second. Higher refresh rates result in smoother motion on screen, which is particularly important for gaming and other applications involving fast-moving images.

Aspect Ratio:
The aspect ratio is the ratio of the width to the height of a display screen. Common aspect ratios include 4:3, 16:9, and 21:9. This ratio determines the overall shape of the display and how content fits on the screen. Different aspect ratios are suited to different types of content; for instance, 16:9 is the standard for most modern televisions and monitors.

Resolution:
Resolution refers to the number of distinct pixels in each dimension that can be ~~display~~ displayed. It is usually quoted as width × height (E.g. 1920 × 1080). Higher resolutions provide

more detail and clarity in the images and text displayed on the screen. As resolution increases, the display can show more detailed and finer images, which is crucial for applications like graphic design, video editing, and high-definition gaming.

Persistence:

Persistence refers to how long a displayed image remains visible on the screen before it needs to be refreshed. This is particularly important in older CRT monitors, where high persistence can lead to motion blur, as images ~~it~~ stay visible longer on the screen. Modern displays like LCDs and OLEDs have lower persistence, reducing motion blur and improving image clarity during fast movements.

Group B

1) Digitize a line with end points A (11, 9) and B (29, 17) using Bresenham's line drawing algorithm

→ Soln,

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{17-9}{29-11} = 0.44$$

Here, $|m| < 1$

$\Delta x = 18$, $\Delta y = 8$, $2\Delta y = 16$, $2\Delta y - 2\Delta x = -20$,

$P_0 = 2\Delta y - \Delta x = 16 - 18 = -2$

k	P_k	x_{k+1}	y_{k+1}	
				$P_0 = -2$
0	-2	12	9	$P_1 = -2 + 16 = 14$
1	14	13	10	$P_2 = 14 - 20 = -6$
2	-6	14	10	$P_3 = -6 + 16 = 10$
3	10	15	11	$P_4 = 10 - 20 = -10$
4	-10	16	11	$P_5 = -10 + 16 = 6$
5	6	17	12	$P_6 = 6 - 20 = -14$
6	-14	18	12	$P_7 = -14 + 16 = 2$
7	2	19	13	$P_8 = 2 - 20 = -18$
8	-18	20	13	$P_9 = -18 + 16 = -2$
9	-2	21	13	$P_{10} = -2 + 16 = 14$
10	14	22	14	$P_{11} = 14 - 20 = -6$
11	-6	23	14	$P_{12} = -6 + 16 = 10$
12	10	24	15	$P_{13} = 10 - 20 = -10$
13	-10	25	15	$P_{14} = -10 + 16 = 6$

k	p_k	x_{k+1}	y_{k+1}
14	6	26	16
15	-14	27	16
16	2	28	17
17	-18	29	17

$p_{15} = 6 - 20 = -14$

$p_{16} = -14 + 16 = 2$

$p_{17} = 2 - 20 = -18$

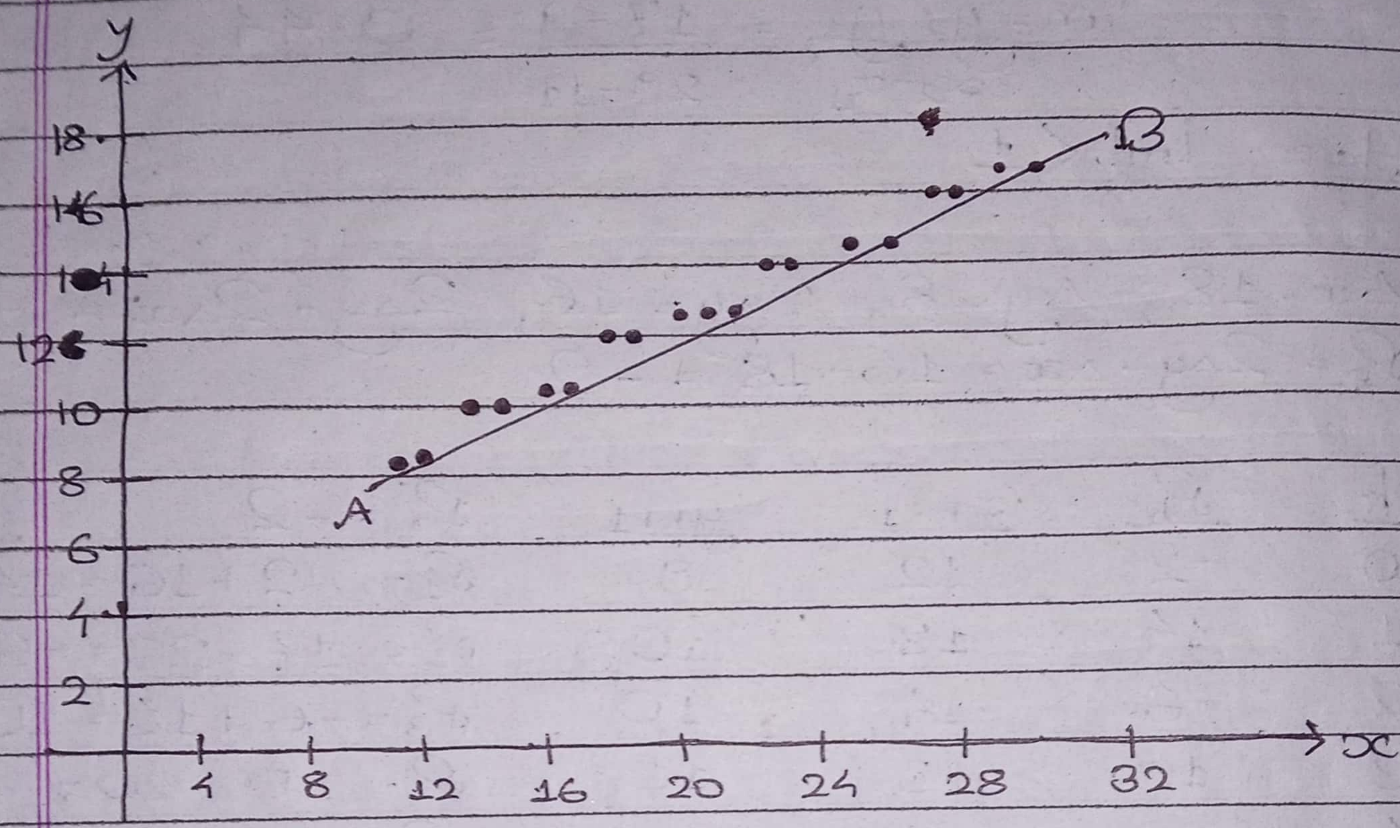

Fig: Digitized line with end points A(11, 9) and B(29, 17)

2) Derive necessary equations for mid point circle algorithm. Digitize a line with end points A(11, 9) and B(29, 17).

→ ~~Derivation~~

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Derivation:

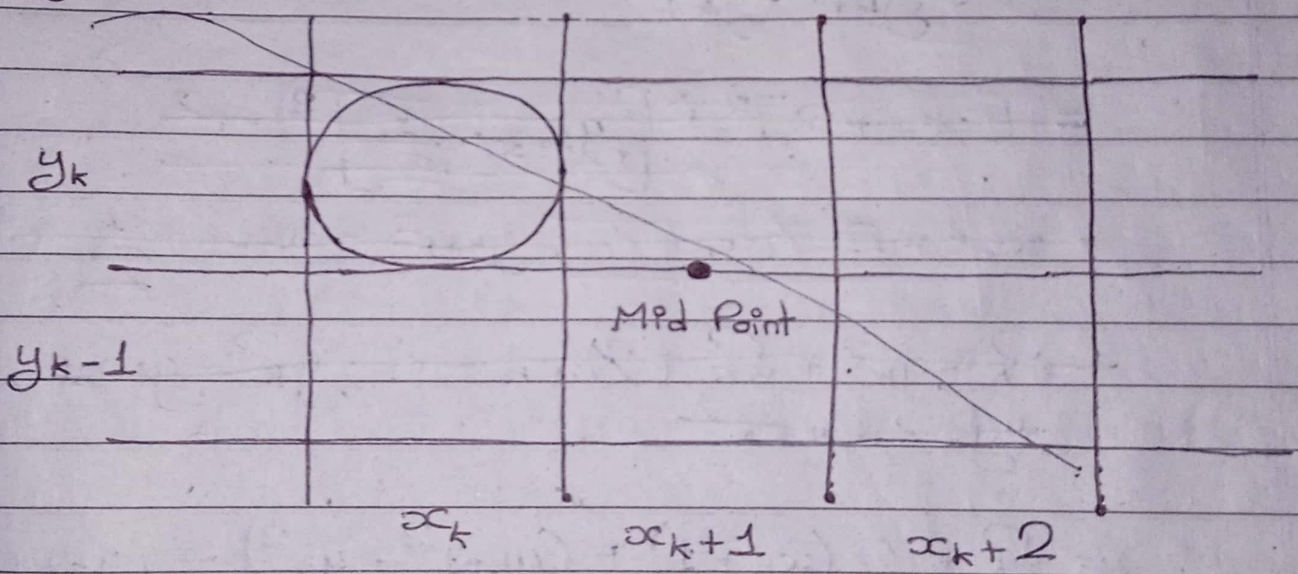
Circle function is defined as:

$$f_{circle}(x,y) = x^2 + y^2 - r^2$$

Any point (x,y) satisfies following conditions:

$$f_{circle}(x,y) \begin{cases} < 0, & \text{if } f(x,y) \text{ is inside the circle boundary} \\ = 0, & \text{if } f(x,y) \text{ is on the circle boundary} \\ > 0, & \text{if } f(x,y) \text{ is outside the circle boundary} \end{cases}$$

Decision parameter is the circle function; evaluated as:



$$P_k = f_{circle}(x_k + 1, y_k - 1/2)$$
$$= (x_k+1)^2 + (y_k - 1/2)^2 - r^2$$
$$= x_k^2 + y_k^2 + 2x_k - y_k + 1 + \frac{1}{4} - r^2$$

$$P_{k+1} = f_{circle}(x_{k+1} + 1, y_{k+1} - 1/2)$$
$$= (x_{k+1} + 1)^2 + (y_k - 1/2)^2 - r^2$$

$$P_{k+1} = f_{circle}(x_{k+1} + 1, y_{k+1} - 1/2)$$
$$= [(x_k + 1) + 1]^2 + \left(y_{k+1} - \frac{1}{2}\right)^2 - r^2$$

$$\cancel{= (x_k + 1)^2 + 2(x_k + 1) + 1 + y_{k+1}^2 - 2y_{k+1} + \frac{1}{4} - r^2}$$

$$\cancel{= (x_k + 1)^2 + y_k - y_k + y_k^2 - y_k^2 + 2(x_k + 1) + 1 + y_{k+1}^2 - 2y_{k+1} + \frac{1}{4} - r^2}$$

$$\cancel{= (x_k + 1)^2 + 2(x_k + 1) + 1 - r^2 + (y_{k+1}^2 - y_k^2) - (y_{k+1} - y_k)}$$

$$\cancel{= [x_k + 2]^2 + \left[y_{k+1} - \frac{1}{2}\right]^2 - r^2}$$

$$\cancel{= x_k^2 + 4x_k + 4 + y_{k+1}^2 - y_{k+1} + \frac{1}{4} - r^2}$$

$$\cancel{= P_k - y_k^2 + P_k + 2x_k + 4 - y_k^2 - y_{k+1} + y_k + y_{k+1}^2}$$

$$= P_k + 2(x_k + 1) + (y_{k+1}^2 - y_k^2) - (y_{k+1} - y_k) + 1$$

And,

$y_{k+1} = y_k$ if $P_k < 0$

$y_{k+1} = y_k - 1$ otherwise

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Thus,

$$p_{k+1} = p_k + 2x_{k+1} + 1 \quad \text{if } p_k < 0$$
$$p_{k+1} = p_k + 2x_{k+1} + 1 - 2y_{k+1} \quad \text{otherwise}$$

Also incremental evaluation of $2x_{k+1}$ and $2y_{k+1}$,

$$2x_{k+1} = 2x_k + 2$$
$$2y_{k+1} = 2y_k - 2 \quad \text{if } p_k > 0$$

At start position $(x_0, y_0) = (0, r)$,

$$2x_0 = 0 \quad \text{and} \quad 2y_0 = 2r$$

Initial decision parameter,

$$p_0 = f_{circle}\left(1, r - \frac{1}{2}\right)$$
$$= 1 + \left(r - \frac{1}{2}\right)^2 - r^2$$
$$= \frac{5}{4} - r$$

For r specified as an integer, round p_0 to $p_0 = 1 - r$.
(because all increments are integer)

Solution:

$$\cancel{m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{17-9}{29-11} =}$$

3) A triangle with vertices A (5, 2), B (4, 1), C (6, 1) is required to be rotated in a clockwise direction by 45 degrees about any arbitrary point (4, 4). Find out the final ~~coordin~~ coordinate positions of the triangle after performing the desired transformation.

→ Solution, Here,

~~F: Rotate by 45° in CW about (4,4)~~

~~i.e. R(45) CW~~

So,

~~F = [cos θ F = R(45) CW~~

~~F = R(45) CW about~~ (4, 4)

~~[cos 45 sin 45~~ $- x_r \cos 45$

~~= [-sin 45 cos 45~~

~~[0 0~~

T_1: Translate fixed point to origin i.e. $T(-x_r, -y_r)$

T_2: Rotate by θ in CW about origin

i.e. R(θ) CW

T_3: Inverse translation of fixed point

i.e. $T(x_r, y_r)$

So,

Net Transformation $(T) = T_3 \times T_2 \times T_1$

or, $T = T(x_r, y_r) \times R(\theta)\ CW \times T(-x_r, -y_r)$

or, $T = \begin{bmatrix} 1 & 0 & x_r \\ 0 & 1 & y_r \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$\times \begin{bmatrix} 1 & 0 & -x_r \\ 0 & 1 & -y_r \\ 0 & 0 & 1 \end{bmatrix}$

or, $T = \begin{bmatrix} 1 & 0 & x_r \\ 0 & 1 & y_r \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} \cos\theta & \sin\theta & -x_r\cos\theta - y_r\sin\theta \\ -\sin\theta & \cos\theta & x_r\sin\theta - y_r\cos\theta \\ 0 & 0 & 1 \end{bmatrix}$

$\therefore T = \begin{bmatrix} \cos\theta & \sin\theta & x_r(1-\cos\theta) - y_r\sin\theta \\ -\sin\theta & \cos\theta & x_r\sin\theta + y_r(1-\cos\theta) \\ 0 & 0 & 1 \end{bmatrix}$

So,

$T = R(45)\ CW$ about $(4, 4)$:

or, $T = \begin{bmatrix} \cos 45 & \sin 45 & 4(1-\cos 45) - 4\sin 45 \\ -\sin 45 & \cos 45 & 4\sin 45 + 4(1-\cos 45) \\ 0 & 0 & 1 \end{bmatrix}$

$\therefore T = \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 4-4\sqrt{2} \\ -1/\sqrt{2} & 1/\sqrt{2} & 4 \\ 0 & 0 & 1 \end{bmatrix}$

Transformed Points

$[A'B'C'] = \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 4-4\sqrt{2} \\ -1/\sqrt{2} & 1/\sqrt{2} & 4 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 5 & 4 & 6 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

$$\therefore [A'B'C'] = \begin{bmatrix} 3.2928 & 1.8786 & 3.2928 \\ 1.8786 & 1.8786 & 0.4644 \\ 1 & 1 & 1 \end{bmatrix}$$

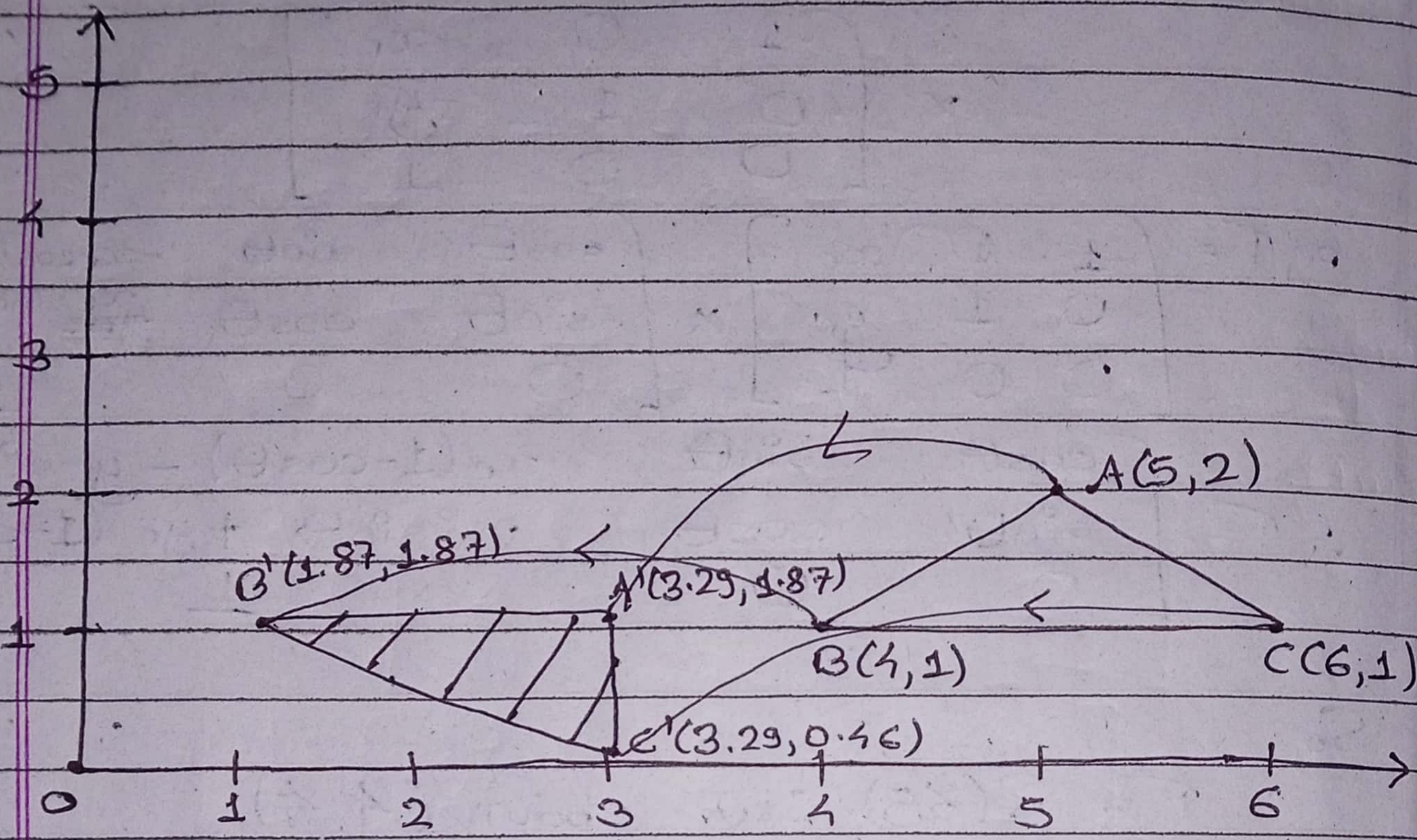


Fig: Original and Transformed Object

4) Reflect a triangle A(1,0), B(3,1), C(1,2) about the line $y = -x + 5$.

→ Solution,

~~We know,~~

$$y = -x + 5$$

Comparing with $y = mx + b$,

$\therefore m = -1$, $\therefore b = 5$

We know,

$$T = \frac{1}{1+m^2}\begin{bmatrix} 1-m^2 & 2m & -2bm \\ 2m & m^2-1 & 2b \\ 0 & 0 & 1+m^2 \end{bmatrix}$$

~~or, T = 1/(1+m²)~~

$$\text{or, } T = \frac{1}{1+(-1)^2}\begin{bmatrix} 1-1 & -2 & 2\times5 \\ -2 & 1-1 & 2\times5 \\ 0 & 0 & 1+1 \end{bmatrix}$$

$$\text{or, } T = \frac{1}{2}\begin{bmatrix} 0 & -2 & 10 \\ -2 & 0 & 10 \\ 0 & 0 & 2 \end{bmatrix}$$

$$\therefore T = \begin{bmatrix} 0 & -1 & 5 \\ -1 & 0 & 5 \\ 0 & 0 & 1 \end{bmatrix}$$

Transformed Points

$$[A'B'C'] = \begin{bmatrix} 0 & -1 & 5 \\ -1 & 0 & 5 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 3 & 1 \\ 0 & 1 & 2 \\ 1 & 1 & 1 \end{bmatrix}$$

$$\therefore [A'B'C'] = \begin{bmatrix} 5 & 4 & 3 \\ 4 & 2 & 4 \\ 1 & 1 & 1 \end{bmatrix}$$

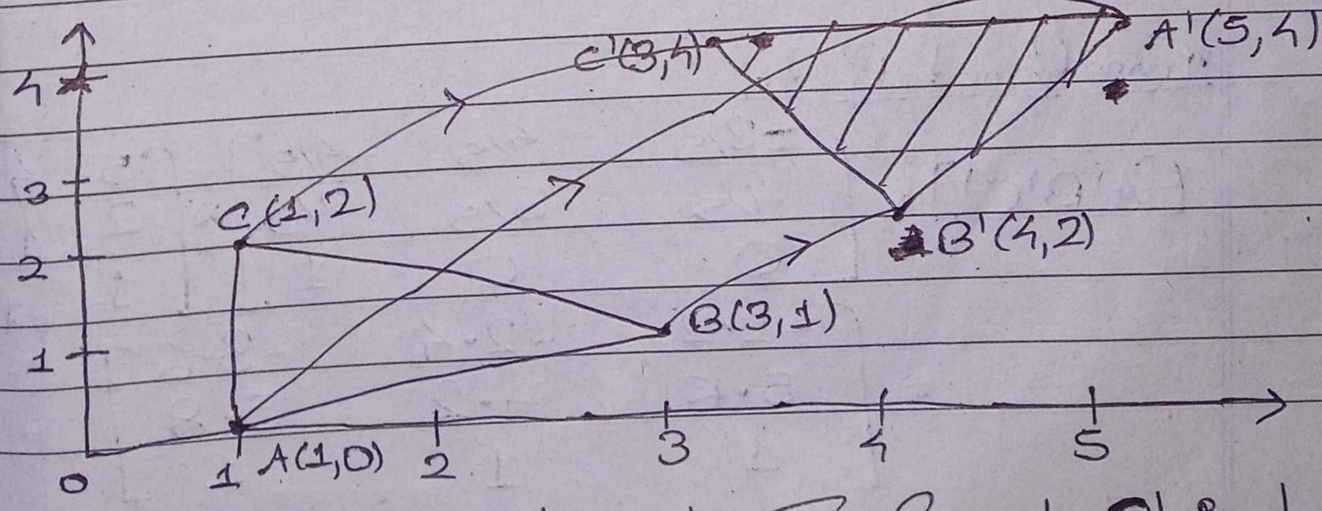


Fig: Original and Transformed Object

5) A triangle with vertices A(5,2), B(4,1), C(6,1) is required to be reflected about an arbitrary line $y = 2x + 1$. Find out the final coordinate positions of the triangle after performing the desired transformation.

→ Solution,

$$y = 2x + 1$$

$$\therefore m = 2, \quad \therefore b = 1$$

We know,

$$T = \frac{1}{1+m^2}\begin{bmatrix} 1-m^2 & 2m & -2bm \\ 2m & m^2-1 & 2b \\ 0 & 0 & 1+m^2 \end{bmatrix}$$

$$= \frac{1}{1+4}\begin{bmatrix} 1-4 & 4 & -4 \\ 4 & 4-1 & 2 \\ 0 & 0 & 1+4 \end{bmatrix}$$

$$= \frac{1}{5}\begin{bmatrix} -3 & 4 & -4 \\ 4 & 3 & 2 \\ 0 & 0 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} -3/5 & 4/5 & -4/5 \\ 4/5 & 3/5 & 2/5 \\ 0 & 0 & 1 \end{bmatrix}$$

Transformed Points

$$[A'B'C'] = \begin{bmatrix} -3/5 & 4/5 & -4/5 \\ 4/5 & 3/5 & 2/5 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 5 & 4 & 6 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} -2.2 & -2.4 & -3.6 \\ 5.6 & 4.2 & 5.8 \\ 1 & 1 & 1 \end{bmatrix}$$

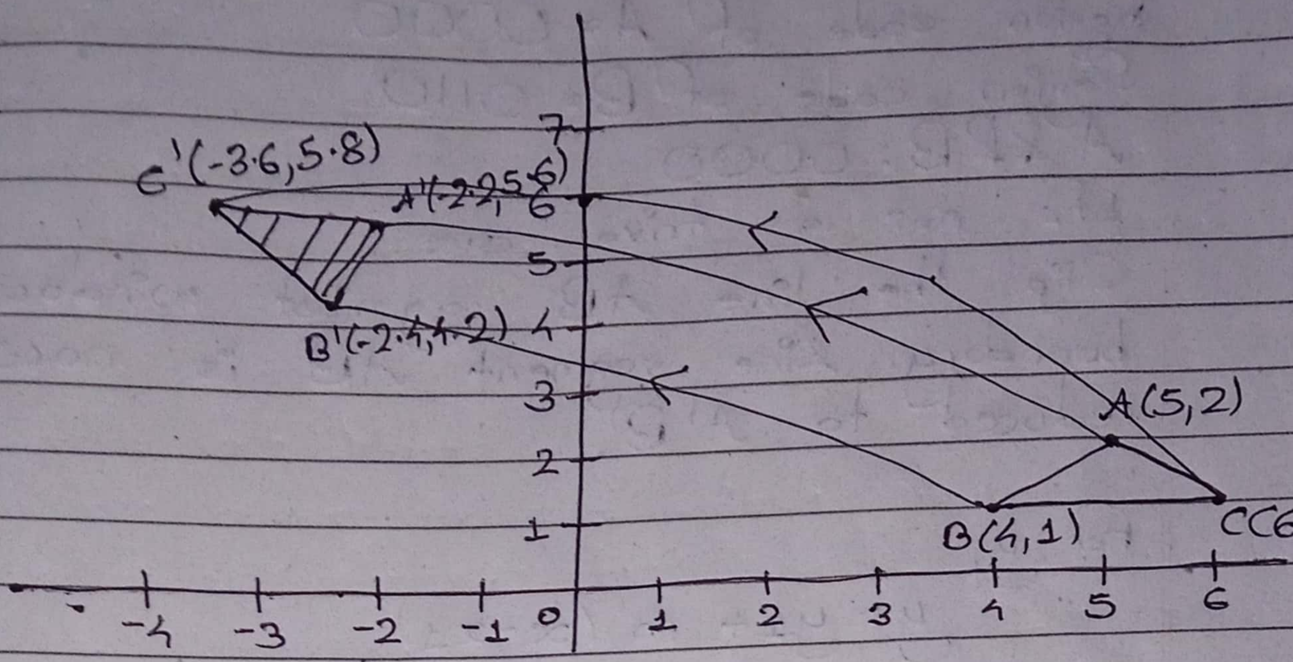
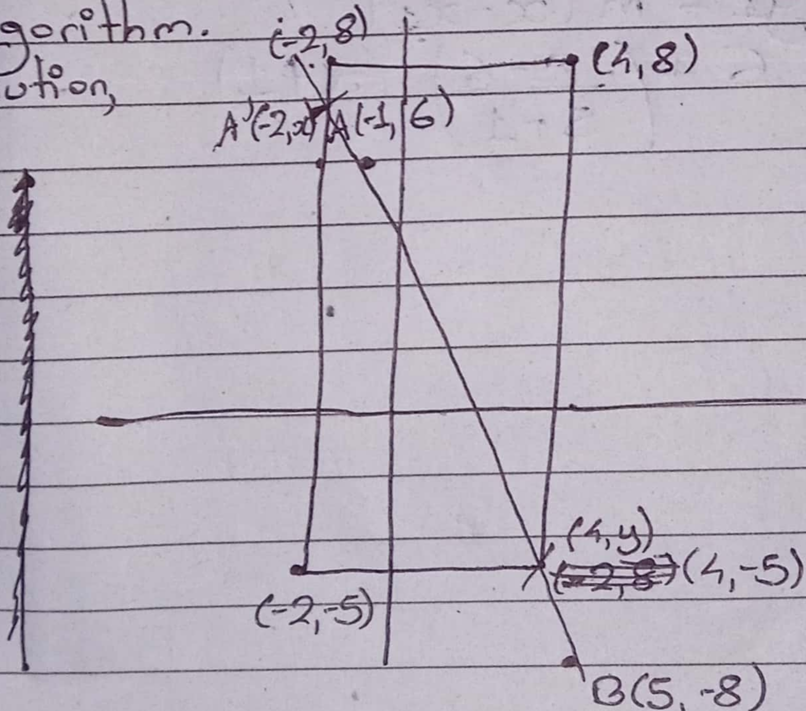


Fig: Original ~~and~~ Transformed Object

7) Clip a line with end point coordinates A(-1, 6), B(5, -8) against a clip window with its lower left corner at (-2, -5) and upper right ~~corner~~ corner at (4, 8) using Cohen - Sutherland algorithm.

→ Solution,



Region code of A = 0000
Region code of B = 0110
A && B : 0000
It's not a trival case.
Clip the line AB against window boundary. Line segment AB is now reduced to A' B'.

For y,

$$y = y_1 + m(x - x_1)$$

$$\text{or, } y = y_1 + \left(\frac{y_2 - y_1}{x_2 - x_1}\right)(x - x_1)$$

$$\text{or, } y = 6 + \left(\frac{-8-6}{5+1}\right)(\cancel{x} = 4 + 1)$$

$$\therefore y = -5.67$$

For x,

$$y = y_1 + m(x - x_1)$$

$$\text{or, } \cancel{y} = 6 + \left(\frac{-8-6}{5+1}\right)(x + 1)$$