

Date: _____

Pixel

• The smallest dot illuminated that can be seen on screen.

Picture

composition of pixels makes picture that forms on screen
↓
whole

Resolution:

No of rows / no of columns

Each mode uses a particular resolution

For Example:-

Mode 19 uses 200 rows and 320 columns i.e. 320*200 resolution.

small resolution

Text and Graphics Modes:-

- * video cards are responsible to send picture data.
- * video cards support different text and graphics modes.
- * Every mode has its own resolution, number of color and refresh rate.

How Text is Displayed
 Text modes need two bytes in
 VDU memory to represent each
 character on screen

ASCII value in one byte
 Attributes in second byte
 character information in VBIOS
 character in graphics mode)
 Represents Text

TEXT MODE COLORS

character in mode 3 (two bytes in
 VDU memory)

- one containing the ASCII value of the character
- and other containing its attribute.

Table:-

configuration

4 color

↑ foreground (Blue Green Red intensity)

↓ background (")

Graphic mode colors

- In the Graphics mode each pixel on the screen has a color associated with it
- Different between Text mode and graphics mode are of Resolution modes.

Text ki resolution low hoti h.
Graphics ki resolution low high
hoti rahi h.



Color in VGA

- The VGA card was first introduced by IBM in April 1987
- * VGA has 4 color planes:
- * red, green, blue and intensity
- * one bit from each of these planes contributing towards one pixel value

(computer aur CPU ko jo vir lagati
hyn aos ko VGA kahaty
h.)

Practical Approach To write
pixel on screen.

The language
used to write codes for graphics
is assembly and C.

Discussion on Pixel Drawing Methods

- * BIOS routines are quite slow
- * Direct memory access method is easy and faster.
- * Its programming is only convenient in mode 13h
- * Library functions are even faster

Line Drawing Techniques

Line

long and nerow geometrical object is calced line.

A line, or straight line, is, roughly speaking, this long, straight geometrical object.

Exp:-

a curve that is long and straight.

Line

slope کی بھی use ہوگی دو چیزوں کے درمیان

- گٹھ Use ہے Comparison

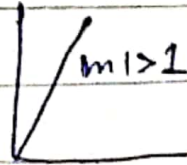
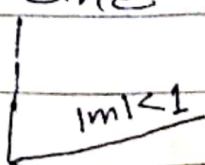
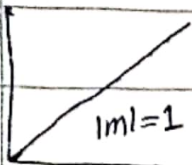
A line may have three forms with respect to slope:

slope = 1

slope > 1

$\text{stop} < 1$

Line cont



1 Incremental line algorithm

This algorithm exploits simple line equation

$$y = mx + b$$

where $m = dy/dx$

and $b = y - mx$

now check if

$$|m| < 1 \text{ then}$$

$$x = x + 1 \text{ whereas}$$

$$y = mx + b$$

1 for increment carry of y

To check $|m|$

Suppose a line has points

$$P_1 (x_1, y_1) = P_2 (x_2, y_2)$$

$$dy = y_2 - y_1 = 18 - 10 = 8$$

$$dx = x_2 - x_1 = 20 - 10 = 10$$

Discussion on algorithm:

- quite simple and easy to understand
- but involves a lot of mathematical calculations.

DDA Algorithm

DDA abbreviated for digital differential analyzer has a very simple technique. Find difference dx and dy as:

$$dy = y_2 - y_1$$

$$dx = x_2 - x_1$$

if $|dx| > |dy|$ then

$$\text{step} = |dx| \quad \text{else}$$

$$\text{step} = |dy|$$

Now very simple to say that step is the total number of pixels required for line.

DDA Algorithm

Next step is to find x increment and y increment:

$$x_{\text{increment}} = dx / \text{step}$$

$$y_{\text{increment}} = dy / \text{step}$$

Next a loop is required that will run 'step' times.

In the loop draw pixel and add x increment to $x1$ and y increment to $y1$

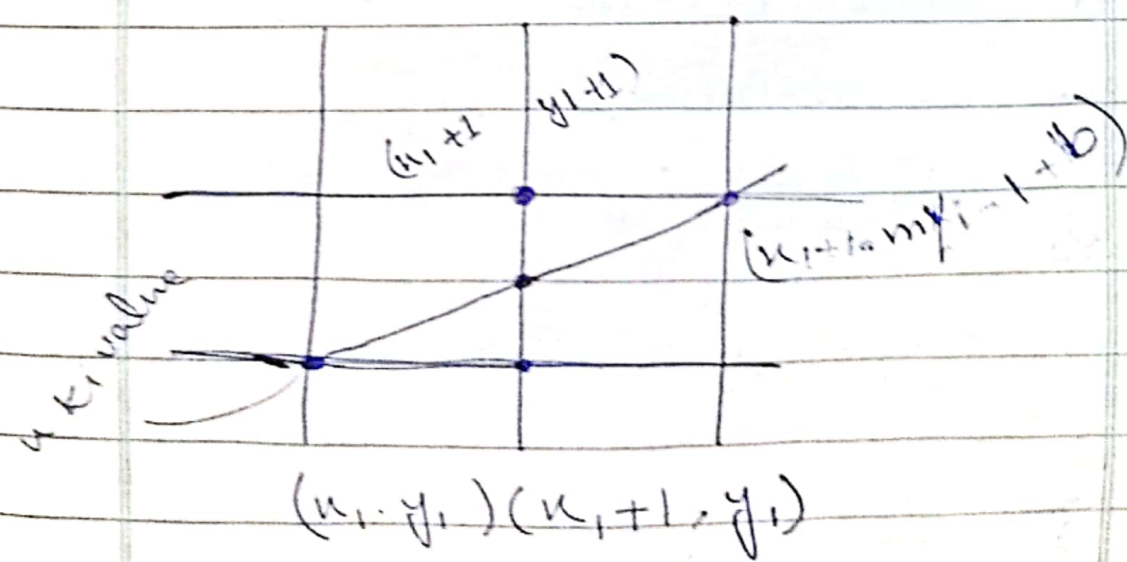
Jo ham pass value di gi hon gi aon ko check karna ha step ky zariy agar to hamari line jo h wo karm h apni original value say Tu hum aor mai $x1$ mai bi increment kary gyn $x1$ mai bi increment kary gyn aur doba loop ko chala ker check karyn gy ky jo line h wo pora pinel py like

Kr rahi h ya nhi.

Ager phr bi hamari line pixel sy kam hi phr hm dobara karyn agyn n, mai y.

BRESENHAM Algorithm

Bresenham's algorithm finds the closest integer coordinates to the actual line, using only integer math. Assuming that the step is positive and less than 1, moving 1 step in the x direction, y either stays the same, or increases by 1. A decision function is required to resolve this choice.



WHAT IS CIRCLE?

Circle is the set of points in a plane that are equidistant from a given point O.

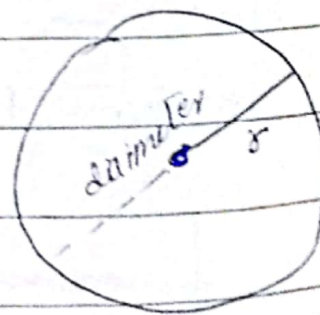
The ~~red~~ distance r from the center is called the radius.

Twice the Radius is known as the diameter $d = 2r$.

full angle, equal to 360° or 2π radius.

$$A = 2\pi r$$

The perimeter C of a circle is called the circumference, and is given by



$$C = 2\pi r$$

CIRCLE DRAWING TECHNIQUES:-

- Input for circle drawing

- one center point (x_c, y_c) and
- radius r

Now, using these two inputs there are a number of ways to draw a circle.

- Circle Drawing using Cartesian Coordinates
- Circle Drawing using polar Coordinates
- Eight Octants Symmetry
- Midpoint Circle Algorithm
- Algorithm

Circle Drawing using Cartesian Coordinates:-

This technique uses the equation for a circle with radius r centered at $(0,0)$:

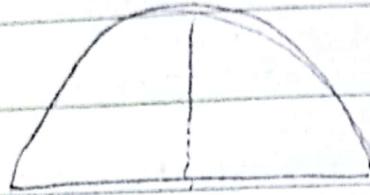
$$x^2 + y^2 = r^2$$

an obvious choice is to plot

$$y = \pm \sqrt{r^2 - x^2}$$

against different values of x

DRAWBACKS / SHORTCOMING



CIRCLE DRAWING using POLAR COORDINATES:

Polar Coordinates:-

Radius r

Angle θ

Calculate points along the circular boundary using polar coordinates r and θ

$$x = x_c + r \cos \theta$$

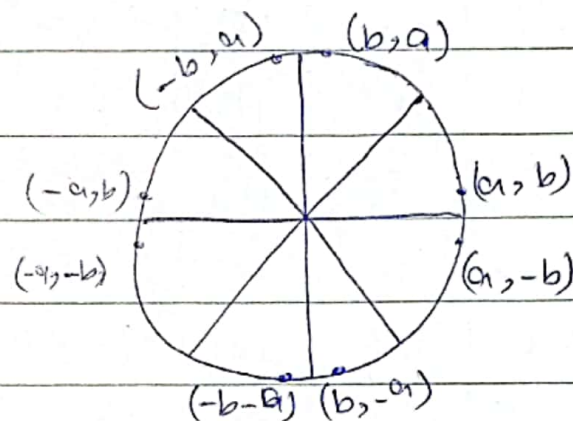
$$y = y_c + r \sin \theta$$

Using above equation circle can be plotted by calculating x

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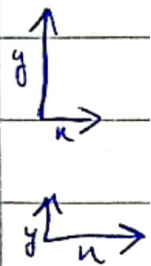
and y coordinates as θ takes value from 0 to 360 degrees or 0 to 2π radians.

EIGHT OCTANTS SYMMETRY



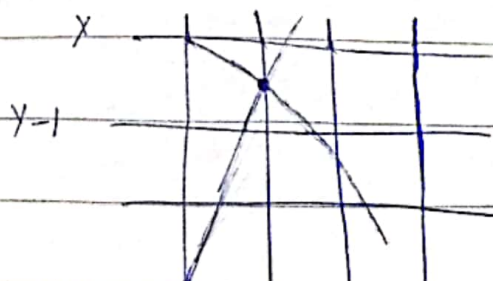
MIDPOINT CIRCLE ALGORITHM

Decision in the y coordinate against increment of x coordinates.



consider only the first octant of a circle of r centered on the origin.

We begin by plotting point $(0, r)$ and end when $x = y$
center point?



EXAMPLE:

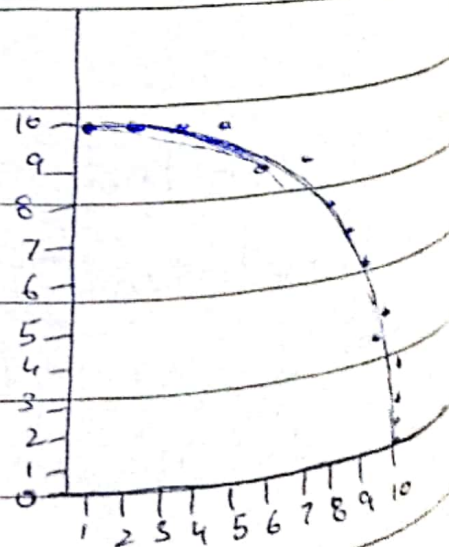
center $(0,0)$

radius $= 10$

P	X	Y
-9	0	10
-6	1	10
-1	2	10
6	3	10
-3	4	9
8	5	9
5	6	8
6	7	7

EXAMPL CONT --

Behaviour of
calculated points
around the circle
is observable.



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Ellipse AND other Curves

Ellipse:-

axis mai do points
holy h. diameter be do
holy h. point f_1 and f_2
fixed do holy h.

Ellips aik
egg numa shekal hoti h.
jis k radius jo hota h
wo choro points sy aik
jasa nahi hota.

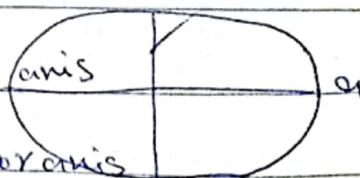
This results
in the two center bipolar
coordinate equation:

$$r_1 + r_2 = 2a$$

Ellipse Count---

Parameter b (Semi-minor axis)

Parameter a (Semi-major axis)



Ellipse Count---

puts the equation in the particularly
simple form

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

S.D. Meo

Ellips Drawing Techniques

input for drawing Ellipse:
one center point,

radius r_x and

radius r_y

Now, using these three inputs
there are a number of ways
to draw an ellipse.

Ellipse Drawing using polar
coordinates;

Another way is to use
polar coordinates r and θ , for
that we have parametric equation

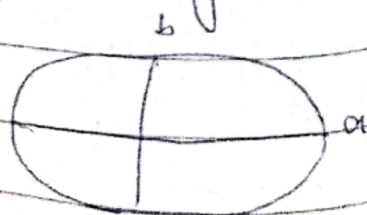
$$x = x_c + r_x \cos \theta$$

$$y = y_c + r_y \sin \theta$$

$\therefore c = \text{Circumference}$

Four - way symmetry

4 octant h.

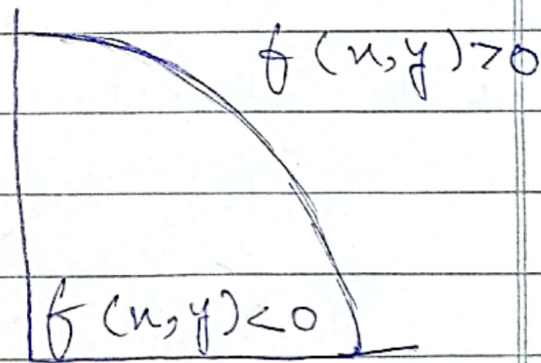


MIDPOINT Ellipse ALGORITHM
consider an ellipse centered at the origin:

To apply the midpoint method, we define an ellipse function:

$$\frac{(x-x_0)^2}{a^2} + \frac{(y-y_0)^2}{b^2} = 1$$

MIDPOINT Algorithm



Other Curves:

Various curve functions are useful in:

object modeling
animation path specifications
Data and function graphing
and other graphics applications

CURVES-

commonly encountered curves include:

Conic

→ trigonometric functions

→ exponential functions

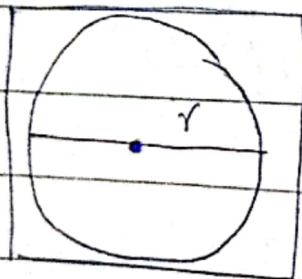
→ Probability distributions

→ general polynomials

→ Spline functions

CONIC SECTIONS:

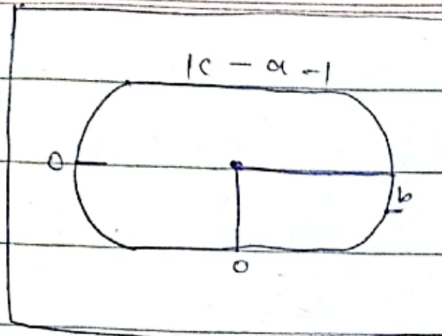
A conic section is the intersection of a plane and a cone.



is a circle
chero direction
mai aik jaga h

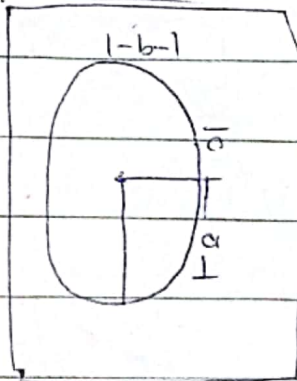
Left sy Right ki Tarif jo
shap ja rahi ho asy hum
Ellips kahaty a

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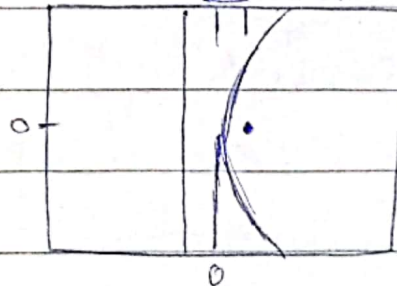
Radius
choro equal
nhi h.

oper sy nachy wali jo
object hamary pass ho gi
two Ellipse (V)

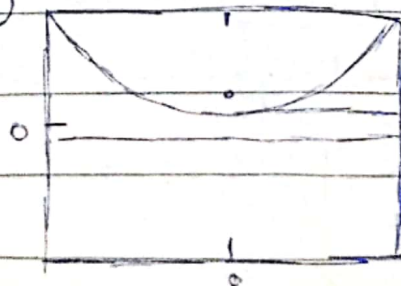


Ellips ki half sharp jo h
aasy hum parabola kehly
h. dper wali horizontal
h.

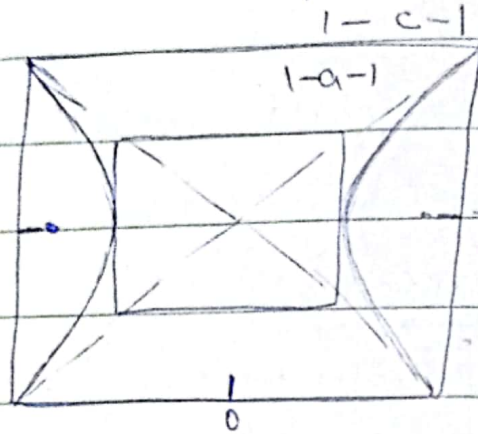
Parabola (h)



Parabola (V)

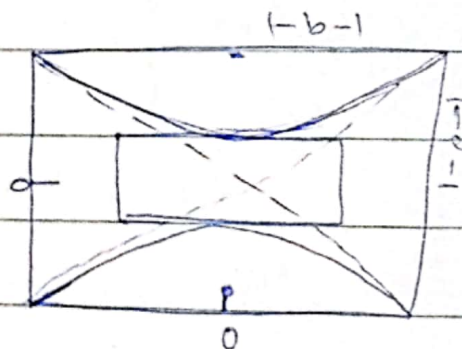


Do curves noty h. do
 parabola noty h. dono
 opass mai opposit noty
 h.



Hyperbola

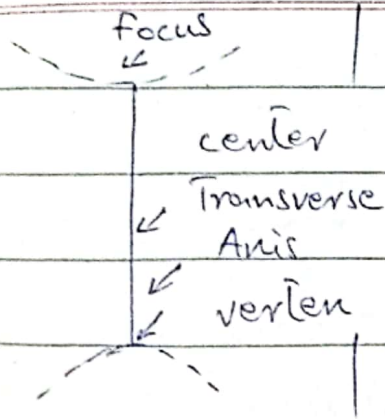
Hyperbola (V)



Hyperbola:

A hyperbola is the set of all points (x, y) in the plane the difference of whose distances from two fixed points is some constant. The two fixed points are called the foci.

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PARABOLA

A parabola is the set of all points (x, y) that are the same distance from a fixed line (called the directrix) and a fixed point (focus) not on the directrix.

See figure for the view of a parabola and its related focus and directrix.

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Date:

Filled - Area Primitives-I

DRAWING Primitives

- point
- Line
- Circle
- Ellipse
- Curves

OBJECT FILLING Two Basic Approaches

Scan-line Between Boundaries

Pixel ki aik line jisay hum
scan line kehly h.

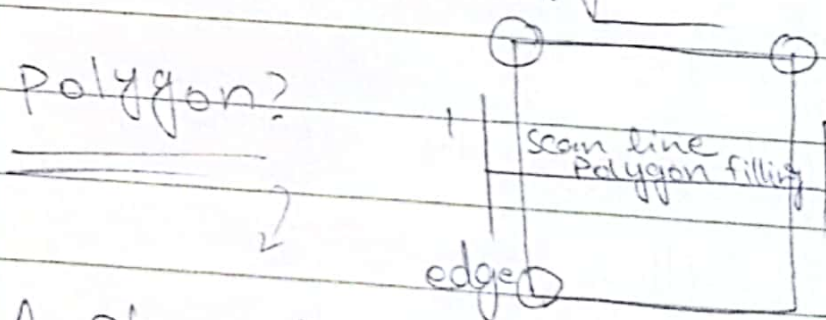
Pixel ki
aik line jis sy mil ker aik
image ban jay aasy hum
scan line kehly h.

jo hamy
object diya gya hote hai
us ki lines ko hum
boundries kehly h.

Select interior point - point outward

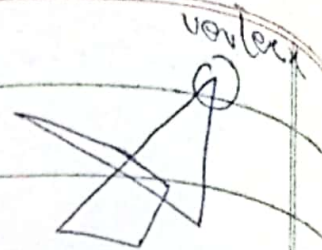
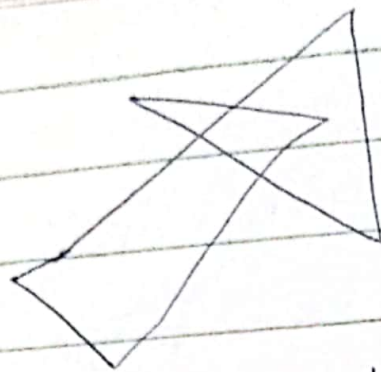
interior point kahly h
 Sentral point ko. Jasy aik
 circle draw kiya circle ka
 jo sentral point hota h. aasy
 hum interior point kahly
 h. yany ky under wala
 point

SCAN-LINE POLYGON FILLING
 Draw straight lines between
 the edges of polygon called
 scan-line polygon filling.



A plan figure with at
 least three straight sides
 and angles, and typically
 five or more.

Date: _____



Kam us kam three edge
aur three ^{angle} planing hony
chaky go hamery pass
polygon hoga.

Boundary - fill:

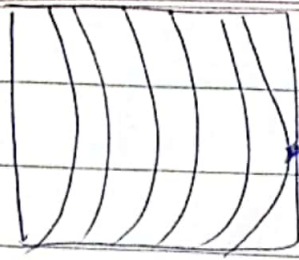
start from interior
point and paint outward
from this point till the
boundary is reached called
boundary - fill



Flood-Fill

start from an
interior point and start
painting outward from
this point till end of boundary

Date: _____



*flood fill

Polygon Type :

divided into
three basic types:

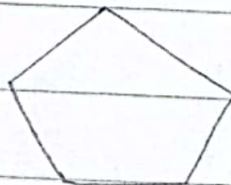
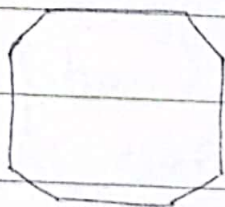
Convex,

Concave

complex

CONVEX

A polygon whose edges can never be intersects inner side, if we extend these edges is called convex polygon.



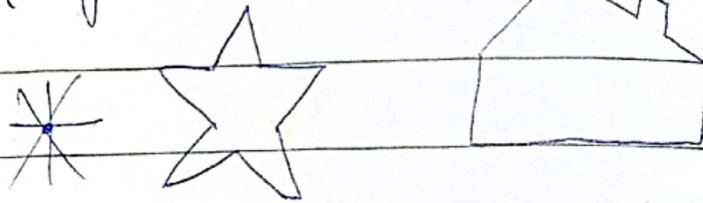
hamari jo line n. wo
object key inner intersect
nhi kary gi outer side py
intersect kary gi aisy ham

Date: _____

convex polygon kehly h.

Concave:

A ploygon whose edges intersects inner side, if we extend these edges is called concave polygon.



inner sid intersect

Complex:

complex polygon are basically concave ploygon that may have self-intersecting edges. its edges are already intersected inside



Filled-Area Primitives-II

There are two basic approaches to area filling on raster systems.

Scan-line poly filling
Boundary-fill and Flood-fill

Scan line aik line aor ky jo do kany hain wo dono ky dono vertices kahlaty h. aur jo puri ki puri line h jo vertex ky center mai jo line hogi wo hamary pass edges kahlaty h. aur do edges ky darmian mai aik line lga di jay ta chaly chaly pixel ko mila kr jab aik line draw ki jati h to wo hamary scan line polygon hoti h.

Scan line filling ka bi matlab bi yahi h ky column or row ky zariq

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colorfull dots ko combine kr
ky aik image bana dya
is hum kshly h scan line
polygon filling

Boundary-fill and flood-fill

interior point select krna h
Boundary tuk point krna
h. pory object ko fill kr dya
h.

Polygon?

Defn

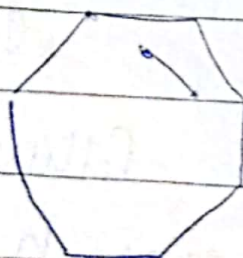
→ convex

→ convex

→ concave

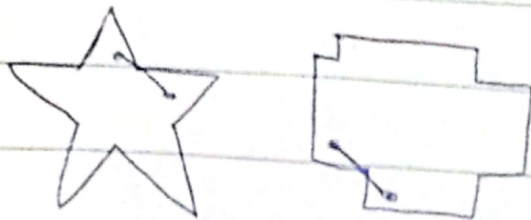
convex polygon

if the answer is no then
polygon is concave



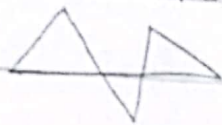
concave polygons

otherwise the polygon is
convex



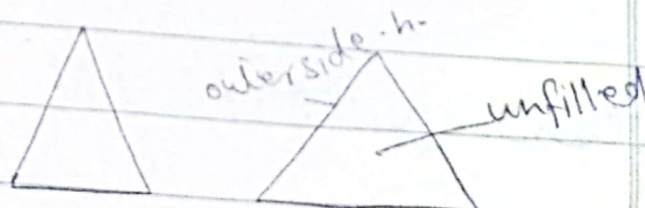
Complex polygons:

that may
have self-intersecting edges



UNFILLED Polygons:

When an unfilled polygon
is rendered, only the
points on the perimeter
of the polygon are drawn.

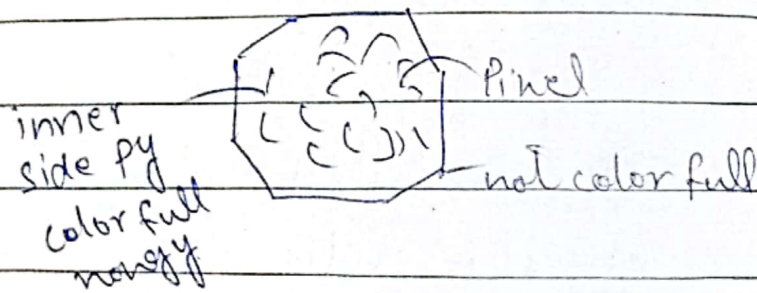


Kisi bi chize ko clear
cut image ko printout
kr lana aasy hum Render
Kahly h.

PARITY

Kon sa pinel hamary
polygon ky andar exist
kary ga aur konsa bahar
exist kary ga

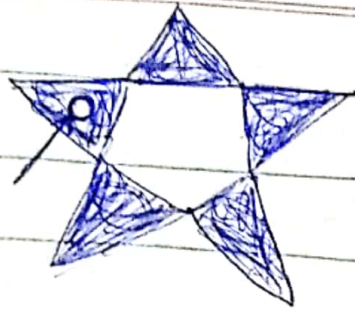
Parity is a concept used
to determine which
pixels lie within a
polygon, i.e. which pixels
should be filled for a
given polygon.



Konsa pinel colorfull rakhna
h aur kon sa h bahar colorfull

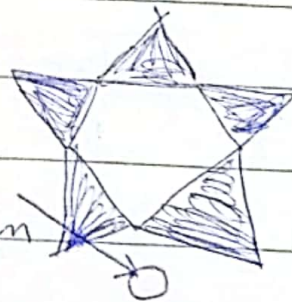
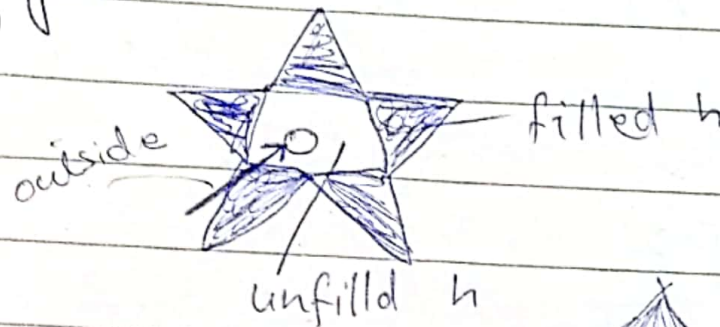
MOD ODD NUMBER of EDGES

Point is inside the
Polygon filled area



EVEN NUMBER OF EDGES I

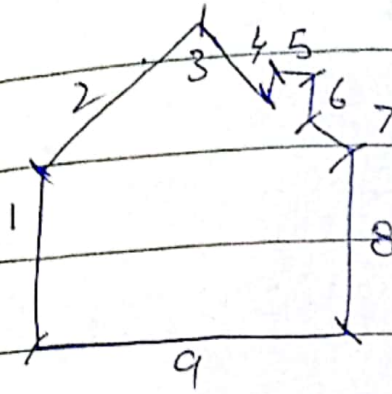
point lies outside the polygon



Polygon filling Algorithm

When filling a polygon, you will most likely just have a set of vertices indicating the x and y cartesian coordinates of each vertex of the polygon. The following steps should be taken to turn set of vertices into a filled polygon.

INITIALIZE ALL of the EDGES



Kisi bi polygon ko fill krny sy pyhly dos ky edge ko count krna hota h

SLOPE

The slope of the edge can be calculated from the formula for a line

mcq s.d. $\rightarrow y = mx + b$

Boundary fill:-

Boundary fill is pixel checking and setting method that involves following steps:

1 $\rightarrow$ check the width and height of area

- 2 → Get the current pixel
- 3 → Apply boundary checking
- 4 → set the pixel
- 5 → call this function recursively and set all neighboring pixels.

— >

Matrices And Simple Matrix operation:-

no of row and columns in may hum apna data stor krty h.

In many fields matrices are used to represent objects and operations on those objects.

Topics

Matrix

A matrix is a collection of numbers arranged into a fixed number of rows and columns.

$$\begin{array}{c} \text{Row} \quad \text{Col} \\ \left(\begin{array}{ccc} 1 & -2 & 3 \\ 0 & 8 & 4.6 \\ 4 & -1 & 0 \end{array} \right) \end{array}$$

row x column = 3×3 matrix.

Element

Each number that makes up a matrix is called an element of the matrix. The elements in a matrix have specific location.

Matrix Dimensions:

The number of rows and columns of a matrix are called its dimensions. Here is a matrix with three rows two columns (a 3×2 matrix)

$$\begin{pmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{pmatrix}$$

3×2

Square Matrix

In a square matrix the number of rows equals the number of columns. In computer graphics, square matrices are used for transformations.

Page -
near

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$$

Matrix Addition

order

if A is an $M \times N$ matrix, and B is also an $M \times N$ matrix, then their sum is an $M \times N$ matrix formed by adding corresponding elements of A and B .

$$\begin{pmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{pmatrix} + \begin{pmatrix} 0 & 2 \\ -1 & 2 \\ 1 & 6 \end{pmatrix} = \begin{pmatrix} 1 & 6 \\ 1 & 7 \\ 4 & 0 \end{pmatrix}$$

Zero Matrix

A zero matrix is one, which has all its elements zero. Here is a 3×3 zero matrix:-

$$\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}_{3 \times 3} = 0$$

Negative of a Matrix:

The negative of a matrix is formed by negative each element of the matrix

$$-1 \times A = -A$$

Example:

$$-1 \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} = \begin{pmatrix} -1 & -2 & -3 \\ -4 & -5 & -6 \\ -7 & -8 & -9 \end{pmatrix}$$

Matrix Subtraction:-

if A and B have the same number of rows and columns the $A-B$ is defined as $A+(-B)$ usually you think of this as to form $A, -B$ from each element of A subtract the corresponding element of B

$$\begin{pmatrix} 5 & 4 & 3 \\ 4 & 0 & 4 \\ 7 & 10 & 3 \end{pmatrix} - \begin{pmatrix} 1 & -2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} =$$

Multiplication of a matrix by a scalar

To multiply a matrix by a scalar, multiply each element of the matrix by the scalar. Here is an example of this.

$$a \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} =$$

Transpose

The Transpose of a matrix is a new matrix whose rows are made with columns of the original

$$\begin{pmatrix} 5 & 4 & 3 \\ 4 & 0 & 4 \\ 7 & 10 & 3 \end{pmatrix}^T = \begin{pmatrix} 5 & 4 & 7 \\ 4 & 0 & 10 \\ 3 & 4 & 3 \end{pmatrix}$$

vector Normalization:-

shrinking ka matlab hota h
ky kisi bary chiz mai
sy aas ka Koch Hisa
nikal ky rakh dyen

Normalization a vector means
shrinking or stretching it so
its magnitude is 1

- a.k.a. creating unit vector
- Note that this does not
change the direction
- Normalize by dividing
by its magnitude;

$$V = (1, 2, 3)$$

$$|V| = \sqrt{1^2 + 2^2 + 3^2}$$

$$= \sqrt{14}$$

$$= 3.74$$

imp
mcq



11

Date: _____

2D Transformation I

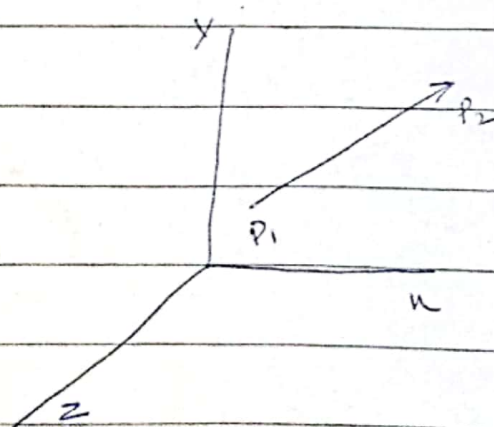
VECTORS:

vector do Tarika ke hote h aur is ke means object ke angle bhi dete aur uska size bhi dete h. aur kam h kay position nahi bhi sakte.

Another important mathematical concept used in graphics is vector.

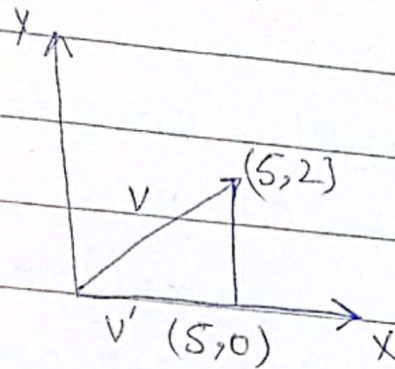
if $P_1 = (x_1, y_1, z_1)$ is the starting point and $P_2 = (x_2, y_2, z_2)$ is the ending point, then the vector

$$V = (x_2 - x_1, y_2 - y_1, z_2 - z_1)$$



VECTOR PROJECTIONS

To length ya vector ja
raha h n anik py lig
kr raha h. humy is
exact value bi pta chal
gai h and θ angle be
exactly position nhi pta chal
sakti



Projection of v onto the
 x -axis

2D MAGNITUDE AND DIRECTION:-

do direction mai aik h angle
hota h. do direction mai
length ya wirth a sakti h

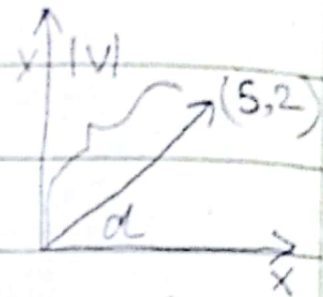
The magnitude (length) of a vector:

$$|V| = \sqrt{V_x^2 + V_y^2}$$

Derived from the Pythagorean theorem

The direction of vector:

$$\alpha = \tan^{-1}(V_y/V_x)$$



α angle to show the ratio

α is angular displacement from the x-axis

3D MAGNITUDE AND DIRECTION

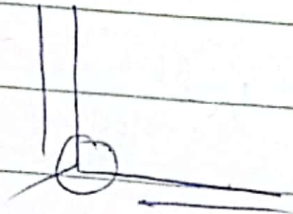
3D

length, width, height

3D magnitude is a simple extension of 2D

$$|V| = \sqrt{V_x^2 + V_y^2 + V_z^2}$$

3D direction is a bit harder
 then in 2D
 Need 2 angle to fully
 describe direction



Vector Normalization

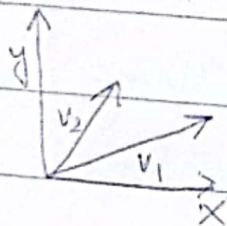
VECTOR ADDITION:

Equation:-

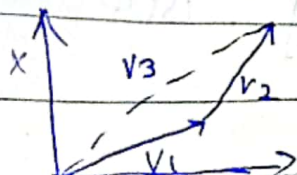
$$V_3 = V_1 + V_2$$

$$= (V_{1x} + V_{2x}, V_{1y} + V_{2y}, V_{1z} + V_{2z})$$

Visually:-



V_1 ko constant rakhy gay
 V_2 ko V_1 ky head sy miladay
 gay kary sy ly kr
 V_2 tuk ka fasla
 V_3 kakhay ga



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VECTOR SUBTRACTION

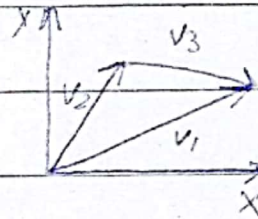
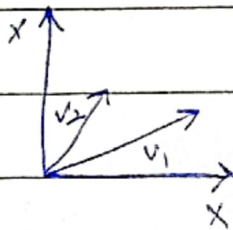
Equation:

$$V_3 = V_1 - V_2$$

$$= V_{1x} - V_{2x}, V_{1y} - V_{2y}, V_{1z} - V_{2z}$$

visually:

V_1 and V_2 ke ending point ke distance vector subtraction kahley ge.



Dot Product:

The Dot product of 2 vectors is a scalar

do angle ke darmiyan fasta malom karny ke liye istemal kiya jata h.

$$V_1 \cdot V_2 = (V_{1x} V_{2x}) + (V_{1y} \cdot V_{2y}) + (V_{1z} \cdot V_{2z})$$

or, perhaps more importantly
for graphics:

$$V_1 \cdot V_2 = |V_1| |V_2| \cos|\theta|$$

where θ is the angle
between the 2 vectors

CROSS PRODUCT

The cross
product of 2 vectors is
a vector

$$V_1 \times V_2 = (V_{1x} V_{2y} - V_{1y} V_{2x}$$

$$V_{1y} V_{2z} - V_{1z} V_{2y}$$

$$V_{1z} V_{2x} - V_{1x} V_{2z})$$

Note that if you are into
linear algebra there is
also a way to do the cross
product calculation using
matrices and determinants.

important
Paper

Basic formation

Translation:

straight line movement

Rotation

Circular movement w.r.t

pivot



Scaling:

change of size



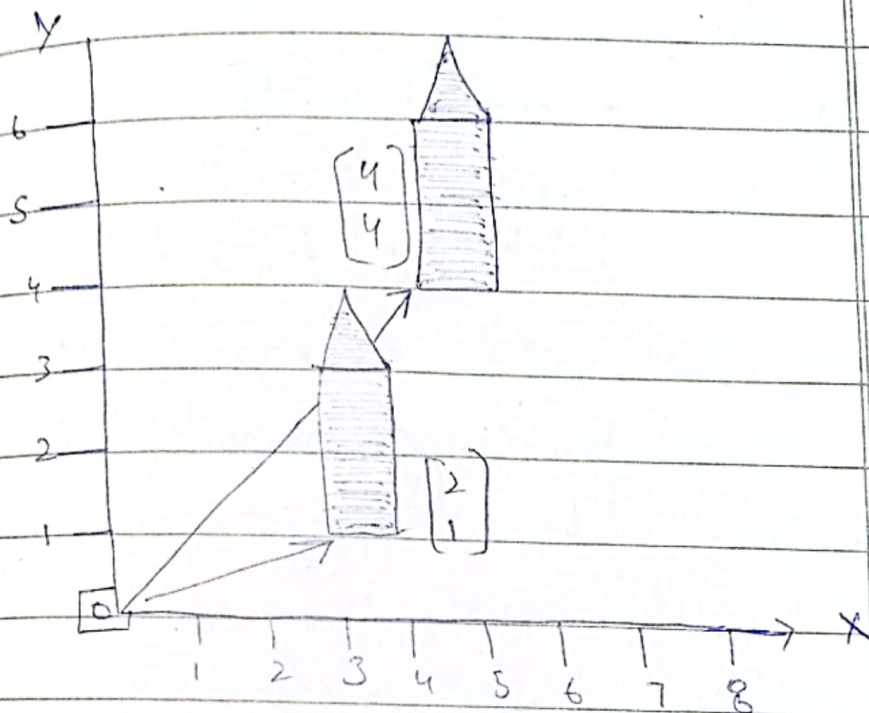
Translation:

$$t_x = 2$$

$$t_y = 3$$

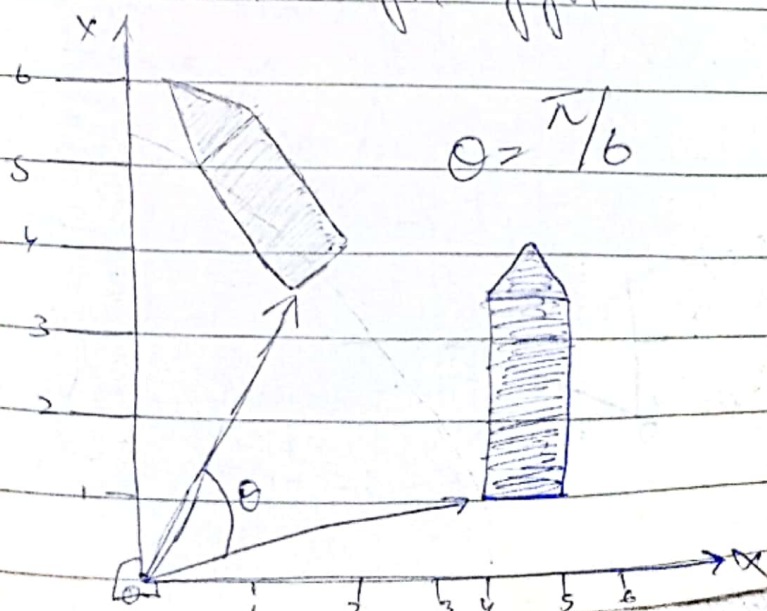
at x-axis $t_x = 2$ in axis
ko 2 point agy key
gy To ye 4 py chala
gay ga

aisi turha y-axis py
 object B py a aur aise
 sy oper ab 3 tuk ghar
 h tu dakey 4, 5 6
 tuk chad gya



ROTATION:-

Circle ki turha hi
 movement karayn gya.



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SCALING:

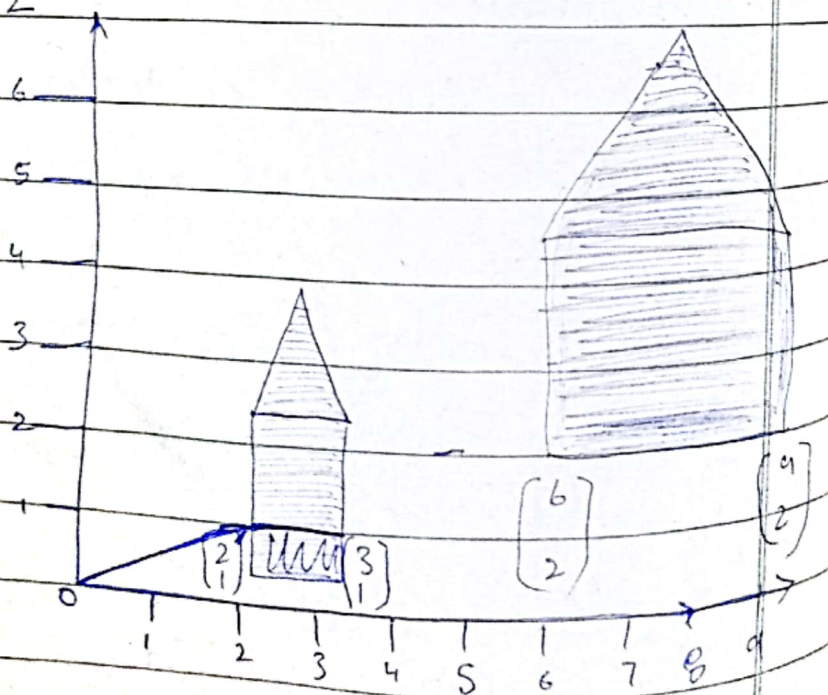
mai size chuta
beka hata h.

X-axis pr
darak 2 point ke agy
hum 3 aur add kary
gy Tu daraky 5 point ke
ber gya.

x ki value mai
bi 2 add karyn gy tu
daraky ky uper wale
hise ber gya h.

$$S_x = 3$$

$$S_y = 2$$



Bhinder

Key