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Computer Graphics

CAT 1

**COHEN SUTHERLAND ALGORITHM**

P2

P1

**Question 1: Clip line p1 and p2**

It involves removing lines which are outside the area of interest and clip the lines which are partially inside the area. It divides a two-dimensional space into 9 regions and then efficiently determines the lines and portions of lines that are inside the given rectangular area.

cohen-sutherland-algo1

Line P1, P2 is partially inside the window: Both endpoints are in different regions. In this case, the algorithm finds one of the two points that is outside the rectangular region. The intersection of the line from outside point and rectangular window becomes new corner point.

**Question 2: Apply Translation, Rotation and Scaling respectively to a line A, B where A (2, 3) and B (5, 6)**

* **Translation**

It is change of position.

We use the matrix of

[1 0 1

0 1 0

tx ty 1]

Line A translates to A (2, 3)\* [1 0

0 1

tx ty ]

= [2, 0

0, 3

2x, 3y]

X’ = X + tx=4

Y’ = Y + ty=6

Line B translates to (5, 6)\* [1 0

0 1

tx ty ]

= [5, 0

0, 6

5x, 6y]

X’ = X + tx=10

Y’ = Y + ty=12

* **Rotation**

In rotation, we rotate the object at particular angle θ theta from its origin.

Using standard trigonometric the original coordinate of point PX, Y can be represented as −

X=rcosϕ...... (1)

Y=rsinϕ...... (2)

Same way we can represent the point P’ X′, Y′ as −

x′=rcos (ϕ+θ) =rcosϕcosθ−rsinϕsinθ....... (3)

y′=rsin (ϕ+θ) =rcosϕsinθ+rsinϕcosθ....... (4)

Substituting equation 1 & 2 in 3 & 4 respectively, we will get

x′=xcosθ−ysinθ

y′=xsinθ+ycosθ

Representing the above equation in matrix form,

[X′Y′]= [XY]\* [cosθ −sinθ

Sinθ cosθ]

P’ = P \* R

Where R is the rotation matrix

R= [cosθ−sinθ

Sinθ cosθ]

Let’s consider our angle of rotation to be 90°

[X′Y′]= [XY]\* [cosθ −sinθ

Sinθ cosθ]

= A (2, 3)\* [cos90 –sin90

Sin90 cos90]

= (2, 3)\* [1 –1

1. 0]

= [2 -3

1. 0]

B (5, 6)\* [cos90 –sin90

Sin90 cos90]

= (5, 6)\* [1 –1

1. 0]

= [5 -6

5 0]

* **Scaling**

Used to change the size of an object. Scaling can be achieved by multiplying the original coordinates of the object with the scaling factor to get the desired result.

Let us assume that the original coordinates are X, Y, the scaling factors are (SX, SY), and the produced coordinates are X′, Y′. This can be mathematically represented as shown below −

X' = X \* SX and Y' = Y \* SY

The scaling factor SX, SY scales the object in X and Y direction respectively. The above equations can also be represented in matrix form as below −

(X′Y′)= (XY)\*[Sx 0

0 Sy]

(X′Y′)= A (2, 3)\*[Sx 0

0 Sy]

= [2x 0

1. 3y]

(X′Y′)=B (5, 6)\*[5x 0

0 6y]