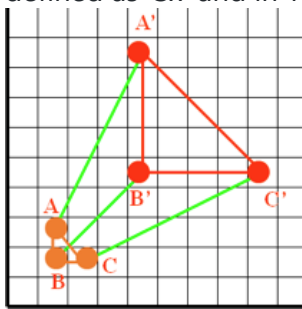


Experiment-6

Aim: To learn scaling Transformation performed on 2-D graphics object.

Theory

- A scaling of an object is used to change the size of the object.
- A translation moves an object to a different position on the screen.
- The scaling transformation is needed to manipulate the initial object coordinate and display the modified object coordinate with the help of scaling factors in X-direction defined as 'Sx' and in Y-directions defined as 'Sy' as shown in figure below:



- We can scale a point in 2-D by multiplying with scaling factor (Sx, Sy) to the original coordinate P(x, y) to get the new coordinate P'(x', y') as:
$$x' = x * Sx;$$
$$y' = y * Sy;$$
- A scaling may moves all the points in the object either closer to the origin or away from origin, with respect to Sx and Sy.
- Scaling transformation can be performed :
 - About the origin :
If the point p (x,y) is scaled about origin with scaling factor Sx, and Sy, then we can write the coordinate of P'(x',y') as:
$$x' = x * Sx;$$
$$y' = y * Sy;$$
 - About an arbitrary point P (px,py):
To perform the scaling about the arbitrary point 'P' we have to follow the steps listed below.
 - a. Translate the 2-D object so that arbitrary point 'P' will coincide with the origin by performing the translation transformation with translation factor T(-px, -py)
 - b. Scale the object with respect to origin, with scaling factor Sx and Sy respectively.
 - c. Inverse Translate the object with respect to the arbitrary point 'P' by performing translation transformation with translation factor T(px,py)
- Scaling can be represented with the use of Homogenous coordinate system using matrix representation as

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} s_x & 0 & 0 \\ 0 & s_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

where , P(x,y) coordinate will be scaled to P'(x', y') with respect to the scaling factor 'Sx' and 'Sy'.

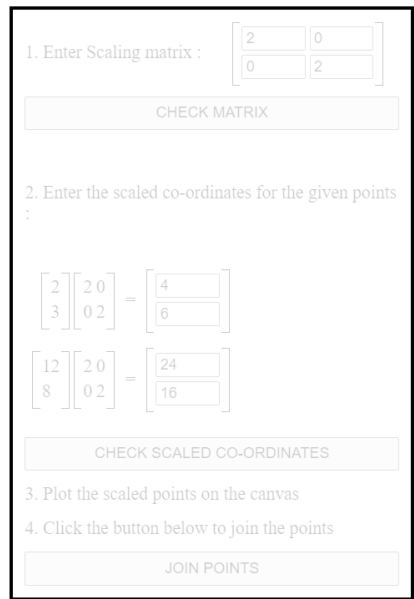
- If the scaling factors are in between 0 and 1 then the points will be moved closer to the origin and the object will be smaller.
- If the scaling factors are larger than 1 then the points will be moved away from the origin and the object will be larger.
- If the scaling factors Sx and Sy are the same, then it is called as uniform scaling else called as differential scaling.

Procedure

ALGORITHM :

1. Start.
2. Accept coordinates to construct a 2-D object.
3. Display the 2-D object.
4. Construct the Homogeneous matrix for the object with reference to the coordinate of the object.
5. Accept the scaling factor Sx, Sy with reference to the coordinate system.
6. Construct the scaled 2-D object with Sx, Sy ($x' = x * Sx$; $y' = y * Sy$) with the use of Homogeneous matrix described earlier.
7. Plot scaled object (x', y') w.r.t. Homogeneous coordinates.
8. Stop.

Stimulation:



Conclusion: Scaling Transformation performed on 2-D graphics object.