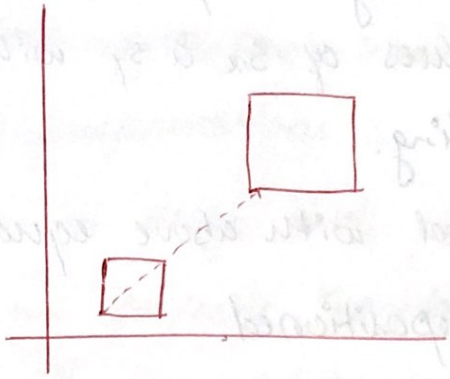
Scaling :-



- It is a transformation that used to alter the size of an object.
- This operation is carried out by multiplying co-ordinate value (x, y) with scaling factor (S_x, S_y) respectively.
- So equation for scaling is given by

$$x' = x \cdot S_x \quad \& \quad y' = y \cdot S_y$$

- These equation can be represented in column vector matrix equation as

$$P' = S \cdot P$$

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

- values less than 1 reduce the size while values greater than 1 enlarge the size of object, and object remains unchanged when values of both factor is 1.

- same values of S_x & S_y will produce uniform scaling and different values of S_x & S_y will produce differential scaling.
- Objects transformed with above equation are both scale & repositioned.
- Scaling factor with value less than 1 will move object closer to origin, while scaling factor with value greater than 1 will move the object away from origin.

Example:-

consider square with left-bottom corner at (2,2) and right top corner at (6,6) apply the transformation which makes its size half.

As we want size half so value of scale factor are $S_x = 0.5$ & $S_y = 0.5$

and co-ordinate of square are A(2,2) B(6,2) C(6,6) D(2,6)

$$P' = S \cdot P$$

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix} \begin{bmatrix} 2 & 6 & 6 & 2 \\ 2 & 2 & 6 & 6 \end{bmatrix}$$

$$= \begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix} \begin{bmatrix} 2 & 6 & 6 & 2 \\ 2 & 2 & 6 & 6 \end{bmatrix} = \begin{bmatrix} 1 & 3 & 3 & 1 \\ 1 & 1 & 3 & 3 \end{bmatrix} //$$