1. *What is Saturation?*

Answer: Color saturation refers to the intensity of color in an image. As the saturation increases, the colors appear to be more pure. As the saturation decreases, the colors appear to be more washed-out or pale.

A highly saturated image has vivid, rich and bright colors, while an image with a low saturation will veer towards a scale of grey. In most monitor devices, televisions and graphic editing programs there's an option to increase or decrease saturation.

Color saturation ultimately is one of the three color properties, the other two being hue and value. Saturation is sometimes called "Chroma" although the two terms have a slightly different meaning.

2. *Define Shade, Tint and Tone.*

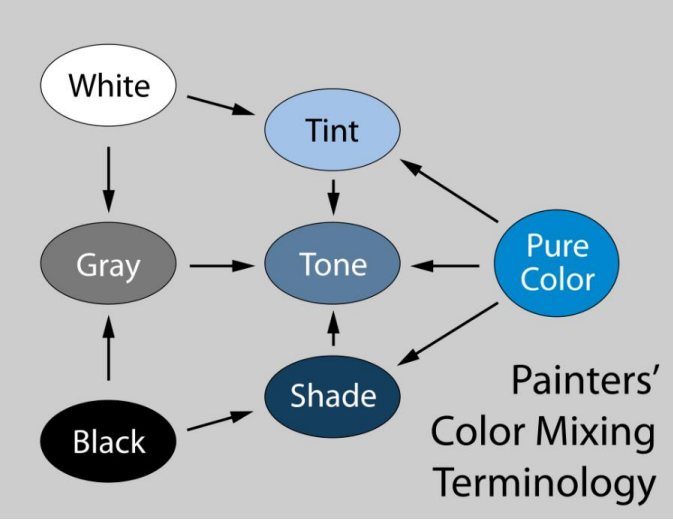
Shade, tint, and tone are terms used to describe variations of a base color.

Shade is a darker version of the base color, created by adding black to the base color.

Tint is a lighter version of the base color, created by adding white to the base color. Pastel colors are generally tinted colors. Tinted color remains the same color, but it is paler than the original.

Tone is a variation of the base color created by adding gray to the base color. Tone is a hue or mixture of pure colors to which only pure gray is added (equal amounts of black and white). Adding gray to a color will make the intensity much duller.

Hue refers to the origin of the colors we can see. Primary and Secondary colors (Yellow, Orange, Red, Violet, Blue, and Green) are considered hues; however, tertiary colors (mixed colors where neither color is dominant) would also be considered hues.

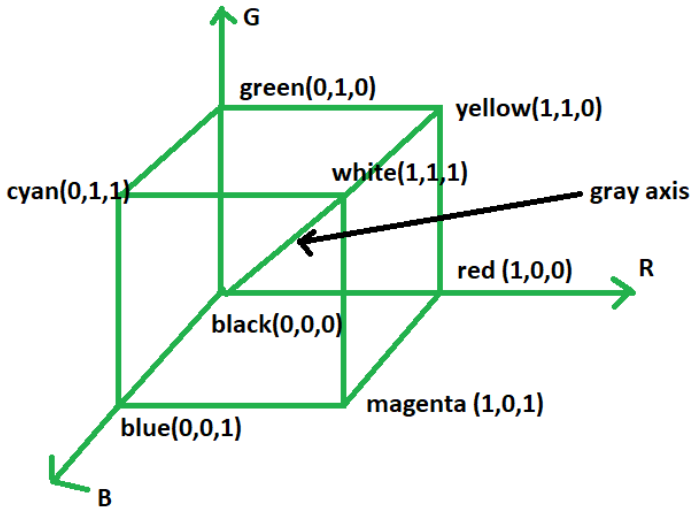


3. *Briefly describe the RGB color model.*

   Answer:

The RGB color model is an additive color model used in computer graphics to represent colors on a display screen. It uses combinations of red, green, and blue light to create a wide range of colors. In this model, each color component is represented by an 8-bit value, ranging from 0 to 255, which determines the intensity of that color component. By varying the intensity of each color component, different colors can be created.

If all the components are at zero the result is black; if all are at maximum, the result is the brightest representable white.



The RGB color model is used in a wide variety of applications, including:

- Computer graphics
- Digital image processing
- Television
- Video games
- Digital photography
- Web design
- Print design

Q:Which one is multiplicative? Translation, Rotation or Scaling?

Multiplicative transformations are those where the transformed object is scaled in all directions from a fixed point, resulting in a change in the object's volume. Scaling is the only multiplicative transformation. Translation and rotation are additive transformations.

Scaling is a transformation that changes the size of an object. It can be either uniform or non-uniform. Uniform scaling changes the size of an object by the same factor in all directions. Non-uniform scaling changes the size of an object by different factors in different directions.

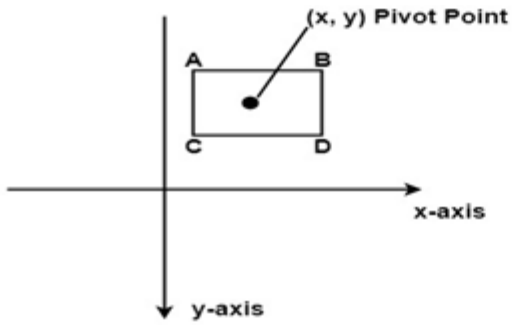
Translation is a transformation that moves an object from one location to another. It is a vector transformation, which means that it is represented by a vector. The vector represents the amount of movement in each direction.

Rotation is a transformation that turns an object around a point. It is a vector transformation, which means that it is represented by a vector. The vector represents the axis of rotation and the angle of rotation.

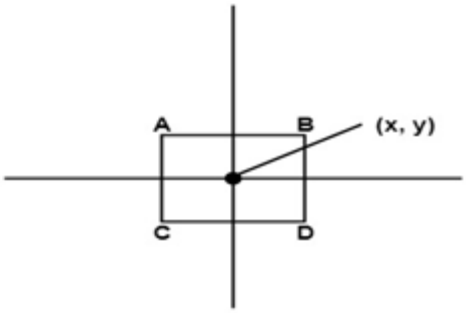
Q: With a neat diagram describe the steps of General Pivot Point Rotation.

For it first of all rotate function is used. Sequences of steps are given below for rotating an object about origin.

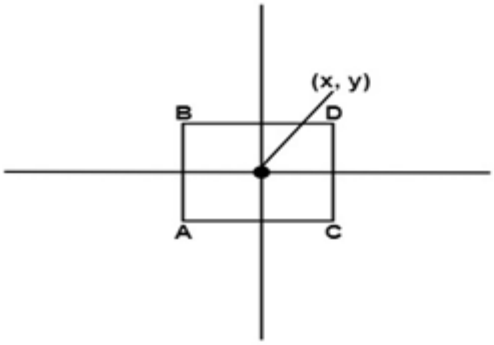
1. Translate object to origin from its original position as shown in fig (b)
2. Rotate the object about the origin as shown in fig (c).
3. Translate the object to its original position from origin. It is called as reverse translation as shown in fig (d).



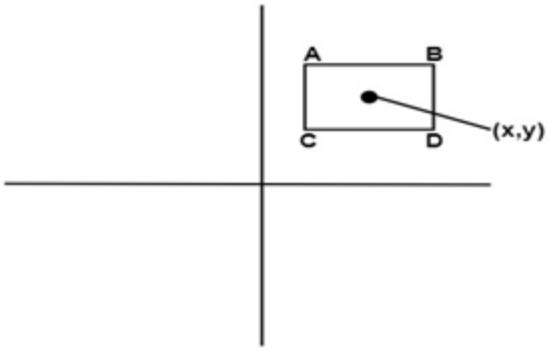
(Original position of object)
Fig (a)



(Translation of object at pivot point)
Fig (b)



(Rotation of object about origin)
Fig (c)



(Retranslation of object to its original position)
Fig (d)

The matrix multiplication of above 3 steps is given below

$$\begin{bmatrix} 1 & 0 & x \\ 0 & 1 & y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos\theta & -\sin\theta & \theta \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -x \\ 0 & 1 & -y \\ 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} \cos\theta & -\sin\theta & x(1-\cos\theta + y\sin\theta \\ \sin\theta & \cos\theta & y(1-\cos\theta) - \sin\theta \\ 0 & 0 & 1 \end{bmatrix}$$

Scaling relative to fixed point:

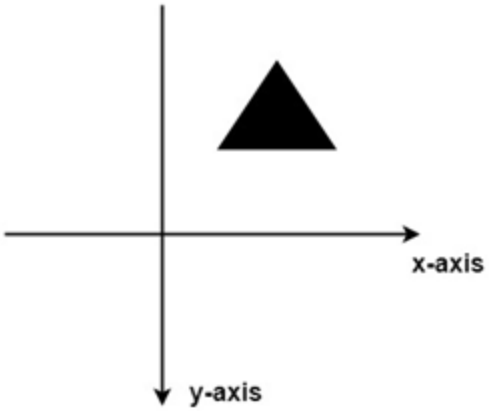
For this following steps are performed:

Step1: The object is kept at desired location as shown in fig (a)

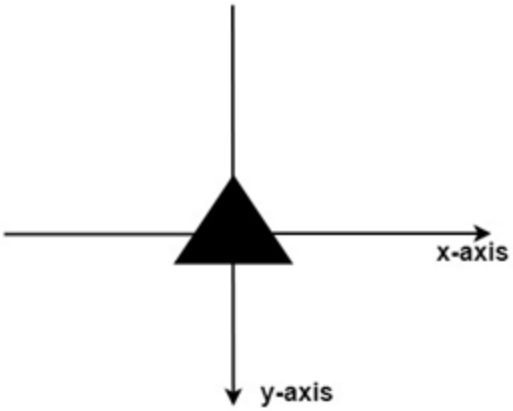
Step2: The object is translated so that its center coincides with origin as shown in fig (b)

Step3: Scaling of object by keeping object at origin is done as shown in fig (c)

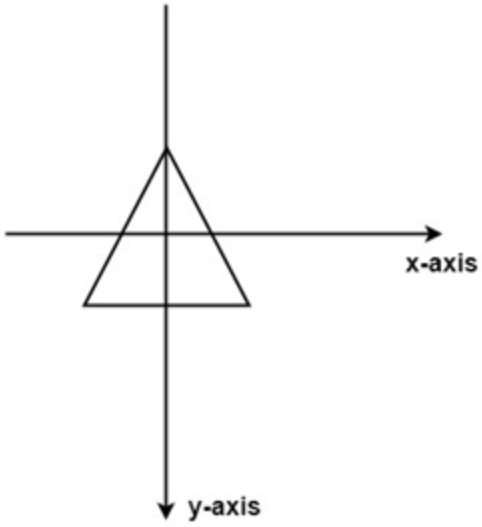
Step4: Again translation is done. This translation is called as reverse translation.



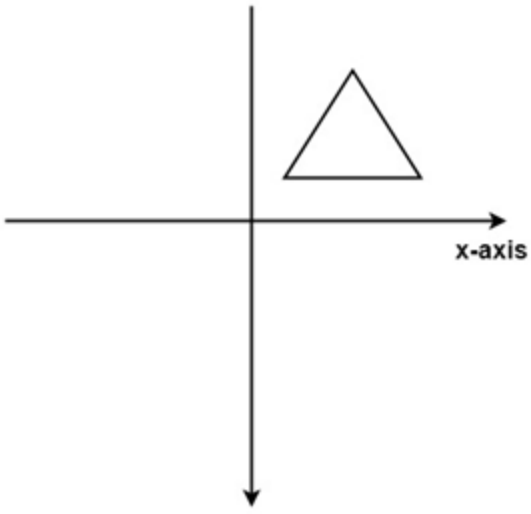
(Original position of object)
Fig (a)



(Object is translated to origin)
Fig (b)



(Object is enlarged by process of scaling)
Fig (c)



(Object is retranslated to original position)
Fig (d)

With only diagram show the rotation of an object with respect to the line y = x.

Q: Write short note on Shear.

There are three types of shear: horizontal shear, vertical shear, and diagonal shear. In horizontal shear, the x-coordinate of each point is shifted based on its y-coordinate, while the y-coordinate remains unchanged. In vertical shear, the y-coordinate of each point is shifted based on its x-coordinate, while the x-coordinate remains unchanged. In diagonal shear, both the x and y coordinates are shifted based on a combination of the other coordinate.

Shear transformations can be expressed mathematically using a transformation matrix, similar to other types of geometric transformations.

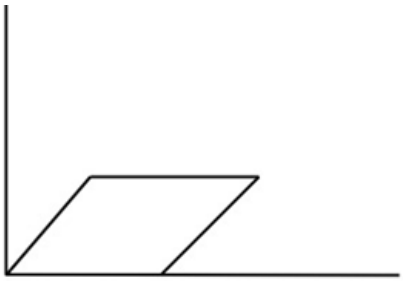
Shearing can be used to perform a variety of operations, such as:

- Stretching or compressing an object in one direction
- Rotating an object about a line
- Skewing an object

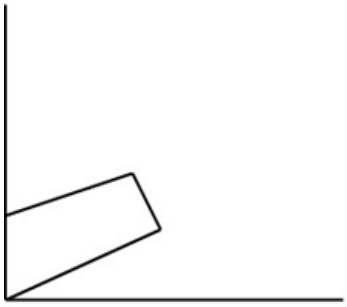
Shearing in the X-direction: In this horizontal shearing sliding of layers occur. The homogeneous matrix for shearing in the x-direction is shown below:

$$\begin{bmatrix} 1 & 0 & 0 \\ Sh_x & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

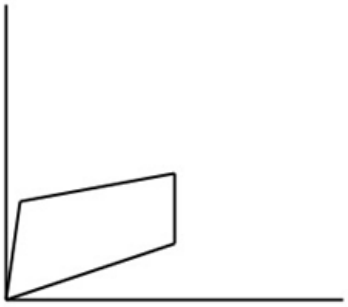
Original Object



Shear in X direction



Shear in Y direction



Shear in both directions

Shearing in the Y-direction: Here shearing is done by sliding along vertical or y-axis.

$$\begin{bmatrix} 1 & Sh_y & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Shearing in X-Y directions: Here layers will be slided in both x as well as y direction. The sliding will be in horizontal as well as vertical direction. The shape of the object will be distorted. The matrix of shear in both directions is given by:

$$\begin{bmatrix} 1 & Sh_y & 0 \\ Sh_x & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

https://www.javatpoint.com/computer-graphics-shearing

https://www.geeksforgeeks.org/shearing-in-2d-graphics/

https://www.gatevidyalay.com/2d-shearing-in-computer-graphics-definition-examples/