Representing Points
In a 2D image, each point can be represented as a vector: (x, y).
These vectors can be considered as arrows starting from the origin (0,0) and pointing to the coordinates of the point.

The Rotation Matrix
A rotation matrix, denoted by R, is a 2x2 matrix used to perform rotations.

The general form of a rotation matrix for an angle θ is given by:
R =
[cos(θ) -sin(θ)]
[sin(θ)   cos(θ)]

θ is the angle of rotation
This matrix rotates the image counterclockwise direction around the origin.

Multiplying by the Rotation Matrix

To rotate a point (x, y), it is multiplied it by the rotation matrix R:
[cos(θ) -sin(θ)] [x]
[sin(θ)   cos(θ)] * [y]

Result:
[cos(θ)x - sin(θ)y]
[sin(θ)x + cos(θ)y]

Example:
Rotation by 90 Degrees
Rotating a point (x, y) by 90 degrees clockwise.

The rotation matrix for 90 degrees is:
[0 -1]
[1   0]

Multiplying this matrix by (x, y):
[0 -1] [x] [-y]
[1   0] * [y] = [x]

So, a point (x, y) rotated by 90 degrees becomes (-y, x).

Applying to the Entire Image

To rotate an entire image, this transformation is applied to each point in the image.
For multiple points (x1, y1), (x2, y2), ..., (xn, yn), each point is multiplied by the rotation matrix to get their new coordinates.

Conclusion

- Linear transformations for rotating 2D images are performed using rotation matrices.
- The rotation matrix R rotates each point by an angle θ.
- Multiplying the point's vector by R gives the new coordinates after rotation.
- This process can be applied to all points in the image to achieve the desired rotation.