**Translation Equation**

Let's say we want to translate a point P(x, y) by tx units in the x-direction and ty units in the y-direction. The translation equation can be represented as:

P'(x', y') = (x + tx, y + ty)

where P'(x', y') is the translated point.

**Example**

Suppose we want to translate the point P(2, 3) by tx = 4 units in the x-direction and ty = 2 units in the y-direction. The translation equation would be:

P'(x', y') = (2 + 4, 3 + 2)

= (6, 5)

So, the translated point P' would be (6, 5).

**Matrix Representation**

Translation can also be represented using a matrix equation:

| x' | | 1 0 tx | | x |

| y' | = | 0 1 ty | \* | y |

| 1 | | 0 0 1 | | 1 |

This matrix equation represents the translation of the point (x, y) by tx units in the x-direction and ty units in the y-direction.

**Scaling Equation**

Let's say we want to scale a point P(x, y) by a scaling factor sx in the x-direction and sy in the y-direction. The scaling equation can be represented as:

P'(x', y') = (sx \* x, sy \* y)

where P'(x', y') is the scaled point.

**Example**

Suppose we want to scale the point P(2, 3) by a scaling factor sx = 2 in the x-direction and sy = 3 in the y-direction. The scaling equation would be:

P'(x', y') = (2 \* 2, 3 \* 3)

= (4, 9)

So, the scaled point P' would be (4, 9).

**Matrix Representation**

Scaling can also be represented using a matrix equation:

| x' | | sx 0 | | x |

| y' | = | 0 sy | \* | y |

| 1 | | 0 0 1 | | 1 |

This matrix equation represents the scaling of the point (x, y) by a scaling factor sx in the x-direction and sy in the y-direction.

**Rotation Equation**

Let's say we want to rotate a point P(x, y) by an angle θ (theta) counterclockwise around the origin (0, 0). The rotation equation can be represented as:

P'(x', y') = (x \* cos(θ) - y \* sin(θ), x \* sin(θ) + y \* cos(θ))

where P'(x', y') is the rotated point.

**Example**

Suppose we want to rotate the point P(2, 3) by an angle θ = 45° (or π/4 radians) counterclockwise around the origin. The rotation equation would be:

P'(x', y') = (2 \* cos(45°) - 3 \* sin(45°), 2 \* sin(45°) + 3 \* cos(45°))

= (2 \* √2/2 - 3 \* √2/2, 2 \* √2/2 + 3 \* √2/2)

= (-√2/2, 5√2/2)

So, the rotated point P' would be approximately (-0.707, 3.535).

**Matrix Representation**

Rotation can also be represented using a matrix equation:

| x' | | cos(θ) -sin(θ) | | x |

| y' | = | sin(θ) cos(θ) | \* | y |

| 1 | | 0 0 | | 1 |

This matrix equation represents the rotation of the point (x, y) by an angle θ counterclockwise around the origin.

**reflection in 2D space, represented mathematically:**

**Reflection Equation**

Let's say we want to reflect a point P(x, y) over the x-axis. The reflection equation can be represented as:

P'(x', y') = (x, -y)

where P'(x', y') is the reflected point.

**Example**

Suppose we want to reflect the point P(2, 3) over the x-axis. The reflection equation would be:

P'(x', y') = (2, -3)

So, the reflected point P' would be (2, -3).

**Reflection over the y-axis**

**To reflect a point over the y-axis, the equation would be:**

P'(x', y') = (-x, y)

**Reflection over a line**

To reflect a point over a line passing through the origin with a slope m, the equation would be:

P'(x', y') = ((m^2 - 1)x + 2my, 2mx + (1 - m^2)y) / (m^2 + 1)

**Matrix Representation**

Reflection can also be represented using a matrix equation:

| x' | | 1 0 | | x |

| y' | = | 0 -1 | \* | y |

| 1 | | 0 0 | | 1 |

This matrix equation represents the reflection of the point (x, y) over the x-axis.

Note: The matrix representation can be modified to represent reflection over the y-axis or a line by changing the values in the matrix.

**shearing in 2D space, represented mathematically:**

**Shearing Equation**

Let's say we want to shear a point P(x, y) by a shearing factor k in the x-direction. The shearing equation can be represented as:

P'(x', y') = (x + ky, y)

where P'(x', y') is the sheared point.

**Example**

Suppose we want to shear the point P(2, 3) by a shearing factor k = 2 in the x-direction. The shearing equation would be:

P'(x', y') = (2 + 2\*3, 3)

= (8, 3)

So, the sheared point P' would be (8, 3).

Shearing in the y-direction

To shear a point by a shearing factor k in the y-direction, the equation would be:

P'(x', y') = (x, y + kx)

**Matrix Representation**

Shearing can also be represented using a matrix equation:

| x' | | 1 k | | x |

| y' | = | 0 1 | \* | y |

| 1 | | 0 0 | | 1 |

This matrix equation represents the shearing of the point (x, y) by a shearing factor k in the x-direction.

Note: The matrix representation can be modified to represent shearing in the y-direction by changing the values in the matrix.