# Group No. 13

# 2D Planar Transformations Simulator

This document provides an overview and user guide for the 2D Planar Transformations Simulator developed using Python and Tkinter. The simulator allows users to perform and visualize various 2D transformations such as Translation, Euclidean, Similarity, Affine, and Projective on different geometries including points, lines, and polygons.

## Features

- Select from five types of transformations.

- Choose geometry type: Point, Line, or Polygon.

- Input transformation parameters directly.

- Visualize both original and transformed geometries on a plot.

## Installation

To run the simulator, ensure you have the following prerequisites installed on your system:

1. Python 3.x

2. Required libraries: numpy, matplotlib, tkinter

Install the dependencies using the command:

pip install numpy matplotlib

## Instructions for Use

### Step 1: Launch the Simulator

Run the Python script in your preferred IDE or terminal. A GUI window will appear titled '2D Planar Transformations'.

### Step 2: Select Transformation Type

From the dropdown menu labeled 'Transformation Type', select one of the following transformations:  
- Translation  
- Euclidean  
- Similarity  
- Affine  
- Projective

### Step 3: Choose Geometry Type

From the 'Geometry Type' dropdown menu, select the type of geometry you wish to transform:  
- Point  
- Line  
- Polygon

### Step 4: Input Transformation Parameters

Enter the required transformation parameters in the labeled input fields. The parameters required depend on the chosen transformation type.

### Step 5: Apply the Transformation

Click the 'Transform' button. The plot will display the original geometry (in blue) and the transformed geometry (in red).

## Transformation Parameter Guide

- **Translation:** Requires Tx, Ty (Translation in x and y directions)

* **Tx (Translation in X direction)**: The distance by which you want to shift the geometry along the x-axis.
* **Ty (Translation in Y direction)**: The distance by which you want to shift the geometry along the y-axis.

- **Euclidean:** Requires θ (Rotation angle in degrees), Tx, Ty

* **θ (Rotation Angle in Degrees)**: The angle by which you want to rotate the geometry, measured counterclockwise from the x-axis.
* **Tx (Translation in X direction)**: The distance by which you want to translate the geometry along the x-axis after rotation.
* **Ty (Translation in Y direction)**: The distance by which you want to translate the geometry along the y-axis after rotation

- **Similarity:** Requires scale, θ (Rotation angle), Tx, Ty

* **Scale**: The scaling factor to uniformly scale the geometry. If scale > 1, the geometry will increase in size; if 0 < scale < 1, the geometry will shrink.
* **θ (Rotation Angle in Degrees)**: The angle by which you want to rotate the geometry (measured counterclockwise from the x-axis).
* **Tx (Translation in X direction)**: The distance to translate the geometry along the x-axis after scaling and rotation.
* **Ty (Translation in Y direction)**: The distance to translate the geometry along the y-axis after scaling and rotation.

- **Affine:** Requires a, b, c, d, e, f (Affine transformation matrix components).

Required Parameters: 6

* **a**: The coefficient that scales the x-coordinate.
* **b**: The coefficient that shears the x-coordinate in the y-direction.
* **c**: The coefficient that shears the y-coordinate in the x-direction.
* **d**: The coefficient that scales the y-coordinate.
* **e**: The translation in the x-direction.
* **f**: The translation in the y-direction.

- **Projective:** Requires a, b, c, d, e, f, g, h (Projective transformation matrix components).

Required Parameters: 8

* **a**: The coefficient that affects the x-coordinate in the projective transformation.
* **b**: The coefficient that affects the x-coordinate in the projective transformation.
* **c**: The coefficient that affects the x-coordinate in the projective transformation.
* **d**: The coefficient that affects the y-coordinate in the projective transformation.
* **e**: The coefficient that affects the y-coordinate in the projective transformation.
* **f**: The coefficient that affects the y-coordinate in the projective transformation.
* **g**: The coefficient that affects the z-coordinate in the projective transformation (homogeneous coordinate).
* **h**: The coefficient that affects the z-coordinate in the projective transformation (homogeneous coordinate).

## Notes and Troubleshooting

1. Ensure all required parameters are entered for the selected transformation type.  
2. If invalid input is provided, the simulator will not function correctly.  
3. Use the 'Polygon' geometry for complex transformations to better observe changes.











