ECE415 -- Homework 1

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```
%The MATLAB code is in the zip, so I do not put the code in this file again.
```

Transformation matrices & Preserved characteristics

Mention: The transformation matrices are the same for the following three polygons (equilateral triangle, square, hexagon).

1. Translation

Translation is 5 pixels in the positive direction of both the X-axis and Y-axis.

Translation matrix:

```
translation =

     1     0     5
     0     1     5
     0     0     1
```

Preserved characteristics:

- The length of sides remain the same.
- The angles between lines remain the same.
- The orientation of object remains the same.

2. Euclidean

Euclidean is based on the translation above and rotate the triangle in 30 degrees clockwise.

Euclidean matrix:

```
euclidean =

    0.8660   -0.5000    5.0000
    0.5000    0.8660    5.0000
         0         0    1.0000
```

Preserved characteristics:

- The length of sides remain the same.
- The angles between lines remain the same.

3. Similarity

Similarity matrix:

```
similarity =

     1    -2     5
     2     1     5
     0     0     1
```

Preserved characteristics:

- The angles between lines remain the same.
- Parallelled lines remain parallel.

4. Affine

Affine matrix:

```
affine =

     1     2     2
     2     1     3
     0     0     1
```

Preserved characteristics:

- Parallelled lines remain parallel.

5. Projective

Projective matrix

```
projective =

    1.0000    2.0000    2.0000
    2.0000    1.0000    3.0000
    0.6000    0.7000    0.5000
```

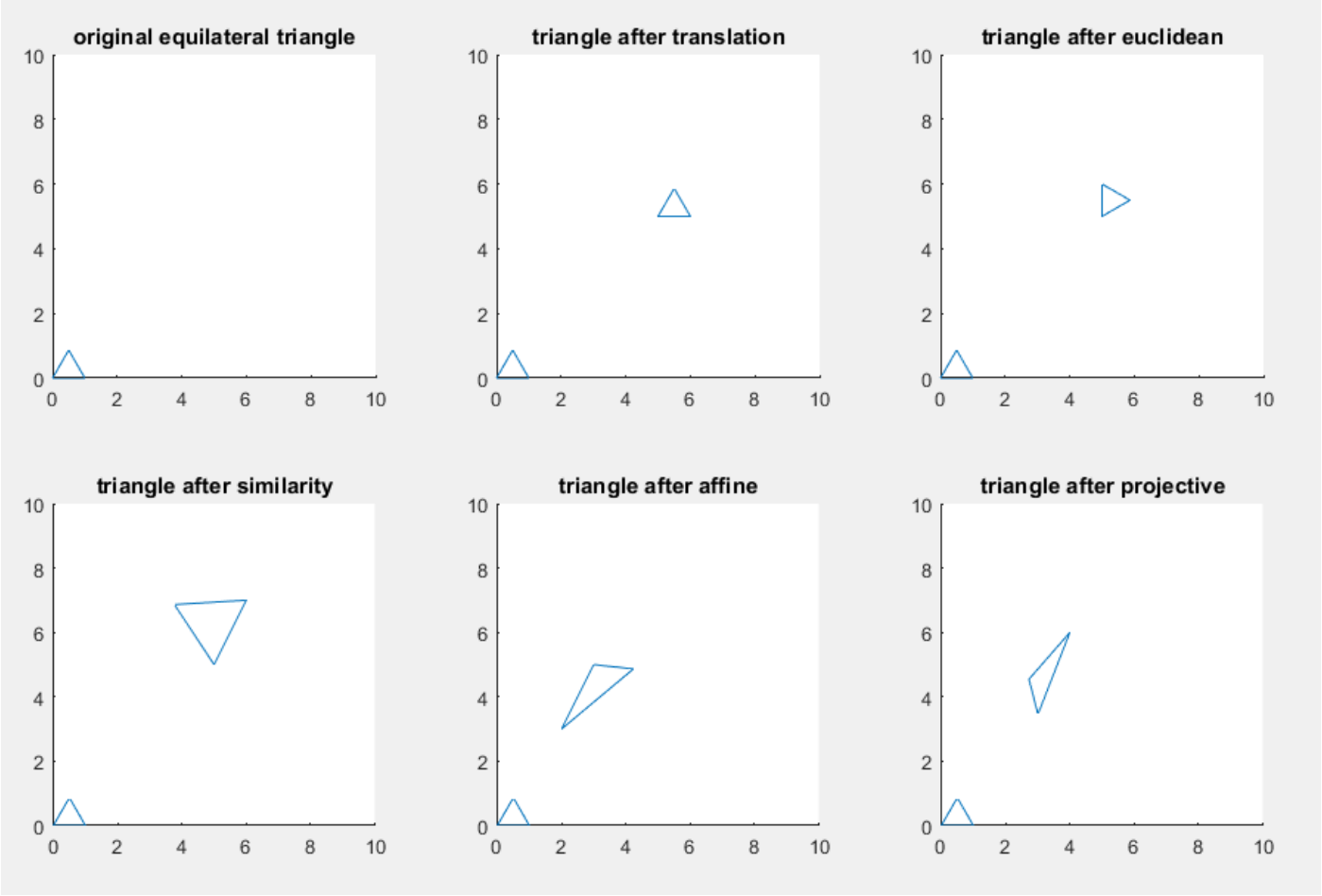
Preserved characteristics:

- Straight lines remain straight.

Plot each input object and its 5 transformed versions & Print out each object's vertices in homogeneous and Cartesian coordinates

1. Equilateral triangle:

Choose the original equilateral triangle as x_1=(0,0), x_2=(1,0), x_3=($\frac{1}{2}$,$\frac{\sqrt{3}}{2}$).

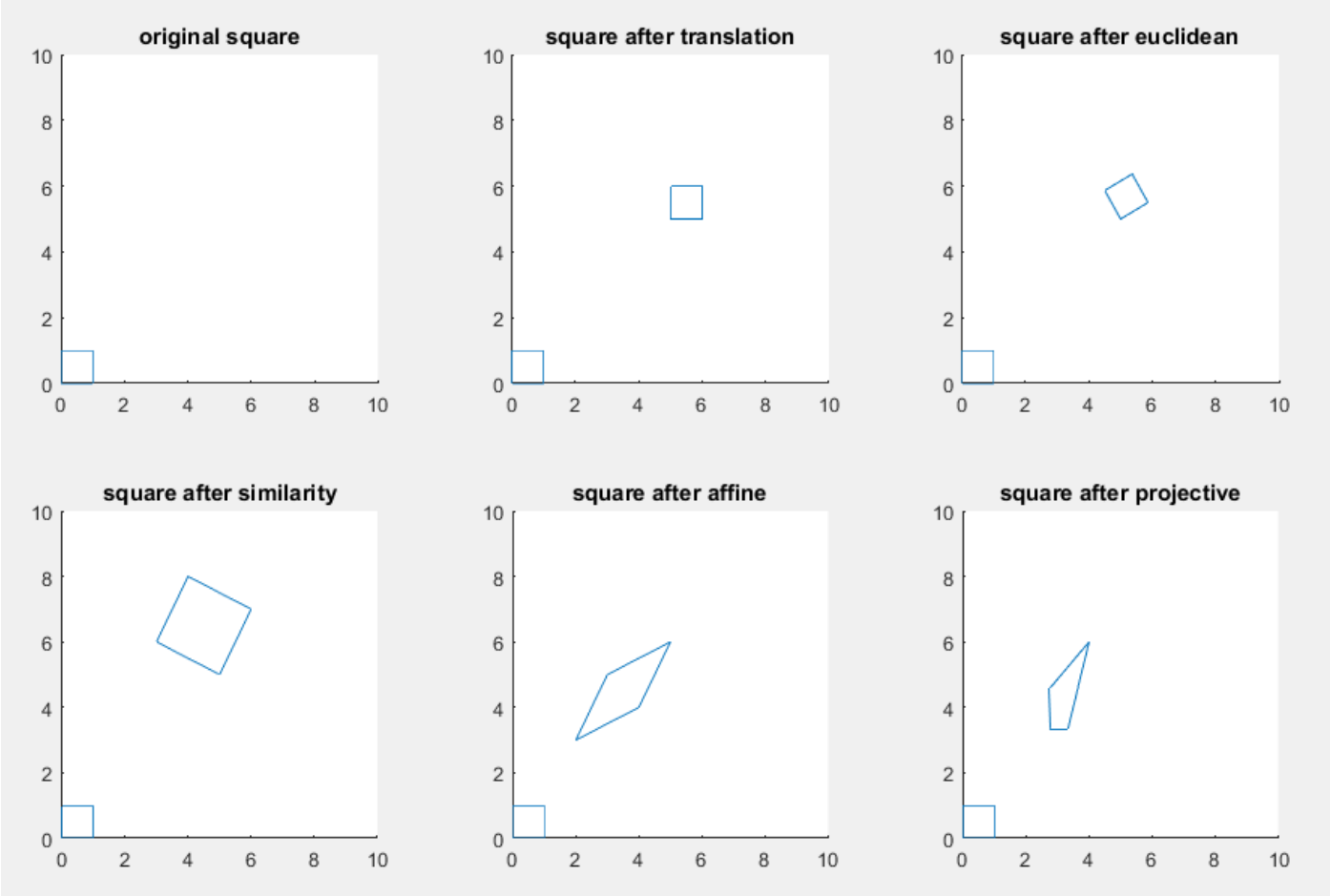


Coordinates		Homogeneous coordinates	Cartesian coordinates
Input objects		ha = 0 1.0000 0.5000 0 0 0.8660 1.0000 1.0000 1.0000	ca = 0 1.0000 0.5000 0 0 0.8660
Transformed objects	Translation	trans = 5.0000 6.0000 5.5000 5.0000 5.0000 5.8660 1.0000 1.0000 1.0000	ctrans = 5.0000 6.0000 5.5000 5.0000 5.0000 5.8660
	Euclidean	eu = 5.0000 5.8660 5.0000 5.0000 5.5000 6.0000 1.0000 1.0000 1.0000	ceu = 5.0000 5.8660 5.0000 5.0000 5.5000 6.0000
	Similarity	sim = 5.0000 6.0000 3.7679 5.0000 7.0000 6.8660 1.0000 1.0000 1.0000	csim = 5.0000 6.0000 3.7679 5.0000 7.0000 6.8660

	Affine	aff = 2.0000 3.0000 4.2321 3.0000 5.0000 4.8660 1.0000 1.0000 1.0000	caff = 2.0000 3.0000 4.2321 3.0000 5.0000 4.8660
	Projective	pro = 4.0000 2.7273 3.0095 6.0000 4.5455 3.4604 1.0000 1.0000 1.0000	cpro = 4.0000 2.7273 3.0095 6.0000 4.5455 3.4604

2. Square:

Choose the original square as x_1=(0,0), x_2=(1,0), x_3=(1,1), x_4=(0,1).

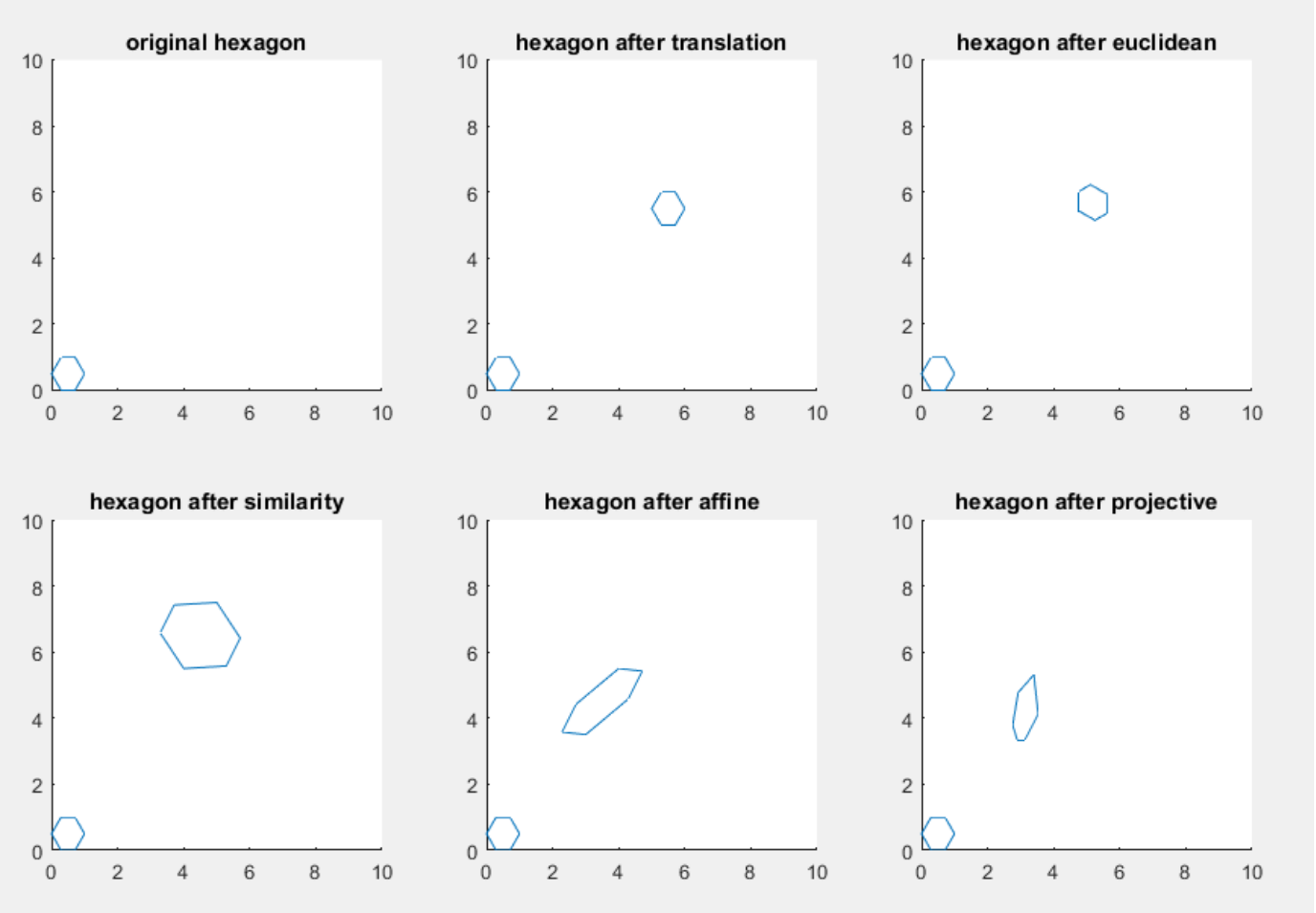


Coordinates	Homogeneous coordinates	Cartesian coordinates
Input objects	ha = 0 1 1 0 0 0 1 1 1 1 1 1	ca = 0 1 1 0 0 0 1 1

Transformed objects	Translation	trans = 5 6 6 5 5 5 6 6 1 1 1 1	ctrans = 5 6 6 5 5 5 6 6
	Euclidean	eu = 5.0000 5.8660 5.3660 4.5000 5.0000 5.5000 6.3660 5.8660 1.0000 1.0000 1.0000 1.0000	ceu = 5.0000 5.8660 5.3660 4.5000 5.0000 5.5000 6.3660 5.8660
	Similarity	sim = 5 6 4 3 5 7 8 6 1 1 1 1	csim = 5 6 4 3 5 7 8 6
	Affine	aff = 2 3 5 4 3 5 6 4 1 1 1 1	caff = 2 3 5 4 3 5 6 4
	Projective	pro = 4.0000 2.7273 2.7778 3.3333 6.0000 4.5455 3.3333 3.3333 1.0000 1.0000 1.0000 1.0000	cpro = 4.0000 2.7273 2.7778 3.3333 6.0000 4.5455 3.3333 3.3333

3. Hexagon:

Choose the hexagon as x_1=(0,$\frac{1}{2}$), x_2=($\frac{1}{2\sqrt{3}}$,0), x_3=(1-$\frac{1}{2\sqrt{3}}$,0), x_4=(1, $\frac{1}{2}$), x_5=(1-$\frac{1}{2\sqrt{3}}$,1), x_6=($\frac{1}{2\sqrt{3}}$,1)



Coordinates		Homogeneous coordinates
Input objects		ha = 0 0.2887 0.7113 1.0000 0.7113 0.2887 0.5000 0 0 0.5000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
Transformed objects	Translation	trans = 5.0000 5.2887 5.7113 6.0000 5.7113 5.2887 5.5000 5.0000 5.0000 5.5000 6.0000 6.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
	Euclidean	eu = 4.7500 5.2500 5.6160 5.6160 5.1160 4.7500 5.4330 5.1443 5.3557 5.9330 6.2217 6.0104 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
	Similarity	sim = 4.0000 5.2887 5.7113 5.0000 3.7113 3.2887 5.5000 5.5774 6.4226 7.5000 7.4226 6.5774 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000

	Affine	aff = 3.0000 2.2887 2.7113 4.0000 4.7113 4.2887 3.5000 3.5774 4.4226 5.5000 5.4226 4.5774 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
	Projective	pro = 3.5294 3.3997 2.9255 2.7586 2.8961 3.1231 4.1176 5.3139 4.7720 3.7931 3.3333 3.3333 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000

Coordinates		Cartesian coordinates
Input objects		ca = 0 0.2887 0.7113 1.0000 0.7113 0.2887 0.5000 0 0 0.5000 1.0000 1.0000
Transformed objects	Translation	ctrans = 5.0000 5.2887 5.7113 6.0000 5.7113 5.2887 5.5000 5.0000 5.0000 5.5000 6.0000 6.0000
	Euclidean	ceu = 4.7500 5.2500 5.6160 5.6160 5.1160 4.7500 5.4330 5.1443 5.3557 5.9330 6.2217 6.0104
	Similarity	csim = 4.0000 5.2887 5.7113 5.0000 3.7113 3.2887 5.5000 5.5774 6.4226 7.5000 7.4226 6.5774
	Affine	caff = 3.0000 2.2887 2.7113 4.0000 4.7113 4.2887 3.5000 3.5774 4.4226 5.5000 5.4226 4.5774
	Projective	cpro = 3.5294 3.3997 2.9255 2.7586 2.8961 3.1231 4.1176 5.3139 4.7720 3.7931 3.3333 3.3333