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:

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

Preserved characteristics:

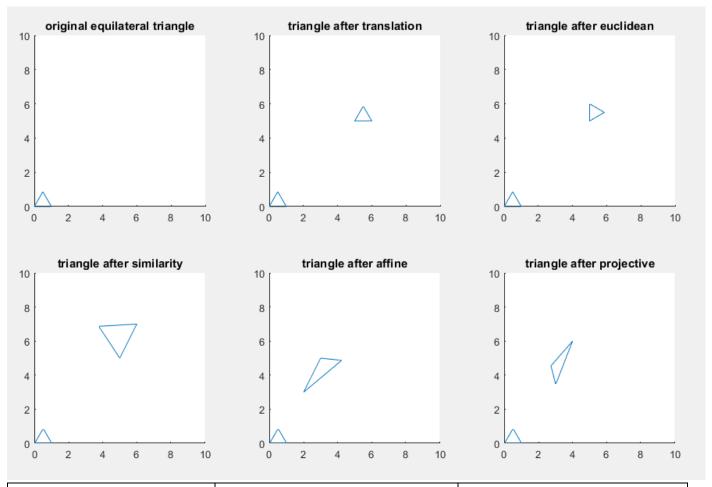
• Straight lines remain straight.

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 $x_1 = (0,0)$, $x_2 = (1,0)$, $x_3 = (\frac{1}{2}, \frac{\sqrt{3}}{2})$.

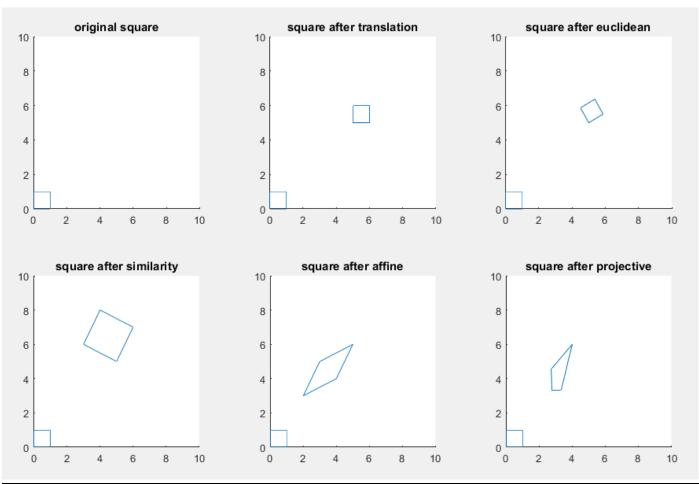


	Coordinates	Homoge	eneous coo	ordinates	Cartesian coordinates			
	Input objects	ha =			ca =			
		0 0 1.0000	1.0000 0 1.0000	0.5000 0.8660 1.0000	0	1.0000 0	0.5000 0.8660	
	Translation	trans =	1.0000	1.0000	ctrans =			
		5.0000 5.0000 1.0000	6.0000 5.0000 1.0000	5.5000 5.8660 1.0000	5.0000 5.0000	6.0000 5.0000	5.5000 5.8660	
Trans	Euclidean	eu =			ceu =			
Transformed objects		5.0000 5.0000 1.0000	5.8660 5.5000 1.0000	5.0000 6.0000 1.0000	5. 0000 5. 0000	5.8660 5.5000	5.0000 6.0000	
cts	Similarity	sim =			csim =			
		5.0000 5.0000 1.0000	6.0000 7.0000 1.0000	3.7679 6.8660 1.0000	5. 0000 5. 0000	6.0000 7.0000	3.7679 6.8660	

Affine	aff =			caff =		
	2.0000 3.0000 1.0000	3.0000 5.0000 1.0000	4.2321 4.8660 1.0000	2.0000 3.0000	3.0000 5.0000	4.2321 4.8660
Projective	pro =			cpro =		
	4.0000 6.0000 1.0000	2.7273 4.5455 1.0000	3.0095 3.4604 1.0000	4.0000 6.0000	2. 7273 4. 5455	3.0095 3.4604

2. Square:

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

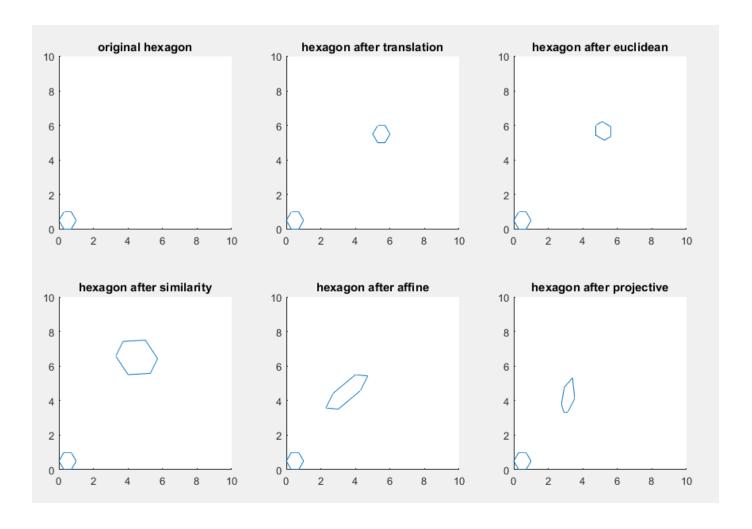


Coordinates			Homo	geneou	is coor	dinates		Cartesian coordinates				
Input	ha =						ca =					
objects								0	1	1	0	
		0	1	1	0			0	0	1	1	
		0	0	1	1		1					
		1	1	1	1							

							ctrans =				
	ب ا	trans =									
	[ra						_			_	
	Translation	5	6	6	5		5	6	6	5	
	lai						5	5	6	6	
	tio	5	5	6	6						
	n	1	1	1	1						
		eu =									
	Н	cu -					ceu =				
	Euclidean										
	lic	5.0000	0	5.8660	5.3660	4.5000	- 00		E 0000	5 2000	4 5000
	les	5.000	0	5.5000	6.3660	5.8660	5.00		5.8660	5.3660	4.5000
	an —						5.00	00	5.5000	6.3660	5.8660
Transformed objects		1.0000	U	1.0000	1.0000	1.0000					
	Similarity	sim =					csim =				
0r.		'									
l Be					_						
ed		5	6	4	3		5	6	4	3	
ob		5	7	8	6		5	7	8	6	
je		1	1	1	1						
cts		-		•							
		aff =					caff =				
	_										
	l f	_	_	_				_	_		
	Affine	2	3	5	4		2	3		4	
	e	3	5	6	4		3	5	6	4	
		1	1	1	1						
	F	pro =					cpro =				
	Projective										
	je	4.000	0	2.7273	2.7778	3.3333	4.000	0	2.7273	2.7778	3.3333
) cti	6.000		4. 5455	3.3333	3.3333	6.000		4. 5455	3.3333	3.3333
	ve						6.000	10	4.0400	3. 3333	3. 3333
1		1.000	0	1.0000	1.0000	1.0000					

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 0.5000 1.0000	0.2887 0 1.0000	0.7113 0 1.0000	1.0000 0.5000 1.0000	0.7113 1.0000 1.0000	0.2887 1.0000 1.0000				
Ti	Translation	trans = 5.0000 5.5000 1.0000	5. 2887 5. 0000 1. 0000	5.7113 5.0000 1.0000	6.0000 5.5000 1.0000	5.7113 6.0000 1.0000	5.2887 6.0000 1.0000				
Transformed objects	Euclidean	eu = 4.7500 5.4330 1.0000	5. 2500 5. 1443 1. 0000	5.6160 5.3557 1.0000	5.6160 5.9330 1.0000	5.1160 6.2217 1.0000	4.7500 6.0104 1.0000				
ots	Similarity	sim = 4.0000 5.5000 1.0000	5. 2887 5. 5774 1. 0000	5. 7113 6. 4226 1. 0000	5.0000 7.5000 1.0000	3.7113 7.4226 1.0000	3.2887 6.5774 1.0000				

	aff =						
Affine	3.0000 3.5000 1.0000	2.2887 3.5774 1.0000	2.7113 4.4226 1.0000	4.0000 5.5000 1.0000	4.7113 5.4226 1.0000	4.2887 4.5774 1.0000	
1	pro =						
Projective	3.5294 4.1176 1.0000	3.3997 5.3139 1.0000	2.9255 4.7720 1.0000	2.7586 3.7931 1.0000	2.8961 3.3333 1.0000	3. 1231 3. 3333 1. 0000	

Coord	linates			Cartesia	an coordina	ites	
Input objects		ca =					
		0 0.5000	0.2887 0	0.7113 0	1.0000 0.5000	0.7113 1.0000	0.2887 1.0000
	Translation	ctrans = 5.0000 5.5000	5.2887 5.0000	5.7113 5.0000	6.0000 5.5000	5.7113 6.0000	5. 2887 6. 0000
Trar	Euclidean	ceu = 4.7500 5.4330	5. 2500 5. 1443	5.6160 5.3557	5.6160 5.9330	5.1160 6.2217	4.7500 6.0104
Transformed objects	Similarity	csim = 4.0000 5.5000	5. 2887 5. 5774	5.7113 6.4226	5.0000 7.5000	3.7113 7.4226	3. 2887 6. 5774
cts	Affine	caff = 3.0000 3.5000	2.2887 3.5774	2.7113 4.4226	4.0000 5.5000	4.7113 5.4226	4. 2887 4. 5774
	Projective	cpro = 3.5294 4.1176	3.3997 5.3139	2. 9255 4. 7720	2. 7586 3. 7931	2. 8961 3. 3333	3. 1231 3. 3333