

Student: Minh Pham
EID: mlp2279

Homework 1

1. (10 points) Given:

```
glutInitWindowSize(800, 600);  
gluOrtho2D(-100.0, 100.0, -100.0, 100.0);
```

Convert the following object coordinates to window coordinates.

Solution:

	Object Coordinates	Window Coordinates
(a)	(0, 0)	(400, 300)
(b)	(-50, 50)	(200, 150)
(c)	(-75, -100)	(100, 600)
(d)	(90, 10)	(760, 270)
(e)	(0, -40)	(400, 420)

2. (5 points) Let:

- α, β, γ be scalars
- A, B, C be points
- u, v, w be vectors

Are the following operations defined?

Answer T/F/? if operation is defined/undefined/don't know.

	Operation	Defined?
(a)	$v - u$	T
(b)	$v - A$	F
(c)	$A - v$	T
(d)	$A + \alpha(B - A)$	T
(e)	$\alpha A + v$	F

3. (5 points) Find a homogeneous-coordinate representation of a plane. Hint: the answer will be a dot product.
4. (15 points) If we are interested in only two-dimensional graphics, we can use three-dimensional homogeneous coordinates by representing a point as $p = [x \ y \ 1]^T$ and a vector as $v = [a \ b \ 0]^T$.

Find the 3x3 rotation, translation, scaling, and shear matrices R,T,S, and H, respectively. How many degrees of freedom are there in an affine transformation for transforming two-dimensional points?

5. (15 points) Derive a rotation matrix where we rotate first about the x-axis $R_x(\theta_x)$, then about the y-axis $R_y(\theta_y)$, and then about the z-axis $R_z(\theta_z)$. Assume that the fixed point is the origin.

$$\begin{bmatrix} 9 & 13 & 17 \\ 14 & 18 & 22 \end{bmatrix}$$