CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 1 | Marks 20 | **SET A**

Date: 15/12/2022 | Time: 35 minutes

1. **[5 marks]** State the differences between parallel and perspective projection

2. Consider the following parameters for an orthographic ray-tracing:

   Camera frame: **E = [−1, 6, 15]^T**, **U = [1, 0, 0]^T**, **V = [0, 1, 0]^T**, **W = [0, 0, 1]^T**
   Image plane: **l = −10**, **r = 10**, **t = 15**, **b = −15**
   Raster image resolution: **10 × 12**
   Sphere: **$(x-5)^2 + (y-12)^2 + z^2 = 100$**

   A ray (with length = 25) is generated from the upper right corner pixel of the raster image.

   a) **[5 Marks]** Find the position of the ray origin on the image plane
   b) **[10 Marks]** Determine whether there will be any ray-sphere intersection

Solution:

1. Go through the book/slides
2. a) [8, 19.75, 15]
   b) D: 77343.75, 2 intersection point exists

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 1 | Marks 20 | **SET B**

Date: 15/12/2022 | Time: 35 minutes

1. **[5 marks]** State the differences between raster and vector images

2. Consider the following parameters for an orthographic ray-tracing:

   Camera frame: **E = [3, 6, 15]^T**, **U = [1, 0, 0]^T**, **V = [0, 1, 0]^T**, **W = [0, 0, 1]^T**
   Image plane: **l = −15**, **r = 15**, **t = 12**, **b = −12**
   Raster image resolution: **8 × 10**
   Sphere: **$(x+5)^2 + y^2 + (z-5)^2 = 64$**

   A ray (with length = 25) is generated from the lower left corner pixel of the raster image.

   a) **[5 Marks]** Find the position of the ray origin on the image plane
   b) **[10 Marks]** Determine whether there will be any ray-sphere intersection

Solution:

1. Go through the book/slides
2. a) [-10.125, -4.8, 15.]
   b) D: 36735.93749999994, 2 intersection point exists

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 2 | Marks 20 | Time: 35 minutes | **SET A**

1. Increase the size of a square OACB by 100 percent so that point B remains fixed; four vertices of the square are: O(2,2), A(2,10), C(10,10) and B(10,2). You must -
    a. **[2 marks]** Mention the steps to perform the task.
    b. **[10 marks]** Determine the composite transformation matrix.
    c. **[3 marks]** Find the final vertices.

2. **[5 Marks]** Explain the problems associated with it if homogeneous coordinates were not used in matrix transformation.

Solution:

1. Steps:
    a) Translate(-10, -2)
    b) Scale(2, 2)
    c) Translate(10, 2)

```
T:
1     0     -10
0     1     -2
0     0     1

S:
2     0     0
0     2     0
0     0     1

TI:
1     0     10
0     1     2
0     0     1
```

```
M:
2     0     -10
0     2     -2
0     0     1

Composite Matrix: T-1 * R * S * P

P':
-6    -6    10    10
2     18    18    2
1     1     1     1
```

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 2 | Marks 20 | Time: 35 minutes | **SET B**

1. Reflect a rectangle OACB along a line $\sqrt{3}y = x$. Four vertices of the rectangle are: A(4, 0), B(8, 0), C(8, 2) and O(4,2). You must -
    a. **[2 marks]** Mention the steps to perform the task.
    b. **[10 marks]** Determine the composite transformation matrix.
    c. **[3 marks]** Find the final vertices.

2. **[5 Marks]** State the properties of affine transformation.

Solution:

1. Steps:
    a) Rotation(60)
    b) Reflect by y-axis
    c) Rootation(-60)

```
R:
0.5   -0.87 0
0.87  0.5   0
0     0     1

Ref:
-1    0     0
0     1     0
0     0     1

RI:
0.5   0.87  0
-0.87 0.5   0
0     0     1
```

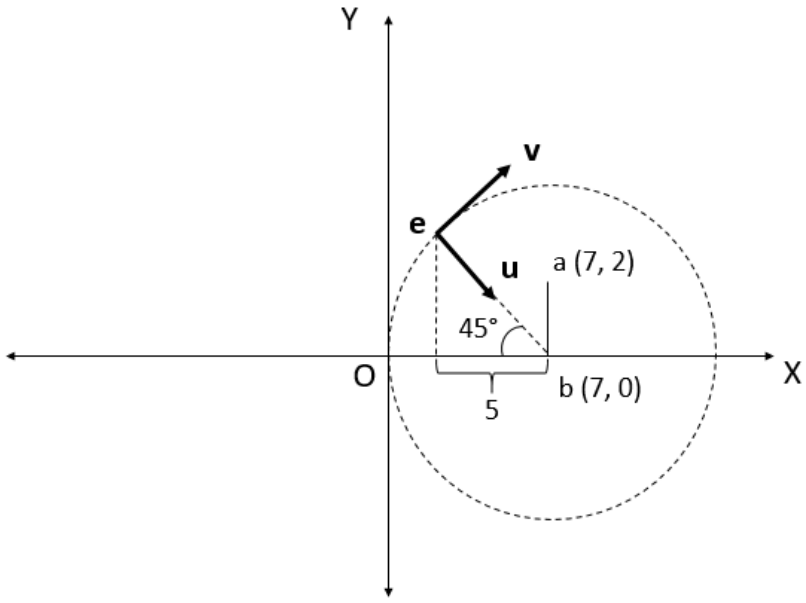
```
M:
0.5   0.87  0.0
0.87  -0.5  0.0
0.0   0.0   1.0

Composite Matrix: R-1 * Ref * R * P

P':
2.0   4.0   5.73  3.73
3.46  6.93  5.93  2.46
1.0   1.0   1.0   1.0
```

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 3 | Marks 20 | Time: 35 minutes | **SET A**

1. Here (in the figure), origin O and basis {x,y} construct a 2D canonical coordinate system. Within this, line ab is our model (Pxy). Now, we want to view it from a new 2D camera with eye e and basis {u,v}; which is rotated by −45 degrees around b. Assume that, u is the viewing direction and b is the center of the circle.



   a. **[15 marks]** Determine the canonical-to-frame matrix
   b. **[5 marks]** Calculate and plot Puv.

Solution:

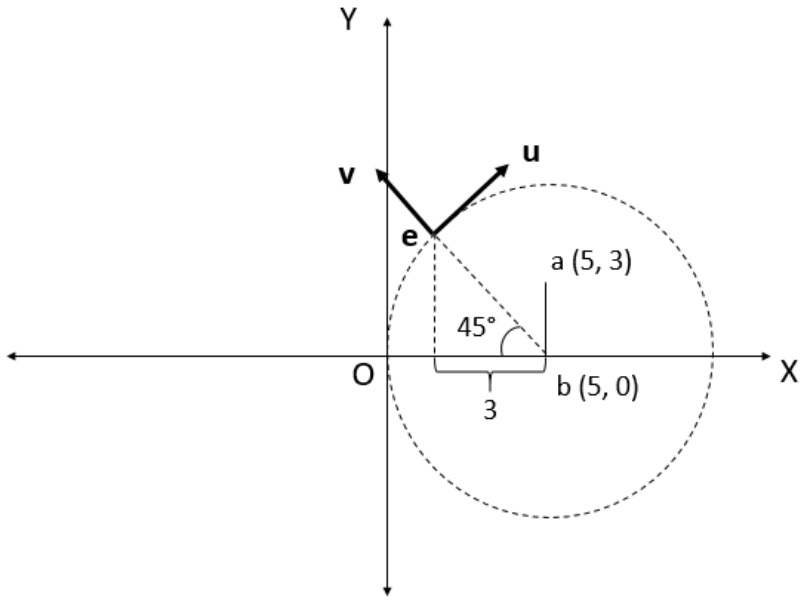
a) Canonical-to-frame matrix:

0.71	-0.71	2.06
0.71	0.71	-4.9
0.0	0.0	1.0

b) Pu: (5.61, 1.49, 1.0)
   Pv: (7.03, 0.07, 1.0)

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 3 | Marks 20 | Time: 35 minutes | **SET B**

1. Here (in the figure), origin O and basis {x,y} construct a 2D canonical coordinate system. Within this, line ab is our model (Pxy). Now, we want to view it from a new 2D camera with eye e and basis {u,v}; which is rotated by +45 degrees around b. Assume that, u is the viewing direction and b is the center of the circle.



   a. **[15 marks]** Determine the canonical-to-frame matrix
   b. **[5 marks]** Calculate and plot Puv.

Solution:

a) Canonical-to-frame matrix:

0.71	0.71	-4.26
-0.71	0.71	-1.42
0.0	0.0	1.0

b) Pu: (1.42, -2.84, 1.0)
   Pv: (-0.71, -4.97, 1.0)

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 4 | Marks 20 | Time: 35 minutes | **SET A**

1. Apply the midpoint line drawing algorithm to draw a line from (-1, -2) to (6, −5) and plot the points. Necessary adjustments of the original algorithm for different octants are provided below:

(1) plot(x, y)	(2) swap(x, y); plot(y, x)	(3) x=−x; swap(x, y); plot(−y, x)	(4) x=−x; plot(−x, y)
(5) x=−x; y=−y; plot(−x, −y)	(6) x=−x; y=−y; swap(x, y); plot(−y, −x)	(7) y=−y; swap(x, y); plot(y, −x)	(8) y=−y; plot(x, −y)

   a) [15 marks] Show the values of the decision variables and the points for each step (in a tabular format).
   b) [5 marks] Plot the final points

Solution:

```
Octant:8
moves x  y  d
----------
     -1 -2 -1
E    0 -2  5
NE   1 -3 -3
E    2 -3  3
NE   3 -4 -5
E    4 -4  1
NE   5 -5 -7
E    6 -5 -1
```

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 4 | Marks 20 | Time: 35 minutes | **SET B**

1. Apply the midpoint algorithm to draw a circle's portions of circumference centered at (-2,-1) on the 3rd, 4th, 5th and 6th octant with radius 6.

   a) [15 marks] For each step, show the values of the decision variables and the points (in a tabular format).

   b) [5 marks] Plot the final points.

Solution:

X Y d 0 6 -5 1 6 -2 2 6 3 3 5 0 4 4 1	octant 3 x: [-2 -3 -4 -5 -6] y: [5 5 5 4 3] octant 4 x: [-8 -8 -8 -7 -6] y: [-1 0 1 2 3] octant 5 x: [-8 -8 -8 -7 -6] y: [-1 -2 -3 -4 -5] octant 6 x: [-2 -3 -4 -5 -6] y: [-7 -7 -7 -6 -5]

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 4 | Marks 20 | Time: 35 minutes | **SET C**

1. Apply the midpoint line drawing algorithm to draw a line from (2, -3) to (-5, −6) and plot the points. Necessary adjustments of the original algorithm for different octants are provided below:

(1) plot(x, y)	(2) swap(x, y); plot(y, x)	(3) x=−x; swap(x, y); plot(−y, x)	(4) x=−x; plot(−x, y)
(5) x=−x; y=−y; plot(−x, −y)	(6) x=−x; y=−y; swap(x, y); plot(−y, −x)	(7) y=−y; swap(x, y); plot(y, −x)	(8) y=−y; plot(x, −y)

a) [15 marks] Show the values of the decision variables and the points for each step (in a tabular format).

b) [5 marks] Plot the final points

Solution:

```
Octant:5
moves x  y  d
----------
     2 -3 -1
E    1 -3  5
NE  -0 -4 -3
E   -1 -4  3
NE  -2 -5 -5
E   -3 -5  1
NE  -4 -6 -7
E   -5 -6 -1
```

CSE 4203 | Computer Graphics | Spring 2022 | Quiz - 4 | Marks 20 | Time: 35 minutes | **SET D**

1. Apply the midpoint algorithm to draw a circle's portions of circumference centered at (3,-2) on the 1st, 2nd, 7th and 8th octant with radius 7.

   a) **[15 marks]** For each step, show the values of the decision variables and the points (in a tabular format).

   b) **[5 marks]** Plot the final points.

Solution:

X Y d 0 7 -6 1 7 -3 2 7 2 3 6 -3 4 6 6 5 5 7	octant 1 x: [10 10 10 9 9 8] y: [-2 -1 0 1 2 3] octant 2 x: [3 4 5 6 7 8] y: [5 5 5 4 4 3] octant 7 x: [3 4 5 6 7 8] y: [-9 -9 -9 -8 -8 -7] octant 8 x: [10 10 10 9 9 8] y: [-2 -3 -4 -5 -6 -7]