Name _____

CS-321
Thursday 12 September 2002
Quiz 1

1. (3 pts.) What is the purpose of a control grid in a cathode ray tube (CRT)?

2. (7 pts.) For the same resolution in pixels (for example, 640x480), why does a text display system require less memory than a graphics display system? Be specific – what types of memory are involved and what data do they hold?

Name _____

CS-321
Thursday 19 September 2002
Quiz 2

1. (3 pts.) What is the advantage of the DDA algorithm over direct implementation of the slope-intercept equation?

2. (4 pts.) What are two of the *assumptions*[1] that Bresenham's line algorithm makes?

   Assumption 1:

   Assumption 2:

3. (3 pts.) What key *observation*[2] does Bresenham's line algorithm make?

[1] An *assumption* is a fact that the algorithm takes as given. An assumption provides constraints on the problem being solved, simplifying the algorithm by excluding conditions that do not satisfy the constraints.
[2] An *observation* is a fact that is noted and, in this case, provides a way to break down or simplify the problem being solved.

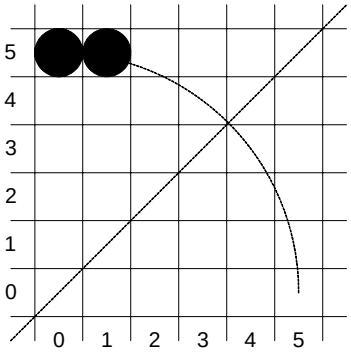
Name _____

CS-321
Thursday 26 September 2002
Quiz 3

Open book and notes
No sharing of materials

1. (8 pts.) Use the midpoint circle algorithm to calculate the next 2 points (after (0, 5) and (1, 5)) on a circle of radius 5 centered at (0, 0). Show your work.

k	p_k	x_{k+1}	y_{k+1}
0	$p_0 = 1 - r = -4$	1	5

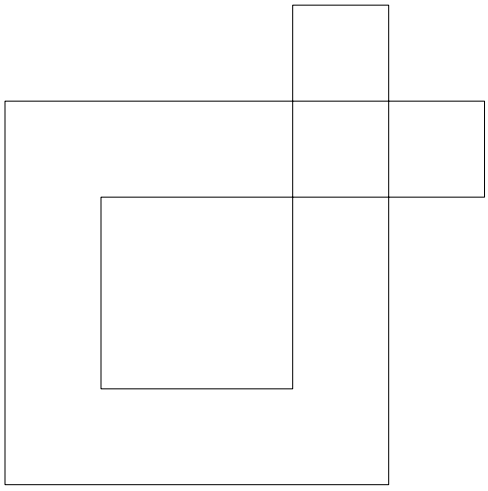


2. (2 pts.) How do you know that you do not need to draw any more points after drawing the points you calculated above (and the symmetric points in the other seven octants)?

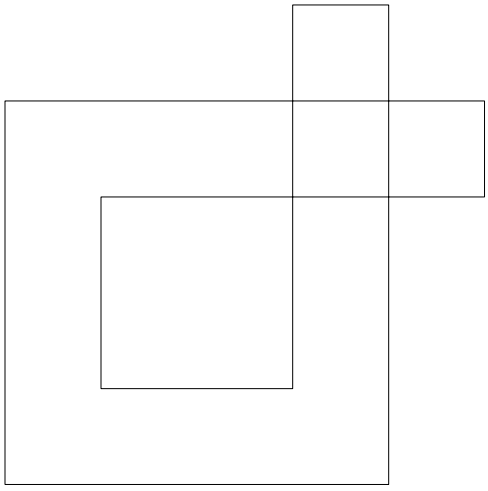
Name _____

CS-321
Thursday 3 October 2002
Quiz 4

1. (5 pts.) Use the odd-even rule to determine which areas of the following polyline should be filled.



2. (5 pts.) Use the non-zero winding number rule to determine which areas of the following polyline should be filled. (Be sure to show the winding number for each region, but you do not need to go through the detailed math as a computer would need to.)



Name _____

CS-321
Thursday 24 October 2002
Quiz 5

A triangle is defined using the following vertices:
(0,0), (3,2), (2,3)

Using homogeneous transformations, rotate this polygon by 36.87° counter-clockwise about the point (2,1). **Hint**: cos 36.87° = 0.8.

Show all work, including the transformation matrix or matrices used.

CS-321
Computer Graphics
Quiz 5 Solution

Dr. Durant
Milwaukee School of Engineering

Thursday 24 October 2002

1 Problem

A triangle is defined using the following vertices: $(0,0),(3,2),(2,3)$.

Using homogeneous transformations, rotate this polygon by $36.87°$ *counter-clockwise about the point* $(2,1)$. Hint*:* $\cos 36.87° = 0.8$.

Show all work, including the transformation matrix or matrices used.

1.1 Solution

$$\begin{aligned} x_t &= 2 \\ y_t &= 1 \\ \theta &= 36.87° \\ \cos\theta &= 0.8 \\ \sin\theta &= \pm\sqrt{\sin^2\theta} = \pm\sqrt{1-\cos^2\theta} = \pm\sqrt{1-0.8^2} = \pm 0.6 \rightarrow 0.6 \end{aligned}$$

$$\begin{aligned} M_t &= \begin{bmatrix} 1 & 0 & x_t \\ 0 & 1 & y_t \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} \\ M_\theta &= \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0.8 & -0.6 & 0 \\ 0.6 & 0.8 & 0 \\ 0 & 0 & 1 \end{bmatrix} \\ M_{-t} &= \begin{bmatrix} 1 & 0 & -x_t \\ 0 & 1 & -y_t \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & -2 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix} \end{aligned}$$

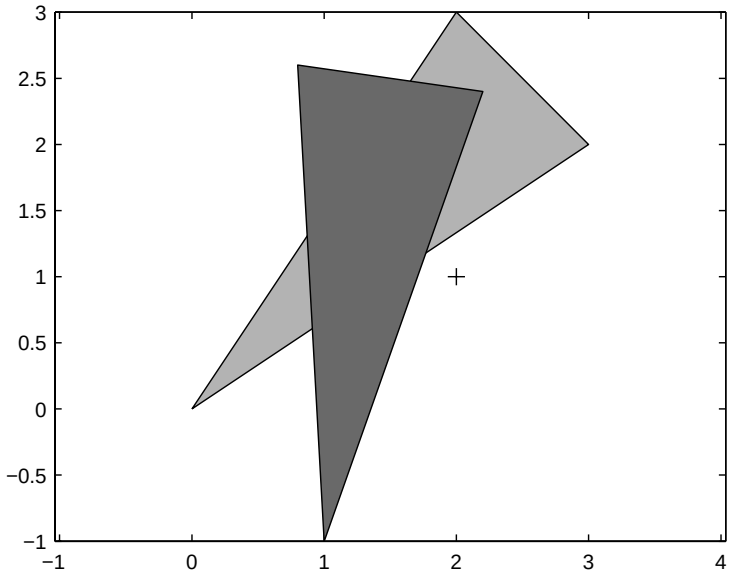


Figure 1: Original triangle (light) and transformed triangle (dark).

$$M_p = M_t M_\theta M_{-t} = M_t(M_\theta M_{-t}) = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0.8 & -0.6 & -1 \\ 0.6 & 0.8 & -2 \\ 0 & 0 & 1 \end{bmatrix}$$
$$= \begin{bmatrix} 0.8 & -0.6 & 1 \\ 0.6 & 0.8 & -1 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P = \begin{bmatrix} 0 & 3 & 2 \\ 0 & 2 & 3 \\ 1 & 1 & 1 \end{bmatrix}$$

$$M_p P = \begin{bmatrix} 1 & 2.2 & 0.8 \\ -1 & 2.4 & 2.6 \\ 1 & 1 & 1 \end{bmatrix}$$

Name _____

CS-321
Halloween 2002
Quiz 5

A triangle is defined with the following vertices: (24,24), (15,0), (0,0)

Using homogeneous transformations:

1. translate the centroid of this triangle to the origin;
2. rotate it 16.26° counter-clockwise about the origin;
3. and shrink it by a factor of 2.

Hints:

- cos 16.26° = 24/25 = 0.96
- sin 16.26° = 7/25 = 0.28
- The centroid of a triangle is the Cartesian average of its 3 vertices.

Show all work, including:

- the basic transformation matrices used;
- the composite transformation matrix (product of basic transformation matrices);
- and the transformed vertices.

CS-321
Computer Graphics
Quiz 6 Solution

Dr. Durant
Milwaukee School of Engineering

Halloween 2002

1 Problem

A triangle is defined with the following vertices: $(24, 24), (15, 0), (0, 0)$.
Using homogeneous transformations:

1. *translate the centroid of this triangle to the origin;*
2. *rotate it* $16.26°$ *counter-clockwise about the origin;*
3. *and shrink it by a factor of 2.*

Hints:

- $\cos 16.26° = 24/25 = 0.96$
- $\sin 16.26° = 7/25 = 0.28$
- *The centroid of a triangle is the Cartesian average of its 3 vertices.*

Show all work, including:

- *the basic transformation matrices used;*
- *the composite transformation matrix (product of basic transformation matrices);*
- *and the transformed vertices.*

1.1 Solution

$$\begin{aligned} x_t &= -(24 + 15 + 0)/3 = -13 \\ y_t &= -(24 + 0 + 0)/3 = -8 \end{aligned}$$

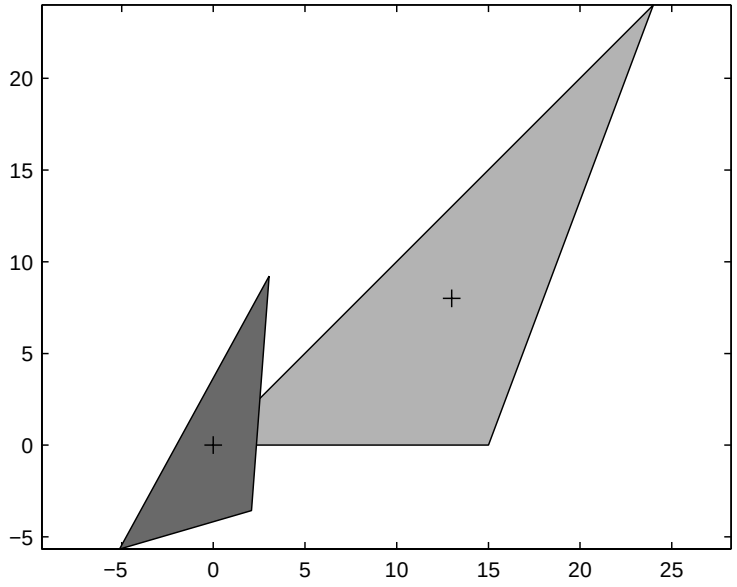


Figure 1: Original triangle (light) and transformed triangle (dark).

$$
\begin{aligned}
M_t &= \begin{bmatrix} 1 & 0 & x_t \\ 0 & 1 & y_t \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & -13 \\ 0 & 1 & -8 \\ 0 & 0 & 1 \end{bmatrix} \\
M_\theta &= \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0.96 & -0.28 & 0 \\ 0.28 & 0.96 & 0 \\ 0 & 0 & 1 \end{bmatrix} \\
M_s &= \begin{bmatrix} x_s & 0 & 0 \\ 0 & y_s & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0.5 & 0 & 0 \\ 0 & 0.5 & 0 \\ 0 & 0 & 1 \end{bmatrix}
\end{aligned}
$$

$$
\begin{aligned}
\bar{M} = M_s M_\theta M_t = (M_t M_\theta) M_t &= \begin{bmatrix} 0.48 & -0.14 & 0 \\ 0.14 & 0.48 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -13 \\ 0 & 1 & -8 \\ 0 & 0 & 1 \end{bmatrix} \\
&= \begin{bmatrix} 0.48 & -0.14 & -5.12 \\ 0.14 & 0.48 & -5.66 \\ 0 & 0 & 1 \end{bmatrix}
\end{aligned}
$$

$$
P = \begin{bmatrix} 24 & 15 & 0 \\ 24 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \qquad \bar{M}P = \begin{bmatrix} 3.04 & 2.08 & -5.12 \\ 9.22 & -3.56 & -5.66 \\ 1 & 1 & 1 \end{bmatrix}
$$

Name _____

CS-321
Thursday 7 November 2002
Quiz 7

1) What information is necessary to properly describe a viewing coordinate system?

2) Describe the transformations typically used to move from world coordinates to viewing coordinates. Explain the role the information in question 1 plays in setting up these transformations.