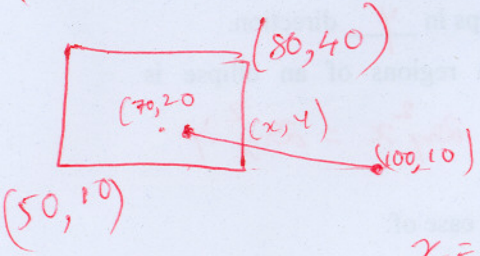
TEZPUR UNIVERSITY Roll No.________________

TU/CSE

Spring Semester Test-2, 2013

9. Use the Cohen-Sutherland line clipping algorithm to clip line P1 (70, 20) and P2(100,10) against the window with coordinates (50,10), (80, 40). Give all the steps of your solution and finally quote the coordinate end points of the clipped line. [8]

$P_1(70,20)$ & $P_2(100,10)$



$P_1 = 0000$

$P_2 = 0010$

$m = \frac{10-20}{100-70} = \frac{-10}{30}$

$x = x_{max} = 80$

$y = y_1 + m(x - x_1)$

$= 20 + (-\frac{1}{3})(80-70)$

$= 20 - \frac{1}{3} \times 10$

$= \frac{60-10}{3} = \frac{50}{3}$ 16.66

(70,20) to (80,16.66)

TEZPUR UNIVERSITY Roll No.____________

TU/CSE

Spring Semester Test-2, 2013

CO 303: COMPUTER GRAPHICS

Full Marks: 20 *Time: 20 mins*

Question 1 to 6 carries 1 mark each. There are a total of 9 questions.

$P_k + 2x_{k+1} + 1$
$= -6 + 4 + 1$

1. If $P_k = -6$, $x_k = 2$, $y_k = 10$, using the midpoint circle equation find $P_{k+1} =$ <u>−1</u>.
2. If Region 1 of an ellipse has slope > 1, then R1 is processed in unit steps in <u>y</u> direction.
3. The equation for the slope at the boundary between the two regions of an ellipse is $dy/dx = -2r_y^2 x / 2r_x^2 y$ or $\frac{dy}{dx} = -1$ or $2r_y^2 x = 2r_x^2 y$.
4. <u>Direct color scheme</u> method stores color codes directly into the frame buffer.
5. If the AND of the region codes of the two line end points is zero it is a case of:
   a) Trivial Rejection b) Trivial acceptance c) Special processing d) None
6. While coloring the pixel (x,y) using a 4-connected boundary fill, the following pixels will be colored.
   a) (x+1, y+1) b) (x, y+1) c) (x-1, y-1) d) All e) None
7. Write two sentences in your own words how you can obtain shades of gray in a monitor with no color capability? [2]

8. Suppose the resolution of your screen is 1024×1024 and the frame-buffer address of (0,0) is 6028. Find the address of the pixels (60, 999) and (61, 1000). Show all formulas. [4]

~~$(x, y) = (0, 0)$~~

$x_{max} = y_{max} = 1024$
$= 1023$

$addr(0,0) = 6028$

$addr(60, 999) = addr(0,0) + y(x_{max}+1) + x$
$= 6028 + 999 * 1024 + 60$
$= \cancel{1030063}\ 1029064$

$addr(61, 1000) = addr(60, 999) + x_{max} + 2$
$= \cancel{1030063}\ 1029064 + 1023 + 2$
$= \cancel{1031088}\ 1030089$

P.T.O.

TEZPUR UNIVERSITY Roll No.______________

TU/CSE

Autumn Semester Test-4, 2013

BTECH: CO 303: COMPUTER GRAPHICS

Full Marks: 20 *Time: 20 mins*

Question 1 to 5 carries 1 mark each. There are a total of 7 questions.

1. T1*T2 = T2*T1 if T1 and T2 are shearing transformations. State True or False: F
2. In event mode, application initiates data entry. State True or False: F
3. If the inverse of a matrix is equal to its transpose, the matrix is ___orthogonal___ matrix.
4. In ___parallel___ projection parallel lines in the world scene project into parallel lines in the 2D display pane.
5. Any selected point within the ___gravity field___ of a line is moved to the nearest point on the line.

6. Magnify the triangle with vertices A(0,0), B(1,1) and C(5,2) to thrice its original size while keeping A(0,0) fixed. Give the scaled coordinates of the triangle. [5]
OR Write a short note on Geometric and attribute tables.

$x' = x \cdot S_x + x_f(1 - S_x)$

$y' = y \cdot S_y + y_f(1 - S_y)$

$S_x = S_y = 2$; $x_f = 0$, $y_f = 0$

$A(0,0) \Rightarrow x' = 0 + 0 = 0$

$y' = 0 + 0 = 0$

$A'(0,0)$

$B(1,1)$

$x' = 1 \cdot 3 + 0 = 3$

$y' = 1 \cdot 3 + 0 = 3$

$B'(3,3)$

$C(5,2)$

$x' = 5 \cdot 3 + 0 = 15$

$y' = 2 \cdot 3 + 0 = 6$

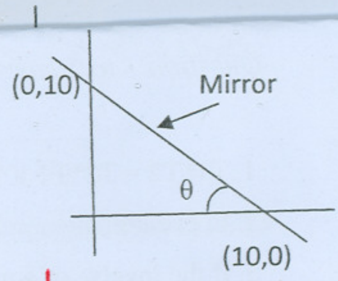
$C'(15,6)$.

TEZPUR UNIVERSITY Roll No.____________

TU/CSE

Autumn Semester Test-4, 2013

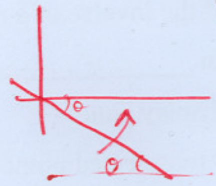
7. A mirror is placed vertically such that it passes through the points (10,0) and (0,10). Find the reflected view of triangle ABC with coordinates A(5, 50), B(20, 40) and C(10, 70). [10]
[Hint: tan θ = 10/10 = 1 *i.e.,* θ =45]



$t_x = 0,\ t_y = -10$

$$T_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -10 \\ 0 & 0 & 1 \end{bmatrix} \qquad T^{-1} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{bmatrix}$$

Next rotate mirror by 45° anticlockwise so that mirror alignms with x - axis



$$R_1 = \begin{pmatrix} \cos 45 & -\sin 45 & 0 \\ \sin 45 & \cos 45 & 0 \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & 0 \\ \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$R_1^{-1} = \begin{pmatrix} \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Reflection about x - axis, $R_{ref_x} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

$$T = T_1^{-1} * R_1^{-1} * R_{ref_x} * R_1 * T_1$$

$$= \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & 0 \\ \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & -10 \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & \frac{10}{\sqrt2} \\ \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & \frac{-10}{\sqrt2} \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & \frac{10}{\sqrt2} \\ -\frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & \frac{10}{\sqrt2} \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{2}-\frac{1}{2} & -\frac{1}{2}-\frac{1}{2} & \frac{10}{2}+\frac{10}{2} \\ -\frac{1}{2}-\frac{1}{2} & \frac{1}{2}-\frac{1}{2} & -\frac{10}{2}+\frac{10}{2} \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 0 & -1 & 10 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0 & -1 & 10 \\ -1 & 0 & 10 \\ 0 & 0 & 1 \end{pmatrix}$$

∴ New coordinates for ΔABC are

$$ABC = \begin{pmatrix} 0 & -1 & 10 \\ -1 & 0 & 10 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 5 & 20 & 10 \\ 50 & 40 & 70 \\ 1 & 1 & 1 \end{pmatrix} = \cancel{-40}$$

$$= \begin{pmatrix} -40 & -30 & -60 \\ 5 & -10 & 0 \\ 1 & 1 & 1 \end{pmatrix}$$

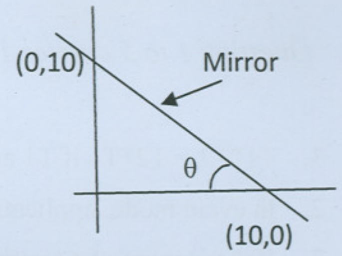
∴ $A_{new} = (-40, 5)$, $B_{new} = (-30, -10)$, $C_{new} = (-60, 0)$

TEZPUR UNIVERSITY Roll No._______________

TU/CSE

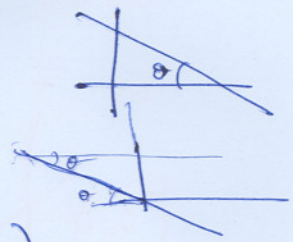
Autumn Semester Test-4, 2013

7. A mirror is placed vertically such that it passes through the points (10,0) and (0,10). Find the reflected view of triangle ABC with coordinates A(5, 50), B(20, 40) and C(10, 70). [10]
[Hint: $\tan\theta = 10/10 = 1$ *i.e.,* $\theta = 45$]



$$T_1 = \begin{pmatrix} 1 & 0 & -10 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad T^{-1} = \begin{pmatrix} 1 & 0 & 10 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

clockwise rot^n 45^0 to align with y-axis



$$R_1 = \begin{pmatrix} \cos 45 & \sin 45 & 0 \\ -\sin 45 & \cos 45 & 0 \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$R_1^{-1} = \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & 0 \\ +\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad Rf_y = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

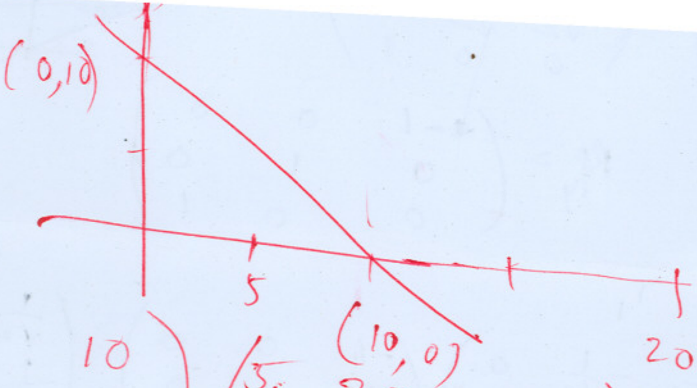
$$T = T_1^{-1} R_1^{-1} Rf_y R_1 T_1$$

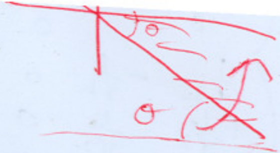
$$= \begin{pmatrix} 1 & 0 & 10 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & 0 \\ \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & - \\ 0 & 1 & \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 10 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & 0 \\ \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & -\frac{10}{\sqrt2} \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & +\frac{10}{\sqrt2} \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 10 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & 0 \\ \frac{1}{\sqrt2} & \frac{1}{\sqrt2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} -\frac{1}{\sqrt2} & -\frac{1}{\sqrt2} & \frac{10}{\sqrt2} \\ -\frac{1}{\sqrt2} & \frac{1}{\sqrt2} & \frac{10}{\sqrt2} \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 10 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 0 & -1 & 0 \\ -1 & 0 & 10 \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0 & -1 & 10 \\ -1 & 0 & 10 \\ 0 & 0 & 1 \end{pmatrix}$$





$$\begin{pmatrix} 0 & -1 & 10 \\ -1 & 0 & 10 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 5 & 20 & 10 \\ 50 & 40 & 70 \\ 1 & 1 & 1 \end{pmatrix} = \begin{pmatrix} -40 & -30 & -60 \\ 5 & -10 & 0 \\ 1 & 1 & 1 \end{pmatrix}$$

TEZPUR UNIVERSITY

Roll No.____________

TU/CSE

Autumn Semester Test-4, 2013

BTECH: CO 303: COMPUTER GRAPHICS

Full Marks: 20 *Time: 20 mins*

Question 1 to 5 carries 1 mark each. There are a total of 7 questions.

1. T1*T2 = T2*T1 if T1 and T2 are shearing transformations. State True or False: F
2. In event mode, application initiates data entry. State True or False: F
3. If the inverse of a matrix is equal to its transpose, the matrix is orthogonal matrix.
4. In parallel projection parallel lines in the world scene project into parallel lines in the 2D display pane.
5. Any selected point within the gravity field of a line is moved to the nearest point on the line.
6. Magnify the triangle with vertices A(0,0), B(1,1) and C(5,2) to thrice its original size while keeping A(0,0) fixed. Give the scaled coordinates of the triangle. [5]
   OR Write a short note on Geometric and attribute tables.

$x' = x \cdot S_x + x_f(1 - S_x)$

$y' = y \cdot S_y + y_f(1 - S_y)$

$S_x = S_y = 2; \quad x_f = 0, \quad y_f = 0$

A(0,0) $\Rightarrow x' = 0 + 0 = 0$

$y' = 0 + 0 = 0$

$A'(0,0)$

B(1,1)

$x' = 1 \cdot 3 + 0 = 3$

$y' = 1 \cdot 3 + 0 = 3$

$B'(3,3)$

C(5,2)

$x' = 5 \cdot 3 + 0 = 15$

$y' = 2 \cdot 3 + 0 = 6$

$C'(15, 6)$.

TEZPUR UNIVERSITY Roll No.______________

TU/CSE

Autumn Semester Major-1, 2013

CO 303: COMPUTER GRAPHICS

Full Marks: 25 *Time*: 60 *mins*

Question 1 to 7 carries 1 mark each. There are a total of 9 questions.

1. For partitioning a line into k partitions along the positive x-direction, the distance between beginning x positions of adjacent partitions is $\Delta x_k = (\Delta x + k - 1)/k$
2. For a 1024×1024 resolution system, if address of pixel (x,y) is 8088, the frame buffer address of the pixel (x+1, y+1) is 8088 + 1024 + 2 = 9114
3. If ORing of the region codes of the endpoints of a line is a non-zero value, it is a case of special processing.
4. In Liang-Barsky line clipping algorithm if $p_k = 0$ and $q_k < 0$ then
   - e a) Line is completely outside the window boundary
   - f b) Line is parallel to the window boundary in consideration
   - g ✓ c) Both (a) and (b)
   - h d) None
5. During processing of pairs of polygon vertices for polygon clipping, if the first vertex is inside and the second vertex outside the window boundary then
   - e a) Save both the intersection point with the window boundary and the second vertex
   - f ✓ b) Save the edge intersection with the window boundary
   - g c) Both (a) and (b)
   - h d) None
6. coherence refers to the property that one part of a scene is related in some way to other parts of the scene.
7. According to odd-even rule, a point is inside a polygon if the conceptual line drawn from this point to a distant point outside the coordinate extents of the polygon has odd number of polygon edge crossings.
8. Give the DDA algorithm. [8]
9. Use the Scanline Polyfill algorithm to fill the polygon ABCDEA. The coordinates of the vertices are A(0,0), B(4,3), C(8,0), D(8,5), E(0,5). Show the SET and AET structures for each step of your algorithm. [10]

```
dx = x2 - x1 ; dy = y2 - y1
x = x1 ; y = y1
if (abs(dx) > abs(dy))
        steps = abs(dx)
else
        steps = abs(dy)
xinc = dx/steps ; yinc = dy/steps ;
setpixel(round(x), round(y));
for( i = 0 ; i < steps ; i++ )
{
        x += xinc ; y += yinc ;
        setpixel( round(x), round(y) );
}
```