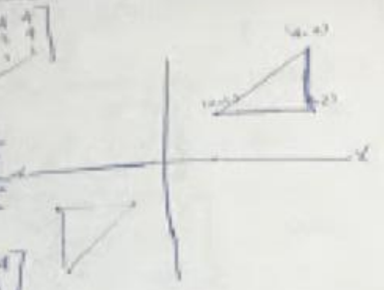
Taibah University
College of computer science and Engineering
Mid-Term 2 Exam 1438-1439

Course : Computer Graphics
Course Code : CS451
Time : 60 minutes

3

Q4: Consider a triangle whose vertices are (2, 2), (4, 2) and (4, 4). Find the transformation matrix and the transformed vertices for reflecting the triangle through the line y = -x. **Show your work** (3 marks)

$$\begin{pmatrix} x' \\ y' \\ 1 \end{pmatrix} = \begin{bmatrix} [illegible] & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 2 & 4 & 4 \\ 2 & 2 & 4 \\ 1 & 1 & 1 \end{bmatrix}$$

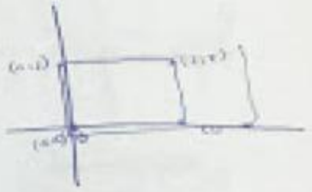


$$= \begin{bmatrix} -2 & -4 & -4 \\ -2 & -2 & -4 \\ 1 & 1 & 1 \end{bmatrix}$$

2

Q5: Consider a square object defined by vertices A(0,0), B(0,2), C(2,2) and D(2,0). Apply the shearing along X axis where SH_x= 2 units. **Show your work** (3 marks)

$$SH_x = \begin{bmatrix} SH_x & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{array}{ccc} 1 & 2 & \\ \begin{bmatrix} 2 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \end{array}$$



$$V = \begin{bmatrix} 0 & 0 & 2 & 2 \\ 0 & 2 & 2 & 0 \\ 1 & 1 & 1 & 1 \end{bmatrix} \quad 1$$

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

$$= \begin{bmatrix} 0 & 0 & 4 & 4 \\ 0 & 2 & 2 & 0 \\ 1 & 1 & 1 & 1 \end{bmatrix} \quad 1$$

Taibah University
College of computer science and Engineering
Mid-Term 2 Exam 1438-1439

Course : C...
Course Code : ...
Time : 60 minutes

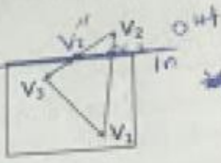
8. When did you sleep last night?
   A. Before 12:00AM. B. After 12:00AM. C. I did not sleep

9. The following matrix is used to, ____________

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

   A. Rotate an object by 90°
   B. ~~Reflect an object about the y-axis~~
   C. ~~Shear an object with $Sh_y = -1$~~
   D. Reflect an object about the x-axis

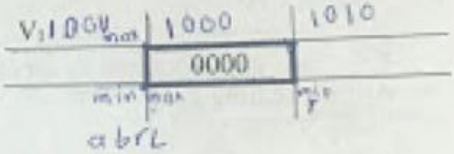
10. Consider the following diagram, what is the result of applying top clip on this polygon?



   A. $V_1\ V'_1\ V_3\ V'_1$
   B. $V_1\ V'_2\ V_3$
   C. $V_1\ V'_1\ V'_2\ V_3$
   D. $V_1\ V_3$

$V_1 V_2$ in out
$V_2 V_3$ out in

11. Cohen-Sutherland Clipping is a line clipping algorithm that uses 4-bit code. What is the code for the point V_1?



   A. 1001
   B. 1000
   C. 0001
   D. 1010

12. The first step for reflecting an object about an arbitrary line y = mx+b is to:
   A. Rotation by $\tan^{-1}(m)$
   B. Translation by (0,-b)
   C. Reflection about x-axis
   D. Inverse rotation and translation

Taibah University
College of computer science and Engineering
Mid-Term 2 Exam 1438-1439

$\frac{27\frac{1}{2}}{30}$

Course : Computer Graphics
Course Code : CS...
Time : 60 minutes

Name: [redacted]

Section: [illegible]

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	D	B	C	A	A	~~B~~ D	C	D	C

Q	11	12
Ans	A	B

1. The curve described by solving $Ax + By + C = 0$ is considered ________
   A. Explicit Curve
   B. Implicit Curve
   C. Parametric Curve
   D. All of the above

2. Cubic polynomial is used to represent curves because:
   A. lower-degree polynomials give too little flexibility in controlling the shape of the curve
   B. higher-degree polynomials require more computation
   C. lowest degree that allows specification of endpoints and their derivatives
   D. All of the above

3. ____B____ curve is a type of curve that passes through all control points.
   A. Approximating
   B. Interpolating
   C. Infinite Curve
   D. Finite Curve

4. The Hermite, Bezier, and Biubic are examples of ______
   A. Explicit Curve
   B. Implicit Curve
   C. Parametric Curve
   D. All of the above

5. The curves that defined by two endpoints and two other points that control the endpoint tangent vectors are ______
   A. Bezier
   B. Splines
   C. Hermite
   D. None of the above

6. The polynomial of Hermite curve can be written as: $X(t) = a_3t^3 + a_2t^2 + a_1t + a_0$ and $X'(t) = 3a_3t^2 + 2a_2t + a_1$ For $p1(x_0, y_0)$ and $p2(x_1, y_1)$, the value of a_0 is ______
   A. x_0
   B. $-3x_0 - 2x'_0 + 3x_1 - x'_1$
   C. x'_0
   D. x_1

   $x_0 = a_0$
   x'_0

7. Let V1(u) and V2 (u) be two parametric curves and u is between 0 and 1. V1(u) and V2(u) have C^1 continuity if:
   A. $V_1(1) = V_2(0)$
   B. $V'_1(1) = V'_2(0)$
   C. $V'_1(1) \neq V'_2(0)$
   D. A and B

Course : Computer Graphics
Course Code : CS451
Time : 60 minutes

4

Q2: To scale an object about a reference point (xr, yr), we need to consider a scaling as a composite transformation which involves three steps.

A) Name the three steps in the correct order. (1 mark)

$$T_{composite} = T_{transit}\, T_{scal}\, T_{transit}^{-1}$$

① translate the object about the original (xr, yr)
② Scale the object
③ translate the object to original position

B) Write the the matrix used for each step. (3 marks)

Step 1 $T_{transit} = \begin{bmatrix} 1 & 0 & -x_r \\ 0 & 1 & -y_r \\ 0 & 0 & 1 \end{bmatrix}$

Step 3 $T_{transit}^{-1} = \begin{bmatrix} 1 & 0 & x \\ 0 & 1 & y \\ 0 & 0 & 1 \end{bmatrix}$

Step 2 $T_{scal} = \begin{bmatrix} S_x & 0 & 0 \\ 0 & S_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$

3½

Q3: Consider the line with endpoints (10, 10) and (30, 25). Translate it by $t_x = -10$, $t_y = -20$ and then rotate it by $\theta = 90°$. **Show your work** (4 marks)

Note: cos 90 = 0 and sin 90 = 1

$$T_{rot} = \begin{bmatrix} \cos 90 & -\sin 90 & 0 \\ \sin 90 & \cos 90 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$T_{tran} = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & -10 \\ 0 & 1 & -20 \\ 0 & 0 & 1 \end{bmatrix}$$

$$T_{composit} = T_{rot} \cdot T_{tran}$$

$$\begin{bmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & -10 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{bmatrix}$$

½

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

2 → 20
-1 → -10

for start point

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 2 \\ 1 & 0 & -1 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 10 \\ 10 \\ 1 \end{bmatrix} = \begin{bmatrix} -8 \\ 9 \\ 1 \end{bmatrix}$$

½

for end poin

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 2 \\ 1 & 0 & -1 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -8 \\ 29 \\ 1 \end{bmatrix}$$