Computer Graphics Assignments

Assignment 1

1) Consider three different raster systems with resolutions of 640 by 480, 1280 by 1024. What size frame buffer (in bytes) is needed for each of this system to store 12 bits per pixel?

2) Suppose an RGB raster system is to be designed using an 8 inch by 10-inch screen with a resolution of 100 pixels per inch in each direction. If we want to store 6 bits per pixel in the frame buffer, how much storage (in bytes) do we need for the frame buffer?

3) How long would it take to load a 640 by 480 frame buffer with 12 bits per pixel, if 10^5 bits can be transferred per second? How much would it take to load a 24 bit per pixel frame buffer with a resolution of 1280 by 1024 using this same transfer rate?

4) How long would it take to load a (640×480) frame buffer with 12-bit per pixel, if 10^5bits can be transferred per second? How long would it take to load a 24 – bit per pixel frame buffer with a resolution of 1280 by 1024 using the same transfer rate?

5) Consider two raster systems with resolutions of (640×480) and (1280 by 1024). How many pixels could be accessed per second in each of these systems by a display controller that refreshes the screen at a rate of 60 frames per second? What is the access time per pixel in each system?

6) How much time is spent scanning across each row of pixels during screen refresh on a raster system with a resolution of 1280 by 1024 and a refresh rate of 60 frames per second?

7) What is the size of frame buffer required to store a SVGA with 24-bit true color video of 10 minutes without compression?

8) Suppose an RGB raster system is to be designed using an 8 inch by 10-inch screen with a resolution of 100 pixels per inch in each direction. How long would it take to load this raster system in frame buffer with 24 bits per pixel, if 105 bits can be transferred per second?

9) Compare and contrast Raster- scan Display with Random-scan Display.

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Assignment 2

1) Digitize the line (40, 65) to (50, 50) using DDA line drawing algorithm.
2) Digitize the line (20, 35) to (30, 43) using DDA line drawing algorithm.
3) Digitize the line (50, 55) to (35, 45) using Bresenham's line drawing algorithm.
4) Digitize the line (60, 35) to (45, 45) using Bresenham's line drawing algorithm.
5) Write a general algorithm of Bresenham's line drawing algorithm. [positive and negative slope for m >1 and m ≤ 1]
6) Derive the Bresenham's decision parameter to draw a line with negative slope and m>1.
7) Derive the Bresenham's decision parameter to draw a line moving from left to right and having negative slope.
8) Derive the Mid-point circle decision parameter with starting point (-r, 0) and moving in clock wise direction.
9) Derive the Mid-point circle decision parameter with starting point (0, -r) and moving in clock wise direction.
10) Derive decision parameter for midpoint circle algorithm assuming the start position as (r, 0) points are to be generated along the curve path in counter clockwise direction.
11) Digitize the circle with radius 12 and center (15,22).
12) Digitize the circle with radius 10 and center (5,2).
13) Digitize the Ellipse with radius Rx = 8 and Ry = 12 and center (10,20).
14) Digitize the Ellipse with radius Rx = 12 and Ry = 7 and center (19,10).

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Assignment 3

1) Develop the matrix to reflect an object about the *line y=mx+b.*

2) How would you reflect an object about a line y=3x+10? Explain the steps with the matrices.

3) Reflect the triangle with vertices A (4, 12), B (6, 15), and C (2, 10) about the line y=4x+2. And draw the final triangle.

4) Suppose a rectangular window has lower left corner at L (8, 9) & upper right corners at R (14, 13). Use Cohen Sutherland algorithm to clip the line with the end points A (7, 8) & B (13, 14) against above provided window.

5) Develop the complete matrix to reflect an object with the reference line y= -x.

6) Use Cohen Sutherland's line clipping algorithm to clip a line starting from (-10, 5) and ending at (20, 10) against the window having its lower left corner at (-5, -5) and upper right corner at (15, 12).

7) Use Liang-Barsky line clipping algorithm to clip a line starting from (10, 25) and ending at (100, 95) against the window having its lower left corner at (20, 20) and upper right corner at (80, 90).

8) Use Liang-Barsky line clipping algorithm to clip a line starting from (2, -5) and ending at (12,28) against the window having its lower left corner at (3, 10) and upper right corner at (15, 25).

9) Find the transformation matrix that transforms the square ABCD whose center is at (2,2) is reduced to half, with center still remaining at (2,2). The coordinate of the square ABCD are A (0,0), B (0,4), C (4,4) and D (4,0). Find the coordinates of new squares.

10) Magnify the triangle with vertices A (0,0), B (1,1), and C (5,2) to twice its size while keeping C (5,2) fixed.

11) A mirror is placed vertically such that is 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).

12) Suppose there is a rectangle ABCD whose coordinates are A (1,1), B (4,1), C (4,4) and D (1,4) and the window coordinates are (2,2), (5,2),(5,5), and (2,5) and the given viewport location is(0.5,0),(1,0),(1,0.5), and (0.5,0.5). Calculate the viewing transformation matrix.

13) Suppose there is a square ABCD whose coordinates are A (0,0), B (0,1), C (1,1) and D (1,0).

a. Shear the square relative to the X_{ref} ***=-1 and Shy = 2***. Calculate the final coordinates and draw it.

b. Shear the square relative to the Y_{ref} ***=-1 and Shx = 1***. Calculate the final coordinates and draw it.

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Assignment 4

1) If you have three coordinates (x1, y1, z1), (x2, y2, z2) and (x3, y3, z3), then how do you find the coefficient of surface normal N (A, B, C)?

2) Perform rotation of a triangle with vertices (10,10,10), (20,20,15) and (15,15,30) about z axis with 90 degree in counter clock wise direction.

3) Develop a matrix to rotate an object about **an axis that is not parallel** to the coordinate axis with necessary figures and steps.

4) Perform rotation of a rectangle with vertices (10,10,10), (20,10,20), (20,20,20) and (10,20,10) about y- axis with 45-degree in counter clock wise direction.

5) Perform rotation of a line with vertices (10,10,10), and (20,20,20) about y- axis with 45-degree in clock wise direction.

6) Find the new coordinates of a unit cube 90^0 rotated about an axis defined by a line (5,4,0) and (6,6,2) and draw the final cube.

7) A unit length cube with a diagonal passing through (0,0,0) and (1,1,1) is shared with respect to YZ-plane with the shear constant=2 in both directions. Obtain the coordinates of all the corners of the cube after shear.

8) Develop the complete 3-Dimensional World-coordinate to View-coordinate transformation matrix.

9) A 3D scene is viewed from point (1,1,1) with camera orientation described by the orientation of three orthogonal vectors (1,1,1), (1,2, -3) and (-5,4,1). Obtain transformation matrix to describe the scene with respect to camera orientation.

10) Develop the 3-Dimensional World-coordinate to View-coordinate transformation matrix to describe the following scenarios

- **a.** View-reference Point or Eye position $\mathbf{P_0 = (3,1,3)}$
- b. Look-at-point $\mathbf{P_{ref} = (2,1,2)}$
- **c.** View-up Vector **V= (0,1,0)**

11) Obtain perspective projection co-ordinates for the pyramid with vertices of base (15,15,10, (20,20,10), (25,15,10), (20,20,10) and apex (20,15,20); given that Z_{prp} =20 and Z_{vp} = 0.

12) Derive the transformation matrix for rotating any object by 45 degree in counter clockwise direction about a line passing through the point (20,30,0) and point (0,30,40).

13) Develop a Matrix to describe the perspective projection of an object in homogeneous coordinate representation.

14) Derive the matrix for Cubic Bezier curve.

15) Why do you Parametric Cubic Curves? Develop the complete Matrix for Hermite Curve.

16) Find the coordinates at U=0.25, 0.5, and 0.75 with respect to the control points (10, 10), (15, 25), (20, 30), and (25, 5) using Bezier function. Draw your curve with given control points**.**