

Computer Graphics Assignment 1

1. What is Hardware Acceleration? Differentiate between a CPU and a GPU
2. Explain the working mechanism of a GPU.
3. List operating characteristics for following display technologies: raster refresh systems, vector refresh systems
4. Differentiate between Raster and Vector Display Technology
5. How much storage is required for each system if 24 bits per pixel are to be stored?
6. 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 9 bits per pixel in the frame buffer, how much storage (in bytes) do we need for the frame buffer?
7. How long would it take to load a 800 by 600 frame buffer with 24 bits per pixel, if 10^6 bits can be transferred per second? How long would it take to load a 32-bit per pixel frame buffer with a resolution of 1280 by 1024 using this same transfer rate?
8. Consider two raster systems with resolutions of 640 by 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 75 frames per second? What is the access time per pixel in each system?
9. A Raster system can produce a total number of 512 different levels of intensities from a single pixel composed of red, green and blue phosphor dots. If the total resolution of the screen is 1280 x 1024, what will be the required size of frame buffer for the display purpose?
10. Write short notes on Refresh rate, Aspect Ratio, Resolution, Persistence
11. If on an average, pixels are accessed from the frame buffer with an access time of 20 ns and the total resolution of the screen is 1024 x 1024, will there be a flickering effect seen on the screen?
12. How does the video controller work along with frame buffer to produce different intensities out of a single pixel on the screen?
13. A raster scan system has 14 inch by 10 inch screen with a resolution of 200 pixels per inch in each direction. If the video controller refreshes the screen at a rate of 60 frames per second how many pixels could be accessed per second and what is the access time per pixel of the screen?
14. Differentiate between Emissive and Non Emissive Display. Explain the working principles of plasma panels, LED and LCDs.
15. Explain different Hardware and Software components used for Graphical display purpose.
16. A laser printer is capable of printing two pages (size 9x11 inches) per second at the resolution of 600 pixels per inch. How many bits per second does such device require? (Assume 1 pixel = n bits)
17. Your mobile phone has a total resolution of 1920 x 1080 with 423 PPI. What is the display size of your mobile?
18. What is the fraction of the total refresh time per frame spent in retrace of the electron beam for a non-interlaced raster system with a resolution of 1024 by 800, a refresh rate of 75 Hz, a horizontal retrace time of 3 microseconds, and a vertical retrace time of 450 microseconds?
19. 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 50 frames per second?
20. Suppose we have a video monitor with a display area that measures 12 inches across and 9.6 inches high. If the resolution is 1280 by 1024 and the aspect ratio is 1, what is the diameter of each screen point?
21. What is a frame buffer? What is its role in producing color display?
22. Explain the use of Computer Graphics in Industry, Data visualization and Simulation.
23. Write an essay on the recent trends in the field of Computer Graphics.



Computer Graphics Assignment 2

1. How is the decision parameter calculated in case of Bresenham's line drawing and Mid point Circle algorithm? What is its role?
2. Explain the logic used to draw lines with negative slope with Bresenham's Line Drawing Algorithm.
3. Derive Bresenham's Line Drawing Algorithm for $|m| > 1$. How can a line with end points $A(x_1, y_1)$, $B(x_2, y_2)$ and slope less than 1 can be drawn if starting point is taken as $B(x_2, y_2)$ using BLA algorithm.
4. Derive necessary equations for drawing a circle using Midpoint Circle algorithm? How can you use this algorithm to draw a circle if the starting point is $(-r, 0)$ moving in clockwise direction?
5. Digitize a line with end points $A(-2, -4)$ and $B(-6, -9)$ using Bresenham's Line drawing Algorithm and DDA as well.
6. Digitize a line with end points $A(19, 9)$ and $B(17, 11)$ using Bresenham's Line drawing Algorithm and DDA as well.
7. Derive necessary equations for Mid point circle algorithm. Digitize a line with end points $A(11, 9)$ and $B(29, 17)$
8. Digitize a circle with a radius of 14 pixels and centered at $(-10, -12)$
9. Digitize a circle described by an equation $(x+5)^2 + (y-3)^2 = 25$
10. Digitize an ellipse with equation: $x^2/1000 + y^2/81 = 1$
11. Derive the criteria necessary to identify the condition when we leave region one and enter region two in case of Mid-point ellipse algorithm.
12. How is DDA different from BLA?
13. Write DDA Algorithm pseudo code for all eight cases.
14. How does Boundary Fill algorithm work? How is it different from Flood Fill algorithm?
15. How does Scanline Polygon Fill algorithm work?
16. What is a four and eight connected approach? What are the limitations of Boundary Fill and Flood Fill algorithm?
17. Write:
 - i) Bresenham's Line Drawing Algorithm for lines with slope less than one
 - ii) Mid point Circle Algorithm
 - iii) Mid point Ellipse Algorithm

Computer Graphics: Assignment 3

1. A point $P(20,20)$ in a circular window with its center at $(100,100)$ and a radius of 90 pixels is required to be mapped to a point in circular viewport having its at $(50,50)$ and a radius of 40 pixels. Where will the point P be placed after the transformation?
2. A triangle with vertices $A(5,2)$, $B(4,1)$, $C(6,1)$ is required to be rotated in a clockwise direction by 45 degrees about any arbitrary point $(4,4)$. Find out the final coordinate positions of the triangle after performing the desired transformation.
3. Reflect a Triangle $A(1,0)$, $B(3,1)$, $C(1,2)$ about line $y = -2x + 5$ then scale it about a fixed point $P(10,10)$
4. A triangle with vertices $A(5,2)$, $B(4,1)$, $C(6,1)$ is required to be reflected about an arbitrary line $y = 2x + 1$. Find out the final coordinate positions of the triangle after performing the desired transformation.
5. A triangle with vertices $A(5,2)$, $B(4,1)$, $C(6,1)$ is required to be rotated by 45 degrees in counter clockwise direction about i. origin and ii. line $y = 5$
6. Clip a line with end point coordinates $A(-1,6)$ $B(5,-8)$ against a clip window with its lower left corner at $(-2,-5)$ and upper right corner at $(4,8)$ using Cohen-Sutherland algorithm.
7. Derive the composite transformation matrix that reflects an object about line 'L' with necessary figures.
8. Find scaling transformation matrix to scale s_x, s_y units with respect to a fixed point $P(x,y)$.
9. Use Cohen Sutherland's algorithm to clip line $(60,50)$ $(100,10)$ against window $(50,10)$ $(80,40)$.
10. Show that 2D reflection thru x axis followed by 2D reflection thru line $y = -x$ is equivalent to a pure rotation (90 degrees) about origin.
11. Prove that scaling followed by rotation is equivalent to shearing.
12. Triangle with vertices $A(1,1)$, $B(7,1)$, $C(4,3)$ is required to be rotated about any arbitrary fixed point $(4,2)$ in a counter clock wise direction by 90 degrees. What will be the final coordinates of the triangle?
13. A point $P(20,20)$ in a window with its lower most left corner at $(10,10)$ and uppermost right corner at $(100,100)$ is required to be mapped to a point in viewport having its lower most left corner at $(30,30)$ and uppermost right corner at $(90,80)$. Where will the point P be placed after the transformation?
14. Derive a composite transformation matrix for mapping a point P in a circular window with a radius of 50 pixels and having its center at $(50,50)$ to a circular view port with a radius of 20 pixels and having its center at $(10,10)$
15. A window has its lower most left corner at $(-5,10)$ and its upper most right corner at $(35,40)$, clip a line segment that has two end points $(-20,5)$ and $(60,20)$. If a view port is defined by $(6,17)$ and $(90,80)$. Find the view port coordinates for the intersection points.
16. Reduce a rectangle with coordinates $A(0,0)$, $B(0,4)$, $C(8,4)$, $D(8,0)$ to twice its original about a fixed point $P(4,2)$ also derive a transformation matrix to convert this rectangle into a square.
17. A Triangle with vertices $A(0,10)$, $B(10,0)$, $C(-10,0)$ is required to be shifted down by 5 units, then rotate in anticlockwise direction by 30 degrees and scaled by twice its original size. What will be the final location?
18. Rotate triangle $A(0,0)$, $B(1,1)$, $C(5,2)$ about origin and about point $P(-1,-1)$ by 45 degrees in a counter clockwise direction
19. Write the series of transformations in matrix form that are needed to place the square shown in the figure A reduced to one third of its original size, into the position shown in figure B where the center of the square is at $(-2,-2)$

Computer Graphics: Assignment 4

1. Explain the issues related to 3D viewing that make 3D viewing more complex than simple 2D viewing.
2. How does 2D Clipping differ from 3D Clipping?
3. Derive the scaling transformation matrix of a point $P = (x, y, z)$ with respect to a fixed point (x_i, y_i, z_i)
4. Derive a transformation matrix for producing orthographic and oblique parallel project on the x_v, y_v plane.
5. What is the significance of a vanishing point in Perspective Projection? Explain the necessary equations responsible for producing perspective projection.
6. Find the perspective projection of a tetrahedron $A(3,4,0)B(1,0,4)C(2,0,5), D(4,0,3)$ onto a projection plane situated at 0. The center of projection should be located at -5.
7. What are different types of parallel and perspective projection?
8. What are the issues regarding drawing a spline using Bezier blending function? Explain with the necessary equations and properties
9. Explain the role of Blending function, Convex Hull and Control points used in Bezier curve.
10. Derive matrix used for forming a quartic spline using the method proposed by Bezier.
11. How is a non-planar surface formed using spline? Explain Bezier surface with equations. Explain its properties.
12. Compute the necessary coordinates for forming a Bezier curve taking four control points $P_1 (10,10), P_2 (40,40), P_3 (60,40), P_4 (80,10)$ and using five line segments.
13. How can fractals be generated? What are its properties?
14. How is 3D viewing pipeline different from 2D viewing pipeline?
15. Explain the 3D Windowing process (Window to Viewport Mapping)
16. How can objects be represented in 3D using polygon table? How is the consistency of the geometric data table checked and what are the rules for generating error free polygon tables?
17. What is a Cubic Bezier curve? Find the coordinate at $t = 0.2$ with respect to control points $(1,1), (4,6), (8,-3), (12,3)$
18. Derive equations for constructing a quadratic Bezier curve with three control points.
19. Derived equations necessary for forming a Parametric cubic curve.

Computer Graphics Assignment 6

1. In case of 3D viewing why is it required to consider illumination model? How does it aid in bringing visual realism?
2. What is illumination model? How does Phong Shading algorithm remove drawbacks of Intensity Interpolation scheme? Explain.
3. What is the effect of intensity interpolation? Explain the shading algorithm that uses this technique.
4. How is shading an object using Flat shading different from shading it using Phong shading technique?
5. What are Mach Bands and how can they be removed? Explain the Intensity interpolation scheme as proposed by Gouraud?
6. What are advantages of Gouraud and Phong shading? Explain the Normal Vector interpolation scheme as proposed by Phong?
7. What is the difference between diffuse and specular reflection? Derive an expression for computing the total intensity of a point illuminated by different light sources ambient, diffuse and specular.
8. Explain Fast phong approach. How does it differ from other shading approaches?
9. Explain Constant Intensity Shading approach by mentioning its advantages and disadvantages
10. Explain the mathematical equations used in case of Gouraud shading for interpolating intensities.
11. Explain the mathematical equations used in case of Phong shading for interpolating normals.
12. In case of Gouraud shading and Phong shading why do you think it is required to compute the average unit normal vectors?
13. What is data visualization? How can various types of data visualized?
14. What are different file formats used for representing graphical data?

Computer Graphics: Assignment 5

1. How can you detect hidden surface using Z buffer approach? What is the limitation of the Z buffer approach? Which algorithm removes this drawback and how?
2. Differentiate between Back Face Detection and A Buffer Approach for detecting visible surfaces in 3D?
3. How does the OSM approach work differently than the ISM Approaches for detecting visible surfaces in 3D?
4. Differentiate between Depth buffer and Depth Sorting Approach for detecting visible surfaces in 3D?
5. Explain the working mechanism of Back face detection algorithm.
6. Why is it required to remove hidden surfaces in 3D viewing?
7. How does hidden surface removal algorithm bring visual realism in graphical scenes?
8. What are list priority algorithms? Explain the working mechanism of Depth sorting approach
9. How does A buffer approach remove hidden surfaces? What are the limitations of Z buffer algorithm?
10. How is the Scan line approach different from z-buffer approach for hidden surface removal?

Computer Graphics Assignment 7

1. What are the common features of every graphical file format? Explain any one of the Graphics file formats that you are familiar with.
2. Why is it required to follow Graphics standards? Explain any one of the Graphics standards that is used for display purpose. What is Language Binding?
3. Explain the need for machine independent graphical languages.
4. Explain the architecture of OpenGL along with the API's used for graphical rendering of objects.
5. Explain the GLU, GLUT and GLU categories of APIs used in OpenGL for rendering Graphical objects.
6. What are different types of data structures that can be used for representing graphical objects?
7. Explain different types of color models
8. Why does a Printing-Press make use of CMYK color model? What are the characteristics of CMYK and RGB color Model?
9. What is a call back function in Open GL? How are they used?
10. What is difference between PHIGS, GKS and OpenGL?
11. Explain the graphical rendering pipeline used in OpenGL.
12. Explain the APIs use in Open GL for
 - i. Projection
 - ii. Lighting
 - iii. Input Handling
 - iv. Performing basic transformations
 - v. Drawing basic output primitives

Grade Improvement Task

Explain the use of computer graphics in simulation and business. Explain how does GPU work? Explain with a figure.
How long would it take to load a 800 by 1024 frame buffer with 24 bits per pixel, if 10^2 bits can be transferred per second? Derive midpoint circle algorithm and digitize a circle.
Write the working mechanism of Boundary Fill algorithm? How is it different from Scanline Algorithm? Reduce a rectangle with coordinates A(0,0), B(0,4), C(8,4), D(8,0) to twice its original about a fixed point P(4,2) also derive a transformation matrix to convert this rectangle into a square.
How does diffuse reflection differ from specular reflection? Derive an expression for computing the total intensity of a point illuminated by different light sources ambient, diffuse and specular. How does the ISM approach work differently than the OSM Approaches for detecting visible surfaces in 3D?
How is a non-planar surface formed using spline? Derive equations for Bezier curve. Explain its properties. Prove that scaling followed by rotation is equivalent to shearing.
How does 3D Clipping work? How can objects be represented in 3D using polygon table? How is the consistency of geometric data table checked and what are the rules for generating error free polygon tables?
How does call back function in Open GL work? How are they used? Why is it required to follow Graphics standards? Explain any one of the Graphics standards that is used for display purpose.
Explain how the use of GPU can be used for hardware acceleration? Explain the refresh logic of a video controller in case of Raster Display system with a diagram.
How does Flood fill algorithm work to fill an object? How is it different from Boundary fill algorithm? A triangle with vertices A(5,2), B(4,1), C(6,1) is required to be reflected about line $2y - 3x = -6$. Find out the final coordinate positions of the triangle after performing the desired transformations.
Derive Bresenham's line drawing algorithm drawing lines with slope less than one and use it to digitize a line with end points A(19,11) B(23,17). What is the difference between a window and a viewport? Clip a line segment with end points A(5,5) and B(120,110) against the window with its lower left corner at (10,10) and upper right corner at (100,100) using Cohen-Sutherland algorithm then transfer the clipped line segment to a viewport with its lower left corner at (-5,-8) and upper right corner at (5,10)
How does intensity interpolation scheme work? Explain with equations. How is A buffer technique different from Depth Sorting Technique for detecting visible surfaces?
Explain the logic used for forming a Quartic Bezier curve. Use the Bezier curve

equations for approximating a curve with control points $P_0(1,2)$, $P_1(2,5)$, $P_2(7,2)$ and four line segments. How can data sets be visualized?
What are fractals? Explain the perspective projection equations. Project a point P(10,2,1) on the view plane situated at (0,0,-1) and the projection reference point situated at (0,0,-4)
Along with the APIs of OpenGL, explain how perspective projection can be formed? Explain language binding and portability, what are its benefits?