Computer Graphics

Introduction & Basics

1. What do you mean by refresh buffer?
2. What is bitmap & pixmap?
3. What do you mean by raster scan? What are its disadvantage and advantage?
4. What is frame buffer?
5. What do you mean by aliasing & ant aliasing?
6. What do you mean by CGS, GKS, PHIGS, SRGP, and SPHIGS?
7. Anti-aliasing a serious problem that it produces unpleasant or even misleading visual effect / artifacts. Discuss situation where that artifacts matter and these in which they do not. Discuss various ways to minimize the effects of jaggies and explain what the cost of those remedies might be.
8. Write a short note on – Computer Art. **[CU 2006]**
9. Write a short note on – Animation. **[CU 2009, 2010]**
10. What do you mean by morphing? Discuss how linear interpolation can be used to transform a line segment into two connected line segments?
11. What is shielding?
12. Write a short note on – Application of computer graphics. **[CU 2010]**
13. Explain the working principle of CRT, LCD and plasma panel. **[SU 2015]**
14. What conventions are used in graphics monitor in defining the origin for X and Y coordinates? **[CU 2010]**

Scan Conversion

15. What is scan conversion? Write 3 drawbacks of scan conversion. **[SU 2013]**
16. Describe Basic incremental algorithm / DDA algorithm. What are its limitations?
17. Use DDA line generation algorithm to draw a line from (2,2) to (8, 6). **[CU 2014]**
18. Use pseudo code to describe the DDA algorithm for scan converting a line whose slope is between $45°$ and $-45°$ i.e. $|m| > 1$. **[SU 2011]**
19. Describe Midpoint line algorithm. What are its limitations? How the floating point calculation in midpoint algorithm be removed?
20. "The 8-way symmetry of a circle can be used to devise an efficient circle drawing algorithm" – justify the statement with a suitable algorithm. **[CU 2011]**
21. Describe Bresenham's line drawing algorithm? Compare it's performance with DDA line algorithm. **[CU 2007, 2011, 2013]**

22. Describe midpoint circle drawing algorithm? How floating point calculation be removed? **[CU 2009]**

23. Using midpoint circle drawing algorithm draw a circle with radius of 8 units and origin at (3, 4). **[SU 2015]**

24. Describe Bresenham's circle drawing algorithm?

25. Find the points required to plot the circle with center (2, 2) and radius 3 using Bresenham's circle drawing algorithm. **[CU 2010]**

26. Describe midpoint ellipse drawing algorithm? **[CU 2007, 2013]**

27. Show why the point-to-line error is always $\leq \frac{1}{2}$ for the midpoint line drawing algorithm? **[CU 2009]**

28. Find the pixels to be chosen to draw a line with end points $(0,0)\ and\ (8,4)$ using (i) DDA (ii) Midpoint (iii) Bresenham line drawing algorithm.

29. Find the pixels to be chosen to draw a circle with radius 5 using (i) Midpoint (ii) Bresenham circle drawing algorithm.

30. Find the pixels to be chosen to draw an ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$, using Midpoint algorithm.

Polygon filling

31. Write an algorithm for rectangle filling?

32. Write an algorithm for polygon filling?

33. What are the steps required to scan convert a polygonal area using scan line algorithm? **[SU 2011]**

2D & 3D Transformation

34. Write a note on: 2D transformation.

35. Discuss translation, Rotation and Scaling with respect to origin in connection with geometric and coordinate transformation in two dimensional structures? How can these represented by matrices? **[CU 2006, 2008 SU 2014]**

36. Write a note on: Composite transformation.

37. Show that, two successive rotations, scaling and translation in 2D in additive, multiplication and additive respectively. **[CU 2012 SU 2014]**

38. What is shear transformation?

39. Prove that we can transform a line by transforming its endpoints and then constructing a new line between the transformed endpoints.

40. Prove that 2D rotation and scaling commute if $Sx = Sy$ or if $\theta = n\pi$ for integral n and that otherwise they do not. **[CU 2009 SU 2011]**

41. What is the advantage of Homogenous coordinate system? **[CU 2011, 2012 SU 2015]**

42. Discuss translation, scaling and rotation in homogenous coordinate.

43. Compare between coordinate transformation and geometric transformation. **[SU 2011]**

44. "One reason that homogenous coordinate are attractive is that 3D points at infinity in Cartesian coordinate can be represented explicitly in homogenous coordinates". How can be done?

45. Consider a circle with centre with centre (0, 0) and radius 4. Suppose the circle is transformed in such a way that its circumference has become half in length and its centre has been shifted to (2, 3). Find out the underlying transformations. **[SU 2011]**

46. Discuss the concept of Inverse transformation

47. Write the general form of the matrix for rotation about a point *P(h, k).*

48. Perform a 45° rotation of the triangle *A(0,0), B(1,1) and C(5,2)* (i) about the origin (ii) about *P(-1,-1).* **[CU 2014 SU 2014 2015]**

49. Magnify the triangle *A(0, 0), B(1, 1) and C(5, 2)* to twice its size while keeping *C(5, 2)* fixed. Write down the steps to find the composite transformation matrix and compute resultant magnified triangle.

[CU 2012]

50. Describe the transformation which reflects an object about a line L.

51. Find the form of the matrix for reflection about a line L with slope m and y intercept $(0, b)$ **[CU 2012]**

52. Show that in 2D, reflection about X axis followed by a reflection through the line $y = -x$ is equivalent to a rotation about the origin. **[CU 2014]**

53. Reflect the diamond shaped polygon whose vertices are A(-1,0) , B(0,-2), C(1,0) and D(0,2) about (a) horizontal line y = x + 2 (b) vertical line x = 2 and (c) line y = x + 2.

[CU 2009 SU 2014]

54. Find the equation of the circle $(x')^2 + (y')^2 = 1$ in terms of xy coordinate assuming that the $x'y'$ coordinate system results from a scaling of a units in x direction and y units in y direction.

55. Find the equation of the line $y = mx + c$ of xy coordinate system to $x'y'$ coordinate system which results from a $90°$ rotation of the xy system.

56. Find the instance of the transformation which places a half size copy of square *A(0,0), B(1,0), C(1,1)* and *D(0,1)* so that the centre of the square is at *(-1,-1).*

57. Consider a triangle $A(4,1), B(5,2)$ and $C(4,3)$. Reflect the triangle about X-axis.

58. Consider a triangle $A(2,2), B(4,2)$ and $C(4,4)$. Rotate the triangle by $90°$ twice about the origin.

59. Consider a point $(3, 2, 1, 1)$ in homogeneous coordinate system. Find the new point after translation in (x, y, z) direction by $(-1, -1, -1)$ followed by successively $30°$ rotation about X-axis and $45°$ about Y-axis.

60. Write a note on 3D transformation. **[SU 2008]**

61. Discuss translation, scaling and rotation with respect to origin in connection with geometric and coordinate transformation in 3D structure. How these can be represented using matrices?

Viewing & Clipping

62. What do you mean by clipping? What is line clipping? **[CU 2007, 2008]**

63. Describe Cohen-Sutherland line clipping algorithm.

64. Let *R* be the rectangular window whose lower left hand corner is at $L(-3,1)$ and upper right hand corner is at *R(2,6)*. Apply Cohen-Sutherland algorithm to clip the line segments *AB* where *A(-4,7)* and *B(-2,10)*, *CD* where *C(-4,2)* and *D(-1,7)*, *EF* where *E(-2,3)* and *F(1,2)* and *GH* where *G(-4,2)* and *H(-1,7)*.

65. State the conditions for which a line will be completely clipped. Clip a line A(3,20), B(13,3) against a rectangular window whose left-bottom and top-corner are at points (5,5) and (25, 15) respectively. **[CU 2012]**

66. What is the significance of region code in the context of Cohen-Sutherland line clipping algorithm? **[CU 2011]**

67. What are meant by interior and exterior clipping? **[CU 2011]**

68. What is polygon clipping? Describe Sutherland–Hodgeman polygon clipping algorithm. **[CU 2008, 2014]**

69. Consider a convex polygon with n vertices being clipped against a clip rectangle. What is the minimum number of vertices in the resulting clipped polygon? What is the minimum number? Consider the same problem for a concave polygon. How many polygons might result? If a single polygon results, what is the longest number vertices it might have? **[CU 2009]**

70. Explain why Sutherland-Hodgeman polygon clipping algorithm works for only convex clipping regions.

Projection

71. What is projection? Mention its importance. **[CU 2010, 2014]**

72. Differentiate between perspective and parallel projection. **[CU 2010]**

73. Classify geometric projection and define each category.

74. Find the perspective projection matrix when the projection plane is normal to Z axis at $z = d$ and at $z = 0$

75. Find the perspective projection of general point p = (x, y, z) onto the projection plane $P_p = (x_p, y_p, z_p)$.

Miscellaneous

76. What is bitplane? What dpi? What is pixel?

77. What is the job of a display controller?

78. Discuss how linear interpolation can be used to transform a line segment into two connected line segments. **[CU 2007]**

79. Write a short note on – Beizer curve. **[CU 2012]**

80. In a 512×512 raster on a monochrome display with an average access rate of 200 nanoseconds / pixel, what is the refresh rate?

81. How many bits are required for a 512×512 raster with each pixel being represented by 3 bits?

82. What is rate of a 1024×1024 frame buffer with an average access rate of 200 nanoseconds / pixel on a simple color display?

83. How many pixels are there in a 1024×1024 frame buffer?

84. How many bits are required for a 24-bit plane 1024×1024element raster?

85. What is the access rate / pixel of a 4096×4096 raster having a refresh rate of 30 frame/ sec?

86. What do you mean by resolution of an image? Compute the resolution of a 2x2 inch image that has 512×512 pixels.

87. What is aspect ratio of an image? If an image has a height of 2 inches and an aspect ratio of 1.5, what is its width? If we want to resize a 1024×768 image to one that is 640 pixels wide with the same aspect ratio, what would be the height of the resized image?

88. Consider an image containing a self of 10,000 1 inch unconnected vector. Contrast the storage required for a vector display list with that for a 1 – bit raster image for a 1024×1024 bit level display to store this image – Assume that it takes 8 – bit opcode to specify vector draw, and four 10 – bit coordinates to store a vector in the vector display list. How do these numbers vary as a function of the number and size of the vectors, the number of bit per pixel, and the resolution of the raster display? What conclusion can you draw about the relative sizes of refresh memory required?