

Arab Academy For Science and Technology & Maritime Transport

College of Engineering & Technology

Computer Engineering Department



EXAMINATION PAPER – Week 7

Course Title: Computer Graphics

Course Code: CC416

Date: Thurs. Nov, 13-2014

Lecturer: Dr. Manal Helal

Time allowed: 60 mins

Start Time: 08:30 a.m.

Student's name:

Reg.# :

Question #	Marks	
	Available	Actual
Graphics Systems	4	
Colors	4	
Line Drawing	4	
Circle Drawing	4	
Ellipse Drawing	4	
Total	20	
Lecturer	Name : Dr. Manal Helal	
	Signature :	
	Date:	

MPC6/1-1

1) Discuss the differences between Raster and Vector Graphics Models, in terms of display devices types, file storage, and drawing methods.

Ans:

Raster: all pixels have values,

Display Device: Raster Scan Display, emit a value for every pixel row by row, column by column, even if there is nothing to draw

File Storage: bigger, all values for all pixels will store a value

Drawing Methods: scan the pixels matrix and display the corresponding pixel colour.

Vector: describe shapes to be drawn

Display Device: Random Scan Display Devices, for example the cathode ray tube can point to a particular pixel position to start drawing from there, no need to scan the whole matrix

File Storage: smaller, only pixels coordinate and color values in the shape are stored

Drawing Methods: Drawing primitives, using geometric equations, or other drawing directions

Colors:

[4 points]

2) Given the following RGB Color values, what are the equivalent YIQ values?

$$\text{RGB} = (62, 29, 64)$$

Use the following conversion matrix:

$$\begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0.595716 & -0.274453 & -0.321263 \\ 0.211456 & -0.522591 & 0.311135 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Ans:

$$(0.299 * 62/255) + (0.587 * 29/255) + (0.114 * 64/255) = 0.1681$$

$$(0.595716 * 62/255) + (-0.274453 * 29/255) + (-0.321263 * 64/255) = 0.0330$$

$$(0.211456 * 62/255) + (-0.522591 * 29/255) + (0.311135 * 64/255) = 0.0701$$

$$\text{YIQ} = (0.1681, 0.0330, 0.0701)$$

3) Given the following line equation:

$$y=4x - 2$$

Trace the Bresenham line drawing algorithm to fill the following table, from a starting point (2, 6) to an ending point (3, 10):

Hints:

$$p_0 = 2\Delta y - \Delta x$$

If ($p_k < 0$)

$$p_{k+1} = p_k + 2\Delta y$$

Otherwise

$$p_{k+1} = p_k + 2\Delta y - 2\Delta x$$

k	x_k	y_k	P_k
0	2	6	-2
1	2	7	0
2	2	8	2
3	3	9	-4
4	3	10	-2

Ans:

Since its obvious that we need to fix y value and calculate when to increment x, we will swap x and y input coordinates, to be from (6, 2) to (10, 3)

Since we have the line equation we can calculate Δy and Δx , taking into consideration the swapping

Generally $m = \Delta y / \Delta x = 4$, making $\Delta y = 4$ and $\Delta x = 1$, after the swapping $\Delta y = 1$ and $\Delta x = 4$

$$P_0 = 2\Delta y - \Delta x = 2 - 4 = -2 \quad \text{decision is to keep y unchanged while incrementing x (7, 2)}$$

$$P_1 = P_0 + 2\Delta y = -2 + 2 = 0 \quad \text{decision is to keep y unchanged while incrementing x (8, 2)}$$

$$P_2 = P_1 + 2\Delta y = 0 + 2 = 2 \quad \text{decision is to increment y while incrementing x (9, 3)}$$

$$P_3 = P_2 + 2\Delta y - 2\Delta x = 2 + 2 - 8 = -4 \quad \text{decision is to keep y unchanged while incrementing x (10, 3)}$$

$$P_4 = P_3 + 2\Delta y = -4 + 2 = -2 \quad \text{decision is to keep y unchanged while incrementing x (11, 3)}$$

Then swap the x, y values again to fill the table

Circle Drawing:**[4 points]**

4) Given a Circle with center at (2, 3) and radius 2, trace the mid point circle drawing algorithm for 4 points:

Hints:

$$p_0 = 1 - r$$

If ($p_k < 0$)

$$p_{k+1} = p_k + 2x_{k+1} + 1$$

Otherwise

$$p_{k+1} = p_k + 2x_{k+1} + 1 - 2y_{k+1}$$

k	x_k	y_k	p_k
0	0	2	-1
1	1	2	2
2	2	1	5
3	2	0	-
4	2	-1	-

Ans:

$$p_0 = 1 - r = -1$$

$$p_1 = p_0 + 2x_1 + 1 = -1 + 2 + 1 = 2$$

$$p_2 = p_1 + 2x_2 + 1 - 2y_2 = 2 + 4 + 1 - 2 = 5$$

decision is to keep y unchanged while incrementing x (1, 2)

decision is to decrement y while incrementing x (2, 1)

decision is to decrement y while incrementing x (3, 0)

With geometrical drawing, you will notice that at this point (3, 0) is outside the circle, because the radius is 2, then we finished this quadrant for this small circle and can just use symmetry (x, -y) to calculate next points without applying the conditions

(2, 0)

(2, -1)

(1, -2)

(0, -2)

5) Discuss the Ellipse geometric properties that were used to transform the mid-point circle drawing algorithm to a mid point ellipse drawing algorithm.

Ans:

Similar concepts with the circle-drawing algorithm are:

1. using mid-point idea to calculate if the point is inside or outside the circle or the ellipse, rather than smaller distances such as in the line drawing algorithm,
2. calculating less points and using symmetry to calculate the other points,
3. starting from (0, 0) as the origin then transforming to the given center point,

Ellipse geometric properties that changed the circle drawing algorithms are:

1. having 2 radii at the major axis and minor axis
2. having 2 foci at 2 mid points on major axis from which the total distances between them and any point on the ellipse is the same.
3. the standard ellipse form considers the major and minor axes to be parallel to x-axis or y-axis, a non standard ellipse form is a transformation of the standard calculations.
4. the symmetry of the ellipse is on the quadrants not on the octants
5. every quadrant is divided into 2 regions, in which the first region fix one coordinate and calculate the other, then in the other region we reverse and fix the other coordinate and calculate the first, based in which coordinate we are processing.