

BCT 2405 Computer Graphical systems:

Please attempt these questions in the assigned groups and submit before stipulated deadline. The deadline is Midnight of **22th june 2020** . Submission is via the email jkuatnotes@gmail.com. Indicate the subject as BCT 2405 then Group number e.g RE: BCT 2405 Group 1 . Ensure that the write up is well done and all the members who did the work are the only ones listed

Any work submitted after the deadline will not be marked and will earn no mark ...not even a zero

NB: In addition to having all programs in the write up , also attach all the programs as Text file such as notepad for ease of us running them as we mark

Ensure that the programs have comments that aid us understanding your logic.

For each given program give the code and the output in your submission

For easier understanding you can refresh through reading of the attached chapters of Hearn, Baker and Carithers book called Computer Graphics with Open GL

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Group 1

1. The French engineer Pierre Bézier while doing the design of Renault automobile bodies , he came up with Bézier-Spline Curve Functions .

Describe them , How are they implemented in Open GL .

2. With aid of an example illustrate the 2D and 3D Bézier-Spline Curve in Open GL

Group 2

1. using OpenGL, write a program that draws a circle using Bresenham circle drawing algorithm: The parameters for the circle are as follows – the radius should be 4 Centimeters and the starting point coordinates are (3,5)
 - a. Draw the same circle at start coordinates (-2,-1) and fill it with Cyan shade (hint RGB #00ffff)
2. Using a working example , Write an OpenGL routine to split a concave polygon, using the vector method as described in Chapter 2 of our reading Text (**Hearn, Baker and Carithers book called Computer Graphics with Open GL**)

Group 3

1. Using OpenGL draw a filled polygon with the following dimensions (8,4;2,4;0,8;3,12;7,12;10,8) hint (GL POLYGON function) might be useful
 - a. Write a function to fill the polygon above in Red (#FF0000.)
 - b. write program to scale up (scaling) the polygon by a factor of 2
 - c. Write a procedure to fill the interior of a given

polygon with shades of asterisks

Group 4

1. using OpenGL, write a program that draws a circle using Midpoint circle drawing algorithm: The parameters for the circle are as follows – the radius should be 5 Centimeters and the starting point coordinates are (0,3)
 - a. write a program to rotate the Circle 90 degrees and fill it with purple shade (hint RGB #800080)
2. Using a working example , Write an OpenGL routine to split a concave polygon, using the rotational method as described in Chapter 2 of our reading Text (**Hearn, Baker and Carithers book called Computer Graphics with Open GL**)

Group 5

1. Using OpenGL, write a program that draws a line using Gupta-Sproull algorithm line drawing algorithm: The parameters for the line are as follows –the starting point (20, 10) and ending coordinates (30, 18).
 - a. What is Line rasterization and the anti-aliasing
 - i. Describe using your line drawn above how is Gupta-Sproull anti-aliasing
2. Using OpenGL, write a program that draws a line using Xiaolin Wu's line algorithm line drawing algorithm: The parameters for the line are as follows –the starting point (15, 10) and ending coordinates (23, 18).
 - i. Demonstrate using the example the Xiaolin Wu's line algorithm does anti-aliasing

Group 6

Next week there is freshers Bash in Juja , they have heard you are the computer graphic Guru. The organizers want a banner written : **JKUAT ROCKS** (the words **JKUAT** in green and **OCKS** in Red)they also prefer a brown background (*might be ugly but client is always right!*)

- a. Demonstrate how this can be achieved Using OpenGL(you may use TrueType and OpenType fonts if need be)
- b. If your client complains that the text size is small how would you increase? please demonstrate with a working code

Group 7

A survey was carried out in Gachororo about youth preference on fruits. 150 youth were interviewed about their fruits of preference as follows

Fruit:	Ovacado	Orange	Banana	Kiwifruit	Mangos	Grapes
People:	36	31	11	26	40	6

- a) Write an OpenGL program that displays the bar chart. Input to the program is to include the data points and the labeling required for the x and y axes. The data points are to be scaled by the program so that the graph is displayed across the full area of a display window. (reading Chapter on Graphics Output Primitives in the book will help)
 - i. Ensure that each bar has the color that closely resembles the ripe fruit under consideration
 - ii. label your x axis as well in black and Y axis in Red

- b) Suppose we wish to start the graph at point (5,5) on the display window, demonstrate how this would be achieved using your question case example

Group 8

A survey was carried out in Gachororo about average youth daily earnings and reported as follows

Day:	Mon	Tue	Wed	Thurs	Fri	Sat
KSh:	500	850	600	570	1000	1020

- a) Write an OpenGL program that displays the line graph . Input to the program is to include the data points and the labeling required for the x and y axes. The data points are to be scaled by the program so that the graph is displayed across the full area of a display window. (reading Chapter on Graphics Output Primitives in the book will help)
- In the first case the data points are to be displayed as **asterisks** joined with straight-line segments, and the x and y axes are to be labeled according to input specifications
 - In the second case , increase the width of the line to 2 and use small boxes as data marks
 - In the third case the draw the line using the blue color and data points as small circles in red and the chart background to be cream (#FFFDD0)

Group 9

Using the data provided in Question for group 7 , Write a program to draw a pie chart (the pie chart should represent the percentages) .

- i. The output of the program should have the name of the pie chart, and the names of the intervals. Each section label is to be displayed outside the boundary of the pie chart near the corresponding pie section.
- ii. Redraw the same Pie chart using the section colors that closely resemble the ripe fruit and put the label and the percentage near its corresponding section
- iii. How would you convert the chart background to gray scale using OpenGL code? demonstrate how this can be achieved

Group 10

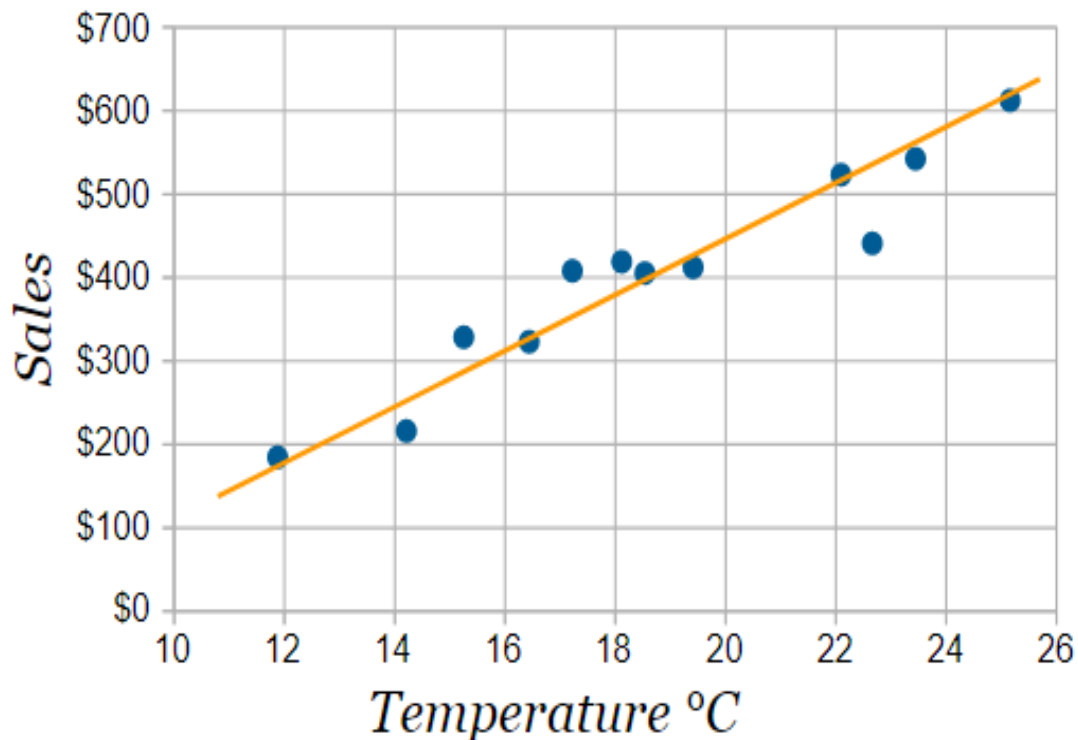
- a) Write a working algorithm for implementing a color lookup table that we discussed in class
- b) The local ice cream shop keeps track of how much ice cream they sell versus the noon temperature on that day. Here are their figures for the last 12 days: (source <https://www.mathsisfun.com/data/scatter-xy-plots.html>) D

<i>Ice Cream Sales vs Temperature</i>	
Temperature °C	Ice Cream Sales
14.2°	\$215
16.4°	\$325
11.9°	\$185
15.2°	\$332
18.5°	\$406
22.1°	\$522
19.4°	\$412
25.1°	\$614
23.4°	\$544

18.1°	\$421
22.6°	\$445
17.2°	\$408

Using OpenGL draw the following based on the above data, attempt to replicate the output shown below where the data points are in blue #0000FF and the line of best fit or trend line is in orange (#FFA500). Ensure that your axis are also labeled

Draw the line of best fit using the DDA algorithm we discussed in class.

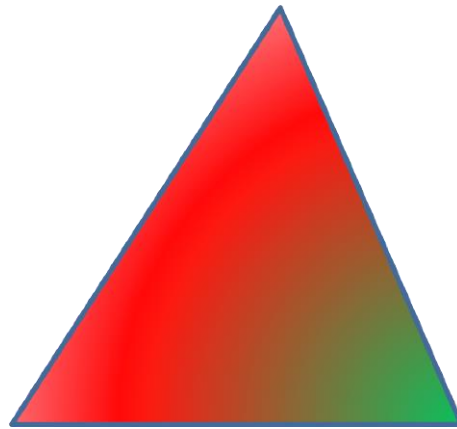


Group 11

- b) Suppose you have a system with a 12 inch by 14 inch video monitor that can display 120 pixels per inch. If memory is organized in one byte words, the starting frame buffer address is 0, and each pixel is assigned 4 bits of storage, what is the frame buffer address of the pixel with screen coordinates (x, y)?
- c) Using OpenGL Draw a figure with coordinate points A(0, 4), B(3, 4), C(4, 0), D(0, 0).
- Apply the translation with distance 2 towards X axis and 2 towards Y axis. Obtain the new coordinates of the square.
 - The translated figure should have a green border line and cream inner shading
 - write an openGL program to rotate the translated figure on Rotation angle = $\theta = 30^\circ$ and show the output

Group 12

- a) Using a working example, prove that the multiplication of transformation matrices for each of the following sequences is commutative:
- Two successive rotations.
 - Two successive translations.
 - Two successive scalings.
- b) Using openGL, draw a triangle with vertices (-1,6 ; 2,0; -4,9)
- Write a program
- Rotate the triangle with a rotation of -45 degrees
 - Vary the shading of the rotated triangle to have a mix of the three primary colors (Below is a hint of how the color shades should look like in the rotated triangleAny color shade fashion will suffice).. a soft-fill algorithm can achieve this



Group 13

- a) Using OpenGL, Write a boundary-fill procedure to fill an 8-connected region of your choice.
- b) Use the midpoint method and symmetry considerations to scan convert the parabola

$$y = 50 - x^2$$

over the interval $-5 \leq x \leq 5$.

Show the working of the method and implement it using OpenGL

(read the chapter on Implementation Algorithms for Graphics Primitives and Attributes)

Group 14

1. How would you set the color of OpenGL display to green and change the fill color to have texture? Do a demonstration example with the circle with parameter starting coordinates

(-3,1) and radius of 4 cm and texture type of the circle of your choice (mention in the write up what you used)

Group 15

1. Using Open GL , draw an Ellipse with centre as (-2,2) given by

$$\frac{(x-2)^2}{36} + \frac{(y+1)^2}{25} = 1$$

- a. Apply the flood-fill algorithm to fill the interior ellipse with cyan Color
- b. Apply shear parameter 2 on X axis and 2 on Y axis and find out the new coordinates of the Ellipse drawn above and plot the resulting figure using openGL
- c. Develop an algorithm for antialiasing elliptical boundaries above
- a. Using Open GL write a program to boundary fill of the the ellipse in (b) with color Green

Group 16

1. Describe using a working examples, the relationship between the following coordinate systems in the graphics (OCS - object coordinate system WCS - world coordinate system VCS - viewing coordinate system CCS - clipping coordinate system NDCS - normalized device coordinate system DCS - device coordinate system)

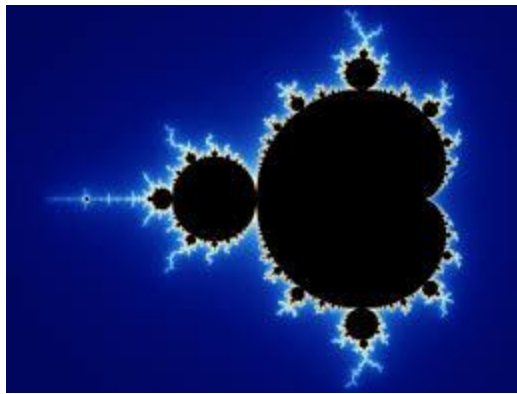
b) Why do we need homogeneous coordinates?

2. Our good Classrep Yvonne , is a fan of Chess. He has lost his chessboard. Write a program in OpenGL that implements a 8 by 8

chessboard. Kimani prefers brown and white color instead of black and white . Help Yvonne out!

Group 17

1. Discuss the concept of Mandelbrot Set as used in Fractal geometry methods in computer graphics
2. How would the image below be drawn using Open GL ..Describe the how using the code



Group 18

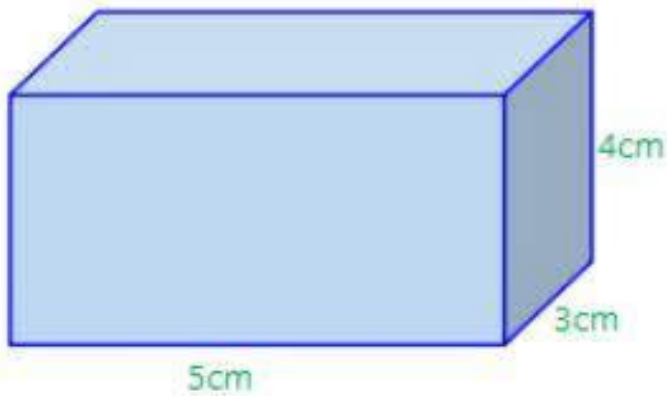
1. Describe two ways of generating Generating Polyhedra in OpenGL namely using 1/. surface tessellation (Platonic solids) and 2./ using the Glut libraries (GLUT Library of Polyhedron Functions)

2. Illustrate with Open GL how to construct the Pot...the famous PoT

[https://www.sjbaker.org/wiki/index.php?title=The History of The Teapot](https://www.sjbaker.org/wiki/index.php?title=The_History_of_The_Teapot)

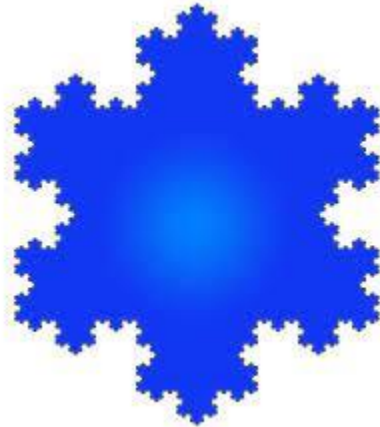
Group 19

1. Illustrate with working example the concept of 3D clipping and viewing
2. Illustrate how the Cohen-Sutherland and Cyrus-Beck are applied in 3D clipping of the image below using Open GL



Group 20

1. Describe the Concept Of Koch Curve as applied in fractal geometry methods
2. Illustrate how one can generate the famous Koch 2D snowflake shown below in OpenGL



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