CAP-5701 Computer Graphics

Assignment 1

FIU KF School of Comp. & Info.

Sciences

1 Exercises

1. (10 points) Consider three different raster systems with resolutions of 800 by 600, 1280 by 960, and 1680 by 1050. What size frame buffer (in bytes) is needed for each of these systems to store 16 bits per pixel? How much storage is required for each system if 32 bits per pixel are to be stored?

2. (5 points) 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. (10 points) List the statements needed to

   - set up an OpenGL display window whose lower-left corner is at pixel position (75, 200) and has a window width of 200 pixels and a height of 150 pixels.
   - and draw a rectangle at the middle of display window with the aspect ratio equal to the aspect ratio of the display window. The area of rectangle must be a quarter of the display window area.

4. (5 points) Explain what is meant by the term "OpenGL display callback function".

5. (10 points) Split a convex octagon given by the list of vertices V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8 into a set of triangles and give the vertices that make up each triangle.

6. (10 points) First prove that the pentagon with the following vertices is concave. Then, convert it into a set of convex polygons:

$$A_1 = (2, 2), A_2 = (5, 3), A_3 = (4, 7), A_4 = (-1, 6), A_5 = (1, 5)$$

2 Programming Assignment (50 points)

For this programming assignment, you need to modify the program posted on Canvas. The given program provides a graphical tool to find all the roots of equation $f(x) = g(x)$ where x varies in a given interval $[min, max]$ and f and g are two functions in this range (for illustration, f is set to the formula of a parabola and g specifies a sine-wave).

2.1 Program Functionality

This program first draws the plot of both functions f and g on the display window (f is drawn with the opaque red color, and g is drawn with semi-transparent blue color). Then, it reacts to the user's left-clicks by searching the area nearby the mouse pointer to find the intersection point of the two plots. To find the intersection point, the program searches for pixels colored with a blend of red and blue.

2.2 What You Need to Do

Your first task is to use this program to find all the roots of the following equation:

$$\cos(x) - x^2 + 4x = 0$$

The second task is to find all the roots of the following equation:

$$x^3 - 3x^2 - 6x + 2 = 0$$

Your calculation errors must be less than **0.1 units**.

3 Deliverables

Submit a zip file containing the following items:

- A pdf file containing your answer to the exercises.
- The source files of your program for the programming assignments (.cpp files)
- A short mp4 video (less than 1 minutes) illustrating how to interact with the program to calculate the roots.