EECS 487 W10 Lab 0

15 problems totaling 30 points.

Due: Tue, 12 January 2010, 3:10 pm, in class

Review the grading policy page of the course web site.

You are allowed to consult both online and offline sources, including humans, to help solve these problems. If you do consult outside sources, i.e., other than yourself and the teaching staff, you MUST cite them. You do not need to cite the teaching staff nor the textbooks nor the lecture notes. These are the only exceptions. What you turn in must be your individual work. Your classmates can give you an idea on how to approach a problem, but they cannot give you any solution to these problems. If you find an online solution to any of these problems, you are allowed to consult them, but not to use them verbatim. You must phrase your solution in such a way that shows you have understood the problem and solution. Violation of any part of the above policy will be a violation of the Honor Code. If you turn in a handwritten solution, please write legibly. Illegible scribble will earn zero points.

To incorporate publicly available code in your solution is considered cheating in this course. To pass off the implementation of an algorithm as that of another is also considered cheating. For example, if the assignment asks you to implement sort using heap sort and you turn in a working program that uses insertion sort in place of the heap sort, it will be considered cheating. If you can not implement a required algorithm, you must inform the teaching staff when turning in your assignment, e.g., by documenting this in your writeup.

1. Intro to OpenGL and GLUT

Open *lab0.c* and examine it.

1.) (2 pts) **Point Drawing.** Locate `/* Task 1: draw 2 points */` and fill in the correct OpenGL draw mode.

2.) (2 pts) **Line Drawing.** Locate `/* Task 2: draw line */` and change the previous part to draw a line instead. Leave the code in line drawing mode.

3.) (2 pts) **Line Thickness.** Locate `/* Task 3: ... */` and set the line thickness to 3 pixels, the default is 1. Be sure to do so before the line is drawn.

4.) (2 pts) **Quadrilateral (Square) Drawing.** Locate `/* Task 4: ... */`. Make it so that a red square is drawn at each end of the line. Each square should be centered on an endpoint and have a side length of `2*ENDHWIDTH`.

5.) (2 pts) **Draw Coordinate Axes.** Locate `/* Task 5: ... */`. Draw a 1-pixel thick green line along the x- and y-axes. Be sure that the axes stretch from edge to edge on the screen.

6.) (2 pts) **GLUT Idle Function.** Locate `/* Task 6: ... */`. Register the provided function `refresh()` to be called when the system is idle.

7.) (2 pts) **Polygon Fill Mode.** Locate `/* Task 7: ... */`. Set the polygon drawing mode to draw lines for the front face instead of filling the polygon.

8.) (2 pts) **Polygon Fill Mode.** Locate `/* Task 8: ... */`. Draw a filled blue square centered at the origin with side length 10. It only should be filled; the endpoints remain drawn as lines instead of filled.

What to turn in: all of your work should consist of modifications to the file `lab0.c`. With the hard copy turned in on 12 Jan, include the output of running the following command on either Linux or MacOS X:

```
unix% openssl sha1 lab0.c
```

Remember that once you have run that command you *must not* modify file `lab0.c` any more. You then need to have either Ari or Carlos check this part of your assignment in person either on Thu, 14 Jan or Fri, 15 Jan. If the SHA1 they compute on your `lab0.c` is different from the one you turned in, your assignment will be considered late by as many days.

2. Linear Algebra

1.) (2 pts) **Angle Between Vectors.** What is the angle, in radians, between $\vec{u} = \langle 1, 2, 3\rangle$ and $\vec{v} = \langle -5, 8, -2\rangle$? What is it in degrees?

2.) (2 pts) **Linear Equations With Matrices.** Given the following system of equations

$$2x + 6y + 2z = -2$$
$$x + 9y + 3z = 1$$
$$-3x - 3y + z = -1$$

find all solutions or demonstrate that none exist. In order to solve this set up the constraint matrix and then use its inverse (by hand or no credit) to find solutions.

3.) (2 pts) **Projection.** Given the two vectors $\vec{u} = \langle -3, 2, 4\rangle$ and $\vec{v} = \langle 2, 0, -1\rangle$, find the component of $\vec{u}$ orthogonal to $\vec{v}$.

4.) (2 pts) **Triangle Area.** Given the two vectors $\vec{u} = \langle -3, 2, 4\rangle$ and $\vec{v} = \langle 2, 0, -1\rangle$, find the area of the triangle with edges $\vec{u}, \vec{v}$, and $\vec{u} - \vec{v}$.

5.) (2 pts) **Matrix Multiplication.** Find $\hat{M}\hat{N}$ and $\hat{N}\hat{M}$ given $\hat{M} = \begin{pmatrix} 1 & 7 & -3 \\ 2 & 2 & -4 \\ 1 & 0 & 7 \end{pmatrix}$ and $\hat{N} = \begin{pmatrix} -5 & 6 & 10 \\ 3 & 5 & -7 \\ 6 & 4 & 2 \end{pmatrix}$. Show all work and triple check the answers; it is all or none here.

6.) (2 pts) **Vector (as a Matrix) Multiplication.** Given the two vectors $\vec{u} = \langle -3, 2, 4\rangle$ and $\vec{v} = \langle 2, 0, -1\rangle$, find $\vec{u}^T\vec{v}$ and $\vec{u}\vec{v}^T$.

7.) (2 pts) **Plane.** Let there be three points $\vec{u} = \langle 1, 2, 3\rangle, \vec{v} = \langle 3, -2, 7\rangle$, and $\vec{w} = \langle -2, -2, 4\rangle$. Find the equation of the plane containing them.