COSC 4370 – Homework 2

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October 2021

1 Problem

This assignment requires the use of OpenGL to reproduce the three provided images as well as create a fourth image. The fourth image must make use of OpenGL's transformation mechanism with at least one instance of nested glPushMatrix methods. At least one triangle must be rendered by feeding the coordinates directly using OpenGL immediate mode in the fourth image. In addition to class materials, this page (https://math.hws.edu/bridgeman/courses/324/s06/doc/opengl.html#basic) was used as reference in becoming familiar with OpenGL functions.

2 Method

The functions problem1(), problem2(), problem3(), and problem4() required modification for the image reproductions and the fourth image respectively. No other part of the provided code needed edits. Problem1 produces a ring of 10 teapots circling around the z-axis. This was achieved using a single loop and OpenGL functions glTranslatef, glRotatef, and glutSolidTeapot. Problem2 produces a staircase comprised of stacked cubes. The method for this recreation required the use of nested loops, glTranslatef, and glutSolidCube. Problem3 produces a pyramid of stacked teapots. This reproduction was solved via nested loops and using glTranslatef and glutSolidTeapot.

For problem4, the image created is a 3-tier birthday bundt cake complete with lit candles around the top and a chocolate shard garnish protruding along the middle tier. The function for this image also uses glTranslatef, glRotatef, glutSolidCube, and both nested loops and a single loop. In addition to these functions used in the previous problems, problem4 also uses another shape glutSolidTorus, the function glBegin(GL_TRIANGLES) to feed triangle coordinates, and nested glPushMatrix() methods.

3 Implementation

3.1 Problem1

To create the ring of teapots, a loop iterating 10 times would create a teapot, move into position for the next teapot via glTranslationf, and rotate to the proper angle for the

next teapot placement. Because the picture contains 10 teapots, dividing 360º by 10 gave the proper rotation angle 36º so that the teapots would lay uniform. Then, after some trial and error with the glTranslatef values, the values to space them across the ring properly were (-.25,0.75,0). After exiting the loop, the glTranslatef repositions on the x-axis so that the tri-color axis is centered in the ring.

3.2 Problem2

In order to reproduce the staircase for problem2, two loops nested together were necessary. Because there are 15 steps, the outer loop iterates 15 times, while the inner loop iterates up to the current value of the outer counter. This is because the outer loop moves vertically down the height of the staircase while the inner loop lays horizontal rows of cubes creating each step. Each row must be longer than the previous row, so the number of iterations is dependent on the counter value of the outer loop. The steps are comprised of cubes made using glutSolidCube. Because the height of the steps is not a full cube's height, the stacks of cubes are placed overlapping to create this effect. After exiting the loops, the axis is recentered using glTranslatef.

3.3 Problem3

To create the teapot pyramid in problem3, a similar strategy to problem2 is used. Starting at the tip of the pyramid and moving down and across with nested loops, glTranslatef is used to position each teapot. Through trial and error, the ideal vertical translation for the outer loop was found to be (-.4,-.4,0) and for the horizontal translation (.8,0,0). As with the previous problems, a final translation after the loops was used to recenter the axis.

3.4 Problem4

The creation of the 3-tier birthday bundt cake requires several steps. First, a matrix is pushed to the stack via glPushMatrix in which the cake layers are positioned and placed. Because the default positioning for the shape used, glutSolidTorus, looks like an aerial view of the "bundt cake", a 90º rotation about the x-axis was necessary before placing any of them. Three of these glutSolidTorus in decreasing sizes were layered. Then, another matrix is pushed and used to place the candles. In this section, a 90º rotation back around the x-axis and a translation to the top rim of the "cake" create the proper positioning for the candle placement. The candles are created by stacking solid cubes like the staircase in problem2 and but rotating around the ring of the top layer similar to the teapot ring in problem1. The inner loop places cubes in rotation across the candles, and the outer loop translates vertically to position the next row of cubes. When the candles are complete, a ring of small solid spheres is added slightly higher to appear hovering over each "candle" to represent the candle flames. The matrices are popped from the stack one by one. Finally, the chocolate shard garnish is created using triangles whose coordinates are fed directly using immediate mode. The garnish is comprised of 4

triangles that appear to be bursting from the second layer of "cake" in celebration of my birthday which was last week.

4 Results

The results are shown in .png files labeled problem1, problem2, problem3, and problem4. They can also be seen below.