

CSE328 Fundamentals of Computer Graphics: Programming Assignment TWO

Programming Assignment TWO (10% of the total course grade, 200 points in total are used for the grading scheme, due at 2:10pm on Wednesday, March 28, 2012)!

Please note that, all programming assignments/projects in this course will be graded based on (1) the correctness of program functionality, (2) the efficiency of program execution, and (3) the quality of programming codes (i.e., whether they are understandable with proper comments)!

This programming project focuses on applying three dimensional graphics techniques to display and edit geometric shapes in common use such as cube, tetrahedron, sphere, cylinder, cone, ellipsoid, torus, etc. Please write an OpenGL program that implements the drawing of polyhedral objects and quadrics primitives. Your program should be able to (1) display wireframe objects, (2) display flat-shaded solid objects, and (3) allow users to interactively translate and scale/zoom the displayed objects. In particular, the entire project must consist of the following components as far as the system functionalities are concerned:

(1) (10 points) First refer to Figure 13-1 (on Page 396 in our textbook) and read the technical contents of Chapter 13.1 and Chapter 13.2 in the book of Computer Graphics with OpenGL (our required textbook for the course). Second, display a cube object similar to the one illustrated in Figure 13-1 of our textbook.

(2) (10 points) Display a tetrahedron object similar to the one illustrated in Figure 13-1 (Page 396) of our textbook.

(3) (30 points) (a) Carefully read the handout prepared by the instructor and fully understand its detailed technical contents (note that, the handout is a hardcopy of Pages 95-102 from the book: OpenGL Programming Guide Fifth Edition: The Official Guide to Learning OpenGL, Version 2); (b) Pay special attention to Figure 2-17 in the handout; (c) (10 points) Based on OpenGL program examples documented in the handout, write a OpenGL program to display an icosahedron of the sphere (i.e., a 20-polygon representation of the sphere); (d) (10 points) Subdivide your icosahedron once and display an improved 80-triangle approximation of the sphere (please refer to Figure 2-17); (e) (10 points) Further subdivide your 80-triangle approximation of the sphere and display a 320-triangle approximation of the sphere (i.e., subdivide your icosahedron twice).

(4) (30 points) Read the second half of the handout (note that, it is a hardcopy of Pages 515-524 in the book: OpenGL Programming Guide Fifth Edition: The Official Guide to Learning OpenGL, Version 2) and pay special attention to the drawing instructions of spheres and cylinders as well as the OpenGL program Example 11-4 on Pages 521-524. Display a sphere, a cylinder, and a cone based on

the program `quadric.c` shown in the handout. It may be noted that, similar examples can also be found in Chapter 13.6 (Pages 401-407) of our required textbook.

(5) (60 points) Based on (3) explained above, generalize your sphere drawing program to display an ellipsoid. In particular, your new ellipsoid drawing program should be capable of displaying a 20-triangle approximation, a 80-triangle approximation, and a 320-triangle approximation for the same ellipsoid, in analogy to (3) (Hint: refer to Pages 398-400 in our textbook (Computer Graphics with OpenGL) for the parametric equation of an ellipsoid).

(6) (60 points). Based on the idea (explained above) currently used to implement functionalities (1)-(5) above, draw a torus (Hint, refer to Pages 398-400 in the textbook for its parametric equation and use polygons to approximate the torus). Although you are free to select the number of polygons to be used to approximate the torus, I suggest that you sample a continuous torus using at least $21 \times 21 = 441$ different points in order to better approximate a torus. Note that, the display quality should be reasonably good!

Please note that this assignment deadline is at the start of our lecture at 2:10pm on Wednesday, March 28, 2012!!!

The project submission is done electronically. Please note that, CSE328 TA will announce the e-submission procedure in class during the next three weeks!!! After submitting your programming assignments/projects via e-submission, you must also write and submit a hard-copy one-page (or two-page) document explaining in details how we can execute you program and verify the above functionalities properly!