CCSI 3161 Assignment #2

Objectives: To develop an understanding of OpenGL transformations and projections, along with the display of geometric objects.

Due date: Nov 6th, 11:59pm.

Hand in: Electronic submission of entire Visual C project (source, compiled, project files, etc.) using dal.ca/brightspace. Please zip up your whole project directory and submit the zip file.

Note, before beginning your assignment, please read:

1. The coding style guideline.
2. The policy on plagiarism.

General Comments:

If you do decide to code on your own machine, you will need to port, re-compile and test your code on the Faculty's Windows machines prior to handing it in (if we can't compile it and run it, we can't mark it). *Marks deducted otherwise!*

Although we use platform independent libraries, please be warned that it will still require some amount of effort to port your code.

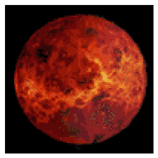
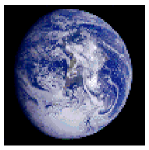
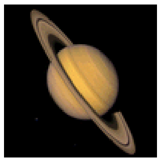
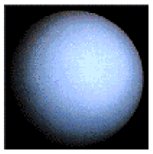
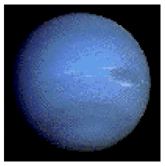
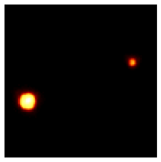
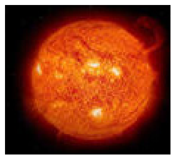
In this assignment you do not have to handle a window re-shape.

You must use the built-in OpenGL transformation commands to rotate, scale and move your objects in this assignment. You should also use depth buffering and double buffering.

The Hitch Hiker's Guide to the Planets [22 marks total]:

(i) Solar System [5]

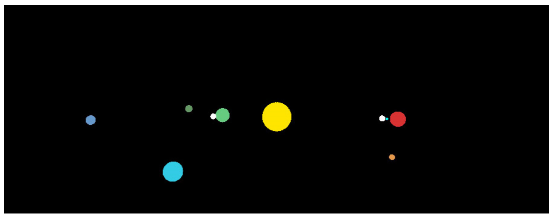
Construct a plausible solar system which has the following objects:

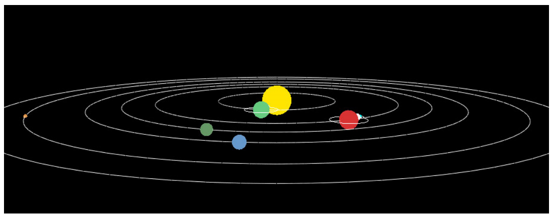
				
Mercury	Venus	Earth	Mars	Jupiter
				
Saturn	Uranus	Neptune	Pluto	The Sun

Your solar system doesn't need to be physically accurate, but please make some effort to represent it plausibly. For example, make Pluto smaller than the other planets, and make Jupiter the largest. Also make sure they are in the right order in terms of their distance from the sun. Do your best to color the planets faithfully but you don't need to texture map them.

The planets should all orbit around the sun (at different speeds) as they move. In addition, you should have a moon orbit the earth. The user can also toggle all orbital paths (rings) to be seen or unseen by pressing the 'r' key. Use GL_LINES to draw the circle paths when on.

Here is an example of what it might look like (but the number of planets, their sizes and color will be somewhat different) :

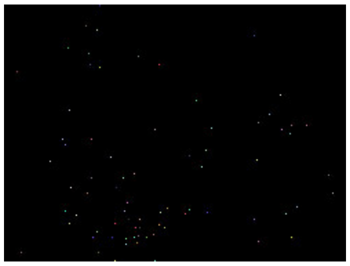




Hint: you can use gluSphere to draw a sphere, or there is source code on the assignment webpage called 'earth.c' that constructs a sphere. It's up to you what you prefer to use.

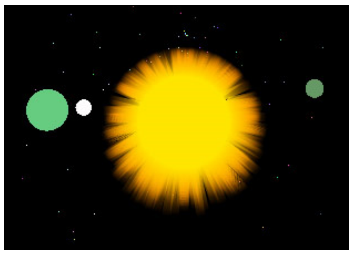
(ii) Stars [1]

Draw random star points in 3D outside of the solar system. Make the stars twinkle with randomly changing colors. The user can toggle the stars on and off by pressing the ‘s’ key. Here’s what they look like:



(iii) The Sun’s Corona [3]

Give the sun a fiery corona. Use a number of semi-transparent lines that begin just inside the sun and stretch outwards, becoming transparent at their tips. The position of the lines at the surface should be random, and all the lines should point outwards from the center of the sun. At each frame of animation the random position/direction of the line should change. That will give it the fiery appearance. It should look similar to this:



The user can toggle the corona on and off by pressing the ‘c’ key.

Hints:

1. You only need to make the lines lie on the XY plane.
2. Make the color of the lines the same as the sun at the end of the line that is touching the sun. Then you can make the tips of the lines a different color.
3. You can also experiment with the line width.
4. You should draw transparent objects last or you might get strange results when depth buffering is turned on.

(iv) Starship Enterprise [4]

Read in the file 'enterprise.txt'. It contains vertices that look like:

```
v 0.242636 0.170825 -0.0272018
v 0.269521 0.170825 -0.0192831
v 0.269521 0.170825 0.195895
…
```

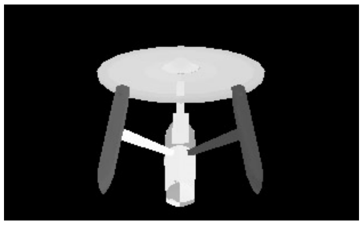
Each 'v' represents a vertex its 3D coordinates.

And, at the end of the file are faces that look like:

```
f 29 30 31
f 29 33 31
f 32 31 33
…
```

These faces are just triangles. The three numbers refer to the three vertices of the triangle (ordered from the start of the text file).

For the model file see: www.cs.dal.ca/~sbrooks/csci3161/assignments/index.html



This is just a big collection of triangles. You need to read in the vertices, and the triangles (which are a set or 3 vertex numbers). Then, you just need a big for loop to display each triangle separately.

Place the enterprise just below and in front of the camera at an appropriate scale.

Hints:

1. Don't panic.
2. You can increase each triangle's color from (1/1989) to (1989/1989), if you think the enterprise looks too flat using all one color. But that is optional

(v) Camera Control [2]

Allow the user to control the position of the camera (at the enterprise) with keyboard keys:

GLUT_KEY_PAGE_UP	:	moves the camera forward
GLUT_KEY_PAGE_DOWN	:	moves the camera backward
GLUT_KEY_ UP	:	moves the camera up
GLUT_KEY_ DOWN	:	moves the camera down
GLUT_KEY_RIGHT	:	moves the camera right
GLUT_KEY_ LEFT	:	moves the camera left

The user can hold down a key to continuously move in a direction, so you might want to use glutKeyboardUpFunc (which tells you when the user has released a key) as well as glutKeyboardFunc (which tells you when a key has been pressed).

Use perspective projection with gluPerspective and use gluLookAt to position the camera.

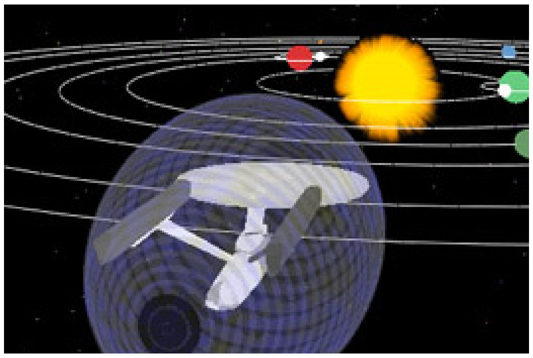
You don't need to tilt the enterprise in the direction that it moves (but it's a nice effect!).

Hint:

1. Use glutSpecialFunc(specialKeys) to register a callback function for the special keys.

(vi) Shields [2]

Make a shield around the enterprise. The shield should be semi-transparent and the color of the shield should change randomly (a little bit to make it shimmer). The user can toggle the shield on and off by pressing the 'k' key.



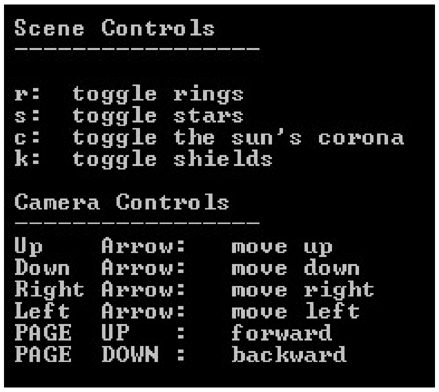
Hints:

1. **1.** This is just a sphere like the planets which is stretched in one direction, and has transparent vertices.
2. **2.** You should draw transparent objects last or you might get strange results when depth buffering is turned on.

(vii) Your own invention [5]: Think up some additional feature(s) for your program. It will need to be something special to get full marks. **Add a readme file that states exactly what your inventions are and how to use them.**

Keyboard controls [0]

Use printf to dump out a listing of all the keyboard key functions that you are supporting. Get the keyboard controls working.



```
Scene Controls
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r:  toggle rings
s:  toggle stars
c:  toggle the sun's corona
k:  toggle shields

Camera Controls
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Up    Arrow:   move up
Down  Arrow:   move down
Right Arrow:   move right
Left  Arrow:   move left
PAGE  UP    :  forward
PAGE  DOWN  :  backward
```