January 2023 CSE 410 - Computer Graphics Sessional
Offline - 1
Assignment on OpenGL

Deadline: 20 June 2023, 11:45 PM

Task 1 : Analog Clock

- Design an analog clock with 3 hands; hour, minute, and second.
- Use your design sense to make the clock look better. (e.g. color gradient etc.)
- There should be a pendulum moving. It should have a period of 2 seconds. Its movement should follow the laws of **physics**. You may find this link useful.

Please see the sample `clock.exe` (windows) / `clock.out` (linux) file.

Bonus

1. Show current time in the clock
2. Top 3 designs in the class would be recognized.

Task 2 : Magic Cube

- The magic cube makes a transition between a sphere and an octahedron.
- Pressing the following keys will change the shape:
  `.` (dot) – sphere to octahedron
  `,` (comma) – octahedron to sphere
- You should draw only one triangle, one cylinder segment and one sphere segment, and then use transformations (translation, rotation, scaling) to put them in the right places.
- Try to make sure the surface stay smooth where any triangle, cylinder segment or sphere segment touch.
- The fully sphere state of the magic cube can be inscribed into the fully octahedron state so that the sphere touches the faces of the octahedron as shown in Figure-1.
- *You need to do a fair bit of geometry for this task.*

Please play with the sample `magic_cube.exe` (windows) / `magic_cube.out` (linux) for clarification.

Hint

- An octahedron has 8 triangular faces, 12 edges and 6 vertices. You need to draw cylinder segments in place of the edges and sphere segments in place of vertices.
- The faces are equilateral triangles. The base triangle that you draw should have its vertices at $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$.
- The dihedral angle (ϕ) of an octahedron (the angle at which two adjacent faces of the octahedron are joined to each other) is $\phi = \arccos(-\frac{1}{3}) = 109.47°$. Therefore, each cylinder segments will make an angle of $180° - \phi = 70.5287794°$ in its center (as shown in Figure-2).
- The sphere should be divided into six identical pieces. It is better to use subdivision methods to draw the sphere segments. You can follow this link.

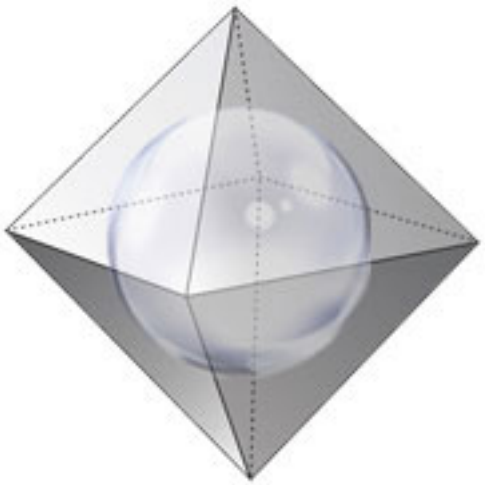

Figure 1: The sphere state can be inscribed inside the octahedron state

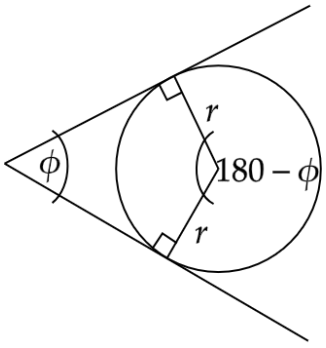

Figure 2: Angle of each cylinder segment.

Task 3 : Movement

This task must be done on top of Task 2.

Controlling Object

You need to control the magic cube as follows:
`a` – rotate the object in the clockwise direction about its own axis
`d` – rotate the object in the counter-clockwise direction about its own axis

Controlling Camera

You need to code a fully controllable camera as follows:

Translation

`up arrow`	–move forward
`down arrow`	–move backward
`right arrow`	–move right
`left arrow`	–move left
`page up`	–move up
`page down`	–move down

Rotation

`1`	–rotate/look left
`2`	–rotate/look right
`3`	–look up
`4`	–look down
`5`	–tilt counterclockwise
`6`	–tilt clockwise

Please play with the sample `magic_cube.exe` (windows) / `magic_cube.out` (linux) for clarification.

Bonus

Implement the following two camera movements.
`w` – move up without changing reference point
`s` – move down without changing reference point

Submission

1. Create a directory with your 7-digit student id as its name.
2. Put all the source files only into the directory created in step 1. The source files should be named `clock.cpp` and `magic_cube.cpp`
3. Zip the directory (compress in .zip format. Any other format like .rar, .7z etc. are not acceptable).
4. Upload the .zip file in Moodle.

Special Instructions

1. Please DO NOT COPY solutions from anywhere (e.g., your friends, seniors, internet). Any form of plagiarism, irrespective of source or destination, will result in -100% marks in the online/offline.
2. This offline is quite complex . So please start early.
3. Do not hardcode. Use variables whenever possible. This would be helpful for you **online**.

Mark Distribution

Task	Mark
1	25
2	60
3	15