

# 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 ( $\phi$ ) of an octahedron (the angle at which two adjacent faces of the octahedron are joined to each other) is  $\phi = \arccos(-\frac{1}{3}) = 109.47^\circ$ . Therefore, each cylinder segments will make an angle of  $180^\circ - \phi = 70.5287794^\circ$  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.

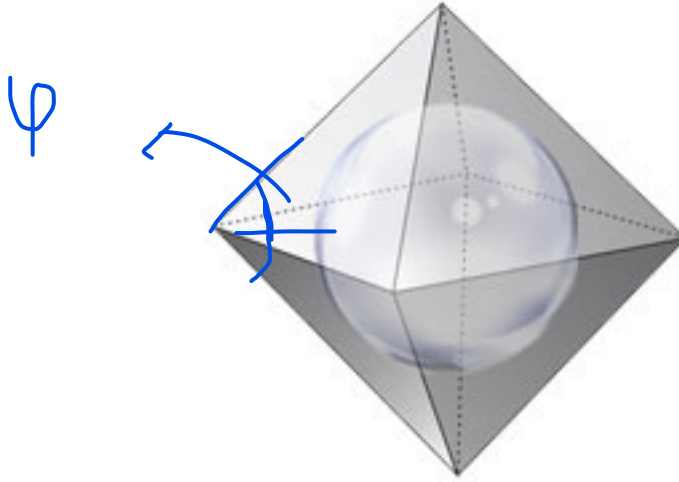


Figure 1: The sphere state can be inscribed inside the octahedron state

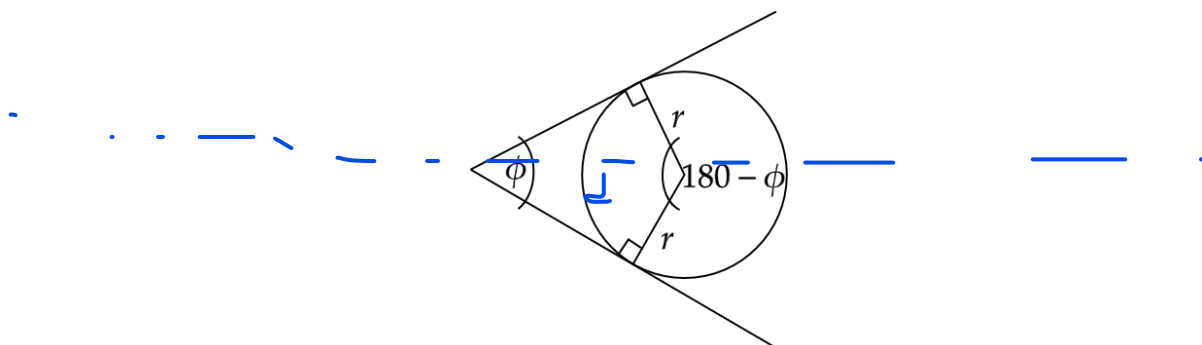


Figure 2: Angle of each cylinder segment.

## 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