**Summer 2020**
**CS 300 | Advanced Computer Graphics I**
**Assignment 0 | Shape Library**

## Description

In this assignment, the main task to generate some 3D shapes procedurally and render them using OpenGL.

1. 5 shapes will be generated: plane (aligned with the XY-plane), cube, cone, cylinder and sphere.
2. Each shape will be centered at the origin and will have one-unit size, i.e. they all fit exactly in a 1x1x1 axis aligned bounding box centered at the origin. The lower left back corner of the AABB is at (-0.5, -0.5, -0.5) and the upper right front corner of the cube is at (0.5, 0.5, 0.5).
3. Shape definition:
   o Plane: it has four vertices
   o Cube: each side has four vertices
   o Cylinder: we divide it radially in slices. The number of slices needs to be passed as a parameter upon initialization of the shape
   o Cone: as with the cylinder, we divide it radially in slices. The number of slices needs to be passed as a parameter upon initialization of the shape.
   o Sphere: it is divided into slices and rings (stacks). This number must be passed as a parameter upon initialization and the amount of slices will be double the rings value.
4. For each vertex the following information must be calculated: position, normal and texture coordinate. Two types of normal should be visible:
   o Face normal: compute the normal for the triangle and render it on the three vertices. That will produce more than one normal for each position and we will consider those as two different vertices.
   o Averaged normal: the result of averaging every normal for a single vertex position.
5. The rendering function must be done from scratch, i.e. you must not use a third-party library to draw your shape.
6. In addition to the regular shape rendering, must be able to render the shape's normal.
7. **Rendering must be done using OpenGL vertex array, either with glDrawArrays or glDrawElements function** (please read the documentation for both an make an educated decision)**.**
8. Generate a texture procedurally that looks look like the following:
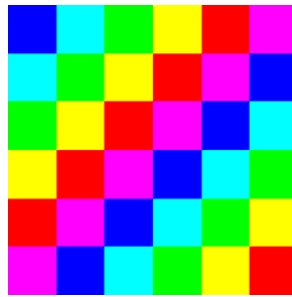
9. Scene setup:
   o Render one object around the origin with scale 20x20x20.
   o Apply the texture on the shape or show texture coordinates as color.
10. Input:
   o <u>Numbers 1 to 5:</u> Change the shape to be rendered
      ▪ 1: Plane
      ▪ 2: Cube
      ▪ 3: Cone
      ▪ 4: Cylinder
      ▪ 5: Sphere
   o <u>N:</u> Toggle normal rendering
   o <u>T:</u> Toggle texture-mapping on/off
   o <u>F:</u> Toggle face/averaged normal
   o <u>M:</u> Toggle wireframe on/off
   o <u>Arrows Up/Down:</u> Rotate the shape along Y-axis
   o <u>Arrows Right/Left:</u> Rotate the shape along X-axis
   o <u>+/-:</u> Increase/reduce number of slices (minimum number of slices should be specified)

## Assignment Submission

Please refer to the syllabus for assignment submission guideline. Failure to the submission guidelines correctly might cause you to lose point.

## Grading Rubrics

The following is a rough guideline on how your assignment will be graded and the weight of each part.

- Shapes construction (10% each for the plane and the cube, 20% or the cone, cylinder and sphere)
   o Correct calculation of shape's vertexes and their attributes
   o Correct construction of shape's triangles
- Miscellaneous
   o Normal Rendering (10%)
   o Texture Mapping toggling and procedural texture creation (10%)