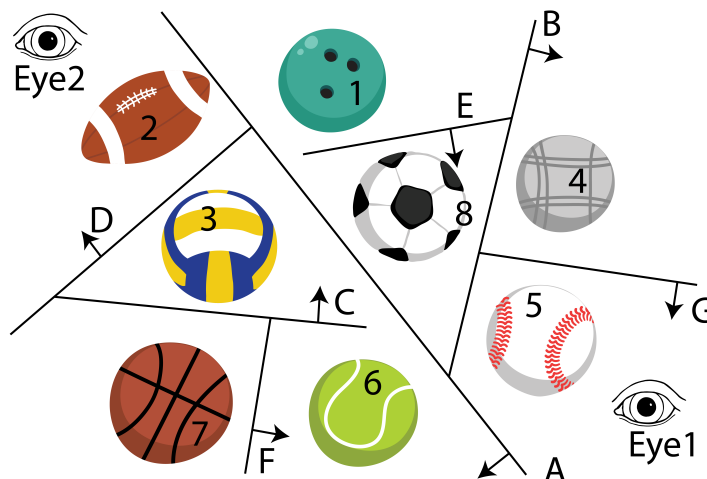


Computer Graphics (COMP3271)

Illumination and Texture

Due Date: 11:59pm, Nov 1, 2019

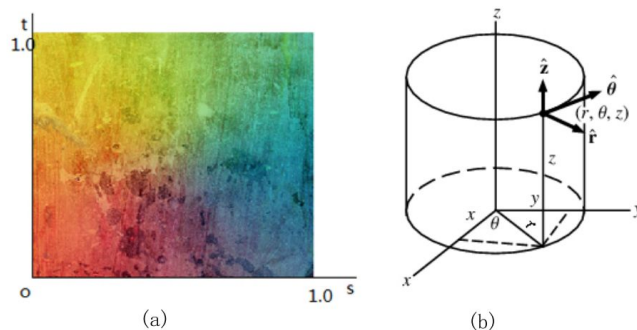
- (20 marks)** Show the difference between perspective projection and orthogonal projection methods by discussing their transformation matrices and rendering results. Also describe how to set up the respective projections using OpenGL.
- (20 marks)** Consider a scene with 8 objects (numbered 1 to 8) as shown in the figure below. Construct the corresponding BSP tree. Based on this BSP tree, give the rendering sequence of the objects from the viewpoints Eye1 and Eye2, respectively.



- (20 marks)**
 - Explain how to detect whether or not a planar boundary face of an object is front-facing.
 - Describe the Z-buffer algorithm briefly, and explain how it is used for hidden surface removal.
- (20 marks)**
 - Describe the three basic components of Phong illumination equation;
 - Describe how the Flat shading method and Gouraud shading method work;
 - Describe the pros and cons of the Phong shading method.

5. (20 marks)

- (a) Consider a texture pattern defined in a unit square $[0, 1]^2$ and a cylindrical surface \mathcal{S} , as depicted in the figure below.



The cylindrical coordinates of a point on \mathcal{S} can be represented as $(r \cos \theta, r \sin \theta, z)$, where r is the radius of the cylindrical surface and $0 \leq \theta \leq 2\pi, 0 \leq z \leq 1$. Suppose we want to wrap the texture on \mathcal{S} . Derive a mapping which assigns a texture coordinates in $[0, 1]^2$ to a point on \mathcal{S} .

- (b) In OpenGL, antialiasing can be controlled by the texture function `glTexParameterf()` with an appropriately chosen minifying or magnification function supplied for the `GL_TEXTURE_MIN_FILTER` or `GL_TEXTURE_MAX_FILTER` texture parameter. Explain the effects of the functions `GL_NEAREST` and `GL_LINEAR` for texture minification or magnification. Which one is more suitable for anti-aliasing?

(Reference page for `glTexParameterf()`: <https://www.khronos.org/registry/OpenGL-Refpages/gl4/html/glTexParameter.xhtml>)