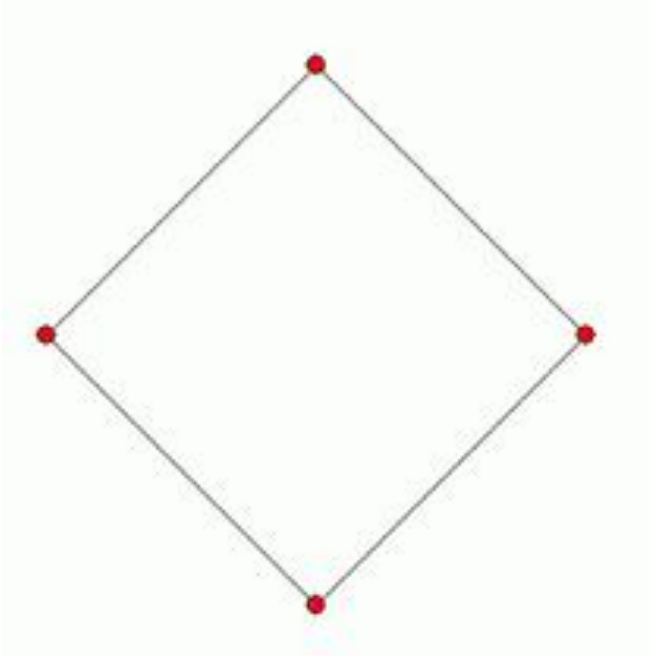
3D Graphics Programming

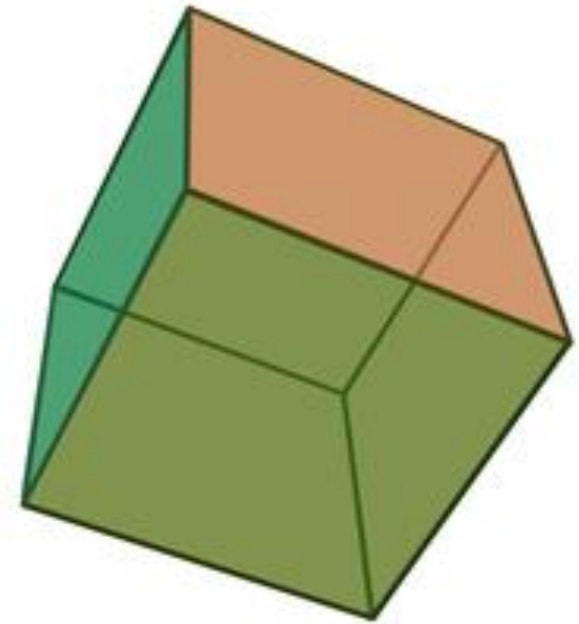
T163 - Game Programming

Week 4

3D Geometry

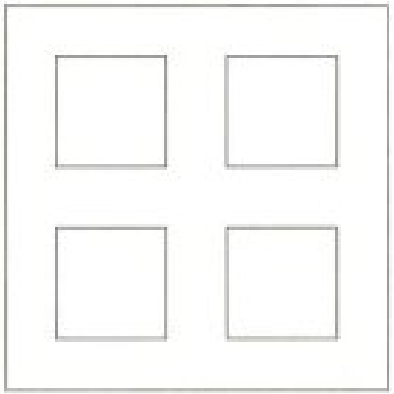
The Third Dimension





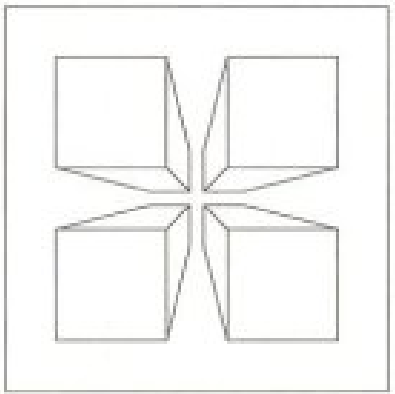
Camera Projections

Orthographic

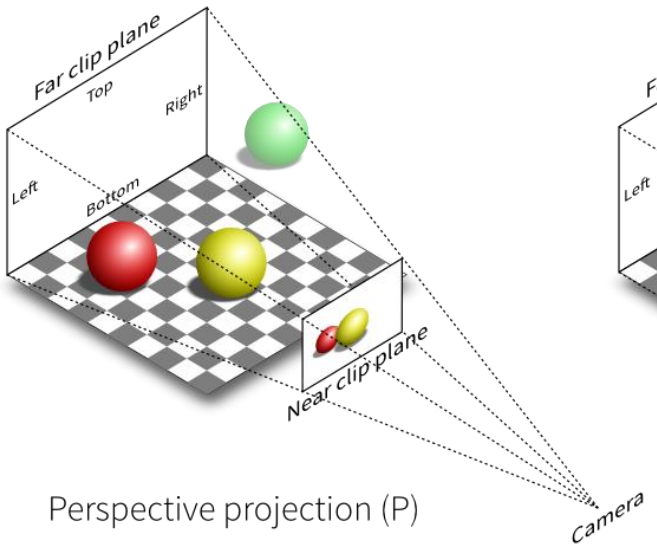


VS

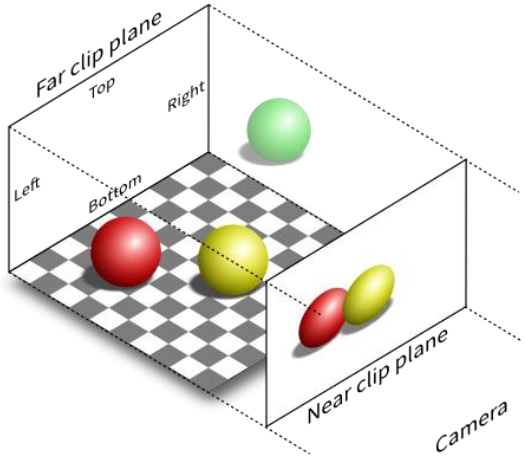
Perspective



Camera Projections

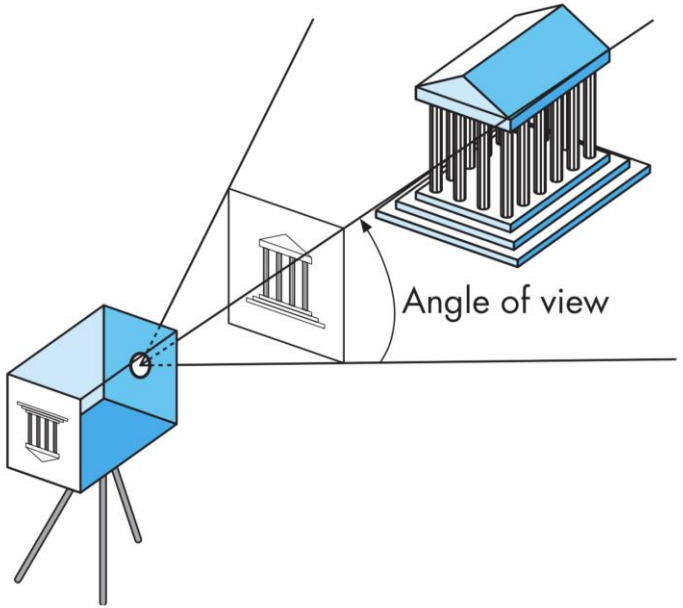


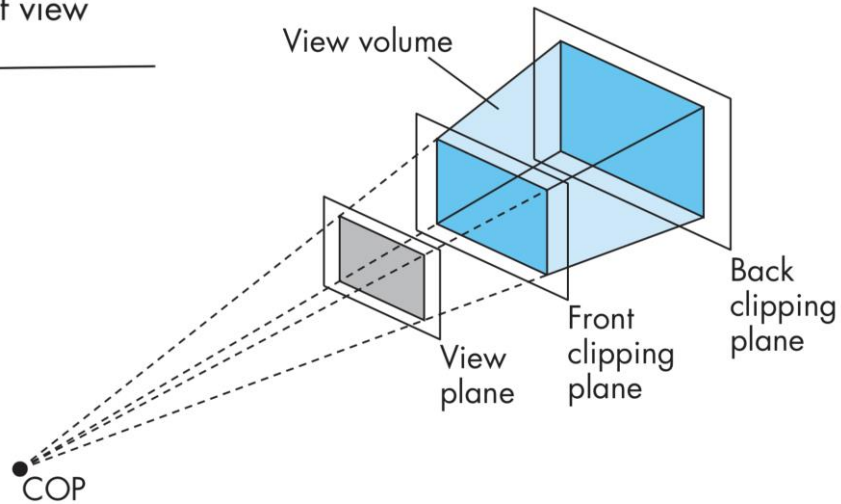
Perspective projection (P)



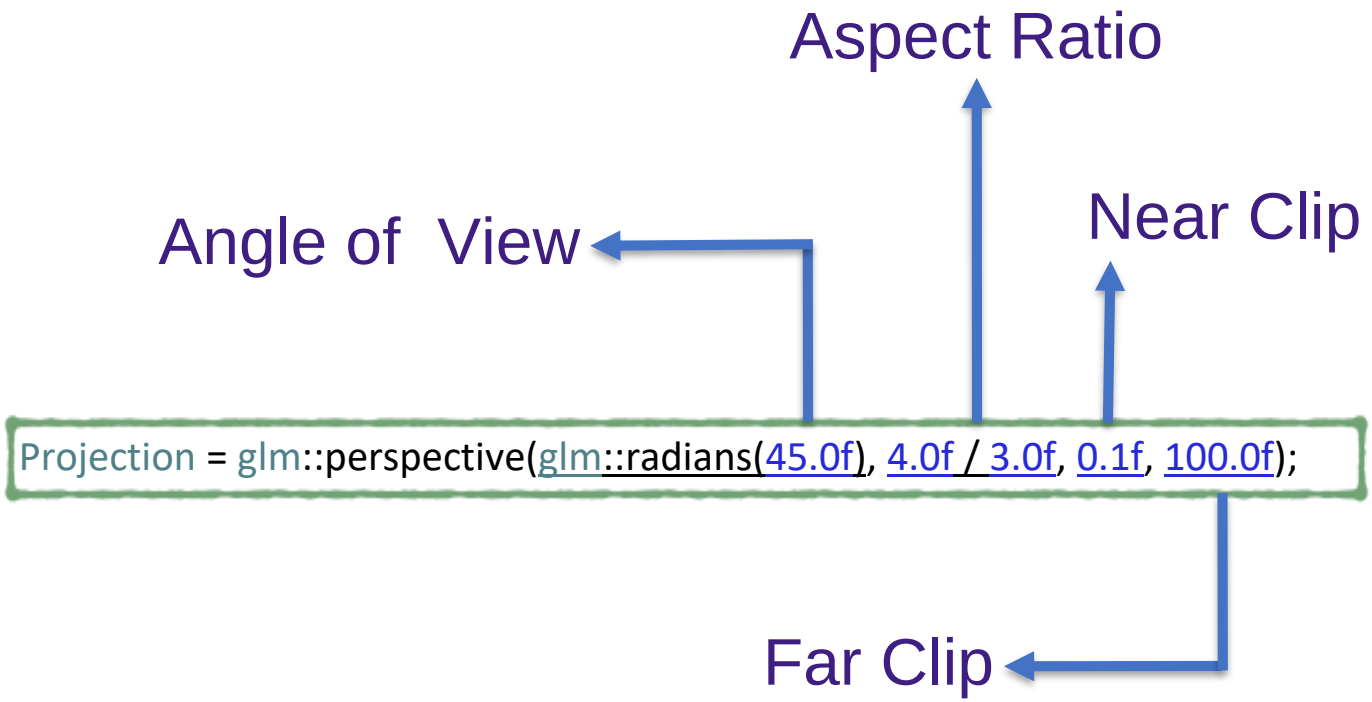
Orthographic projection (O)

Camera Projections

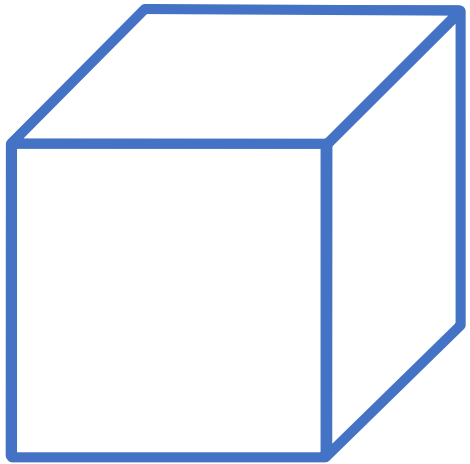




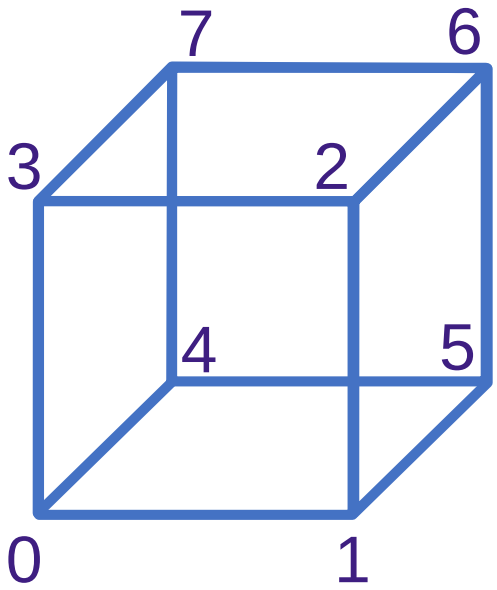
Camera Projections



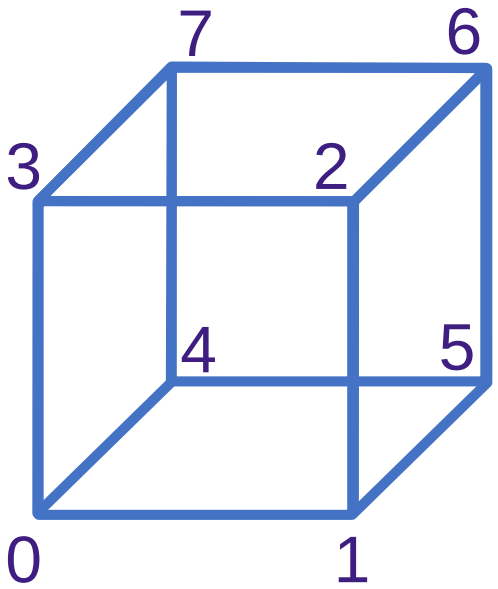
Rendering a 3D Object

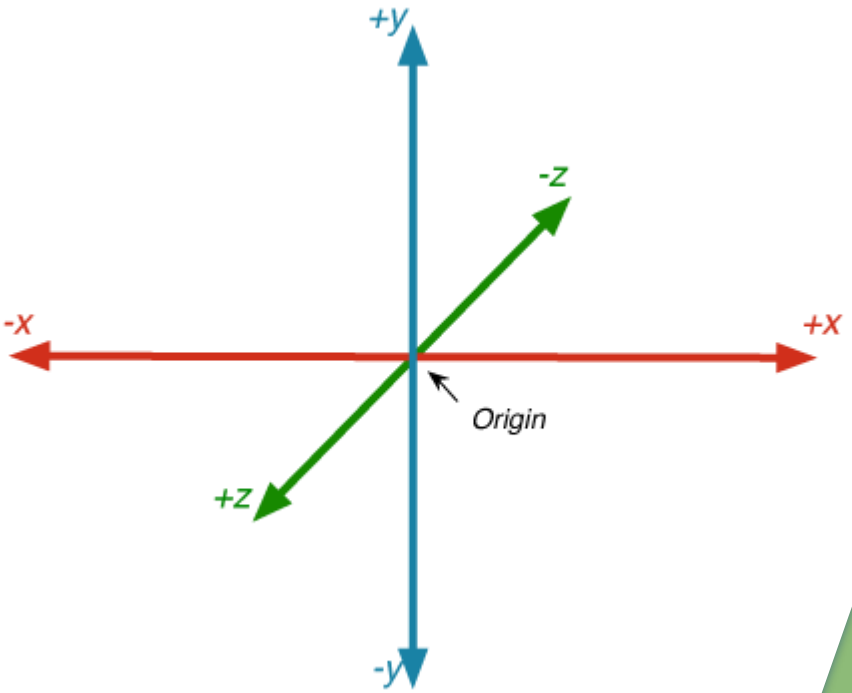


Rendering a 3D Object

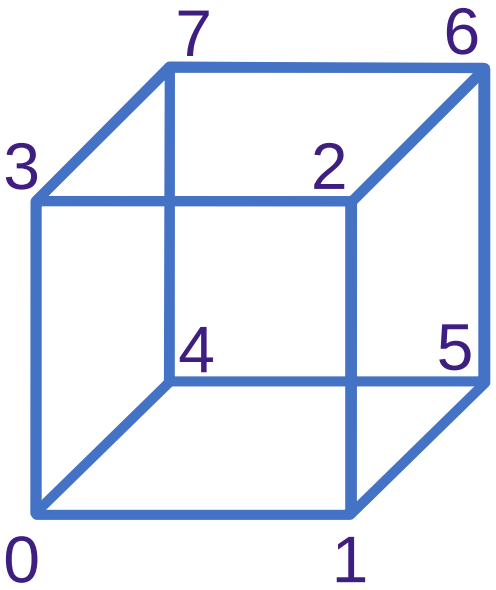


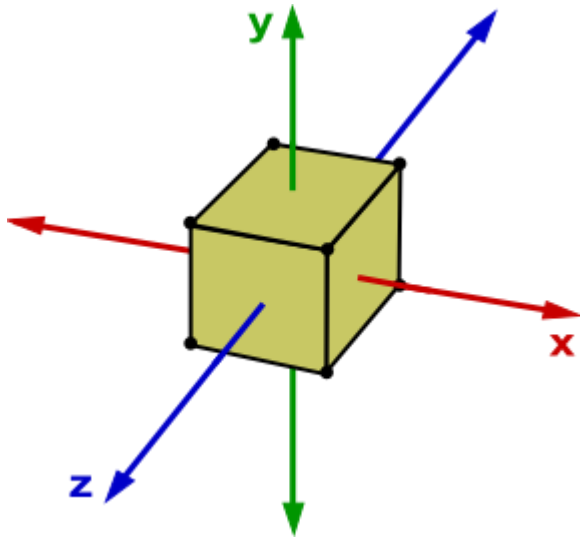
Rendering a 3D Object



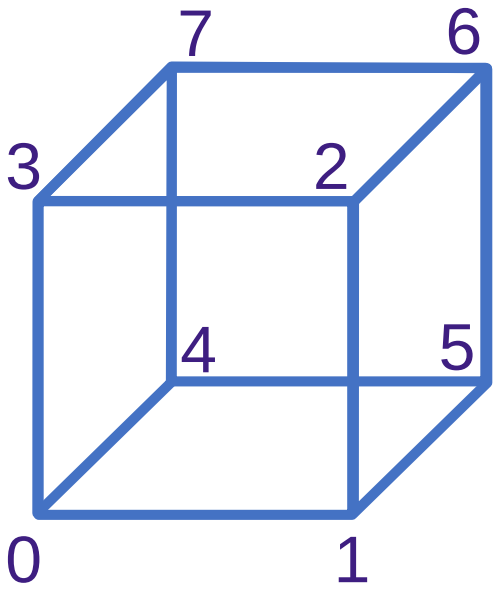


Rendering a 3D Object





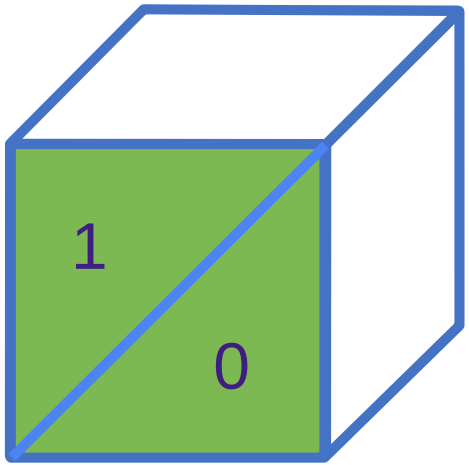
Rendering a 3D Object



Vertex List

V0 = (-1, -1, 1)
V1 = (1, -1, 1)
V2 = (1, 1, 1)
V3 = (-1, 1, 1)
V4 = (-1, -1, -1)
V5 = (1, -1, -1)
V6 = (1, 1, -1)
V7 = (-1, 1, -1)

Rendering a 3D Object

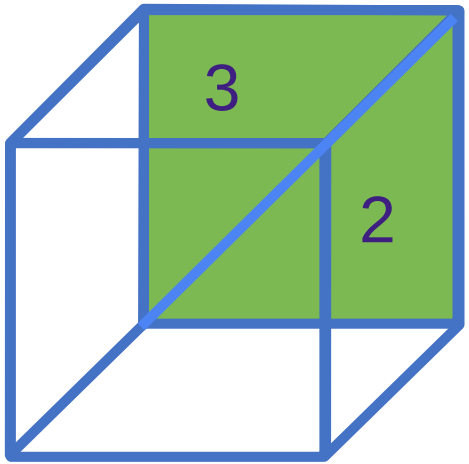


Index List

Front Face

Triangle0 = (0, 1, 2)
Triangle1 = (2, 3, 0)

Rendering a 3D Object

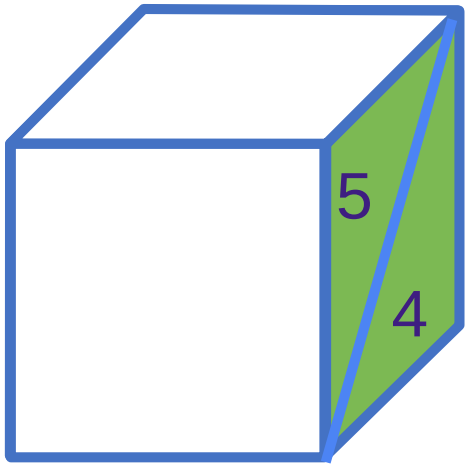


Index List

Back Face

Triangle2 = (4, 5, 6)
Triangle3 = (6, 7, 4)

Rendering a 3D Object



Index List

Right Face

Triangle4 = (1, 5, 6)

Triangle5 = (6, 2, 1)

Rendering a 3D Object

Index List

```
GLushort cube_index_array[] = {
    // front
    0, 1, 2,
    2, 3, 0,
    // top
    1, 5, 6,
    6, 2, 1,
        .
        .
        .
};
```

Vertex List

```
float cube_vertices[] = {
        -0.45, -0.45,  0.45,
         0.45, -0.45,  0.45,
                  .
                  .
                  .
};
```

- Note that while the vertices array is 1D, OpenGL will know to render them three at a time, so the index 0 represents the 1st three floats, 1 represents the 2nd group of floats, etc.
- It is very helpful to write out your vertex data in code with comments and line breaks

Rendering a 3D Object

New IBO for the Index List

```
glBindBuffer(GL_ARRAY_BUFFER, ...);
glBufferData(GL_ARRAY_BUFFER, ...);
```

```
glBindBuffer(GL_ELEMENT_ARRAY_BUFFER, ...);
glBufferData(GL_ELEMENT_ARRAY_BUFFER, ...);
```

Rendering a 3D Object

New IBO for the Index List

```
GLuint cube_IBO;
glGenBuffers(1, &cube_IBO);
glBindBuffer(GL_ELEMENT_ARRAY_BUFFER, cube_IBO);
glBufferData(GL_ELEMENT_ARRAY_BUFFER, sizeof(index_list), index_list, GL_STATIC_DRAW);
```

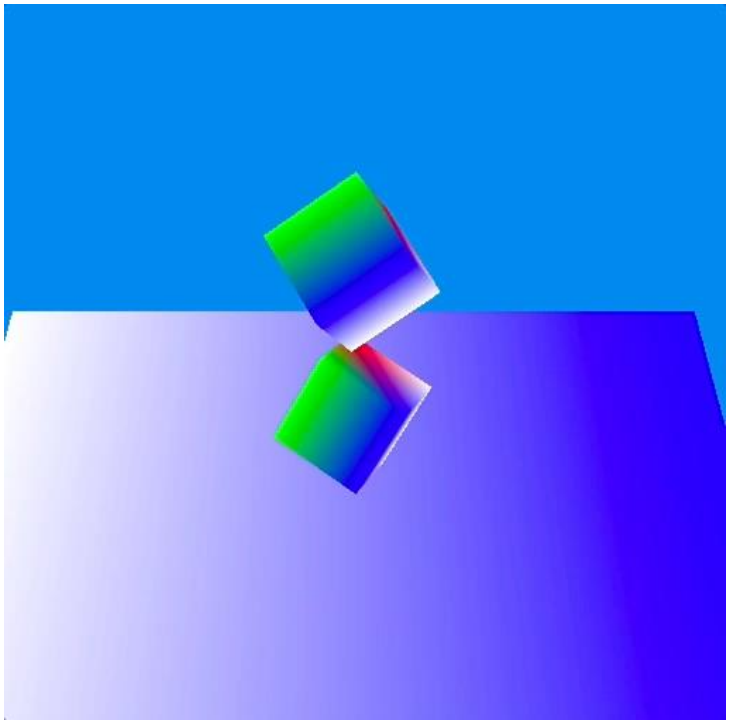
Rendering a 3D Object

New IBO for the Index List

```
glDrawArrays(GL_LINE_STRIP, 0, NumVertices);
```

```
glDrawElements(GL_TRIANGLES, 36, GL_UNSIGNED_SHORT, 0);
```

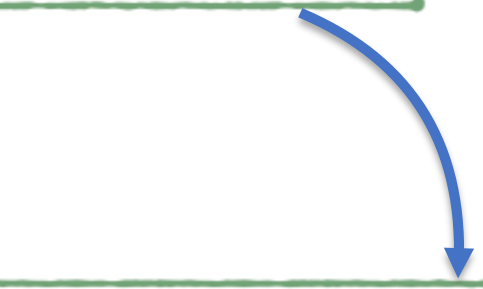
Depth Testing



Depth Testing

When Initializing, Enable Depth Mode

```
glutInitDisplayMode(GLUT_RGBA);
```



```
glutInitDisplayMode(GLUT_RGBA | GLUT_DEPTH);
```

Depth Testing

When Initializing, Enable Depth Test

```
glEnable(GL_DEPTH_TEST);
```

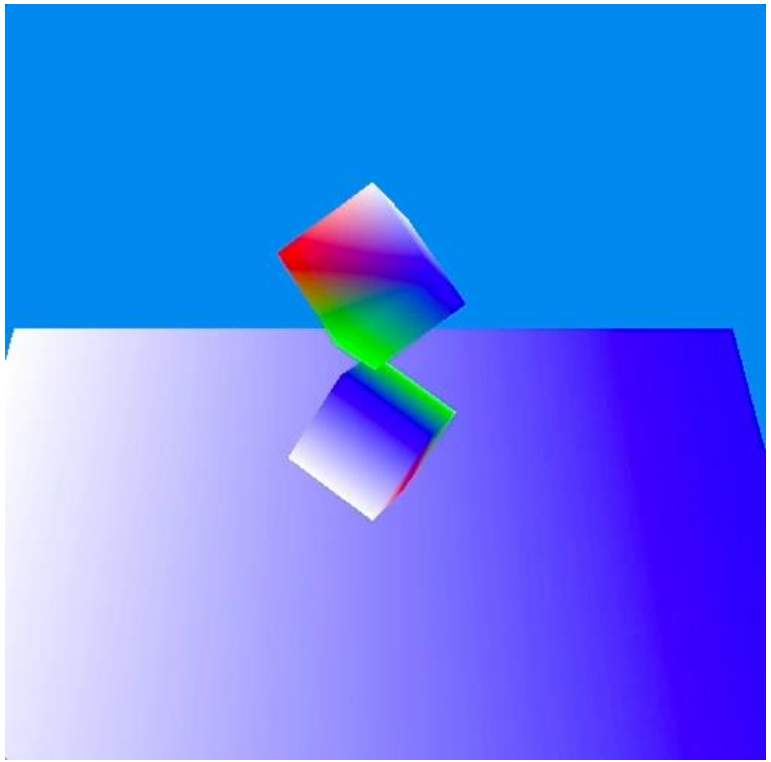
Depth Testing

When Drawing, Clear Depth Buffer

```
glClear(GL_COLOR_BUFFER_BIT);
```

```
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
```

Depth Testing



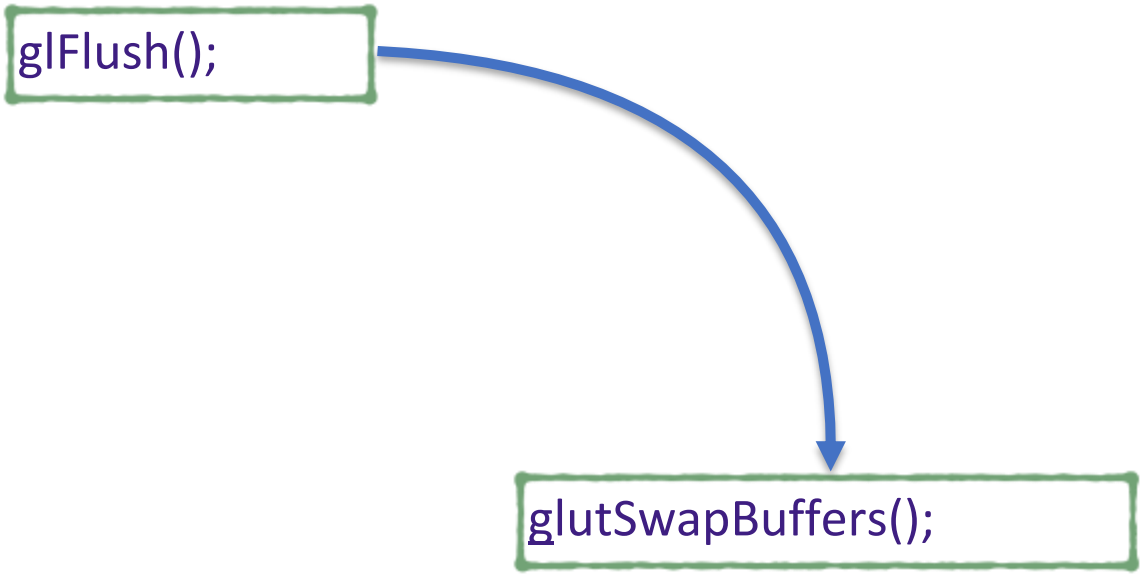
Depth Testing

Use Double Buffering

```
glutInitDisplayMode(GLUT_RGBA);
```

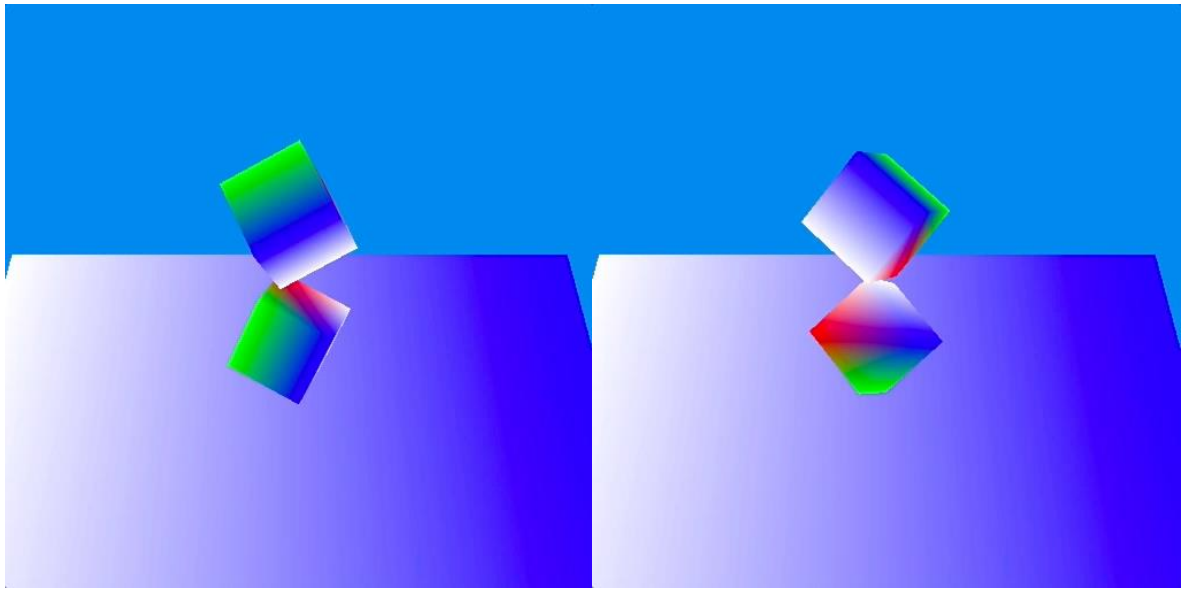
```
glutInitDisplayMode(GLUT_RGBA | GLUT_DOUBLE);
```

Depth Testing



Results in Smoother Animations?

Depth Testing



Week 4

Lab Activities

Week 4 Lab

- For the lab, see Hooman's material (with video)
- OpenGL examples covered:
  - More indexed draws
  - Projections
    - Orthographic and perspective

Week 4

End