CSC 240
Computer Graphics

Fall 2015
Smith College

Outline: 11/2

- Recap Lighting and Lab 10
- Start hierarchical models
- Hierarchical models lab: robotic arm

White background slides from Eitan Mendelowitz

Lab 10: light properties

```
ambient_color = [ 0.2, 0, 0, 1]
diffuse_color = [1, 0, 0, 1]

glLightfv(GL_LIGHT0, GL_AMBIENT, ambient_color)
glLightfv(GL_LIGHT0, GL_DIFFUSE, diffuse_color)

glLightfv(GL_LIGHT0, GL_POSITION, light_position)
```

Another way: material properties

```
ambient_color = [ 0.2, 0, 0, 1]
diffuse_color = [1, 0, 0, 1]

glMaterialfv(GL_FRONT, GL_AMBIENT, ambient_color)
glMaterialfv(GL_FRONT, GL_DIFFUSE, diffuse_color)

glLightfv(GL_LIGHT0, GL_POSITION, light_position)
```

General form:

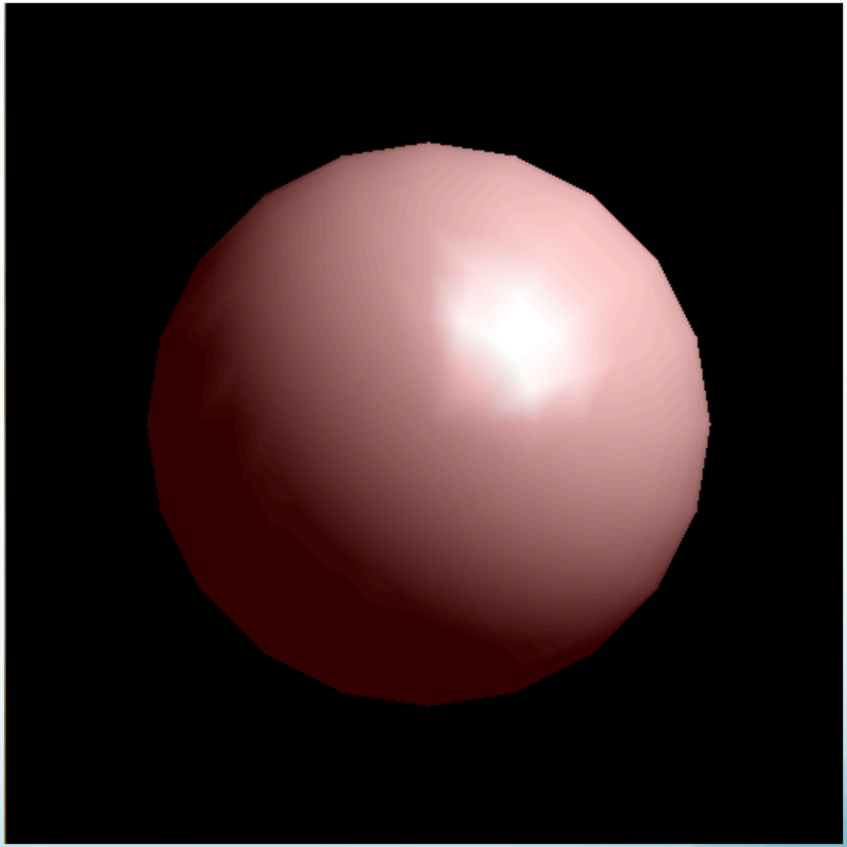
```
        glMaterialfv(face, type, color)
```

Ambient and Specular

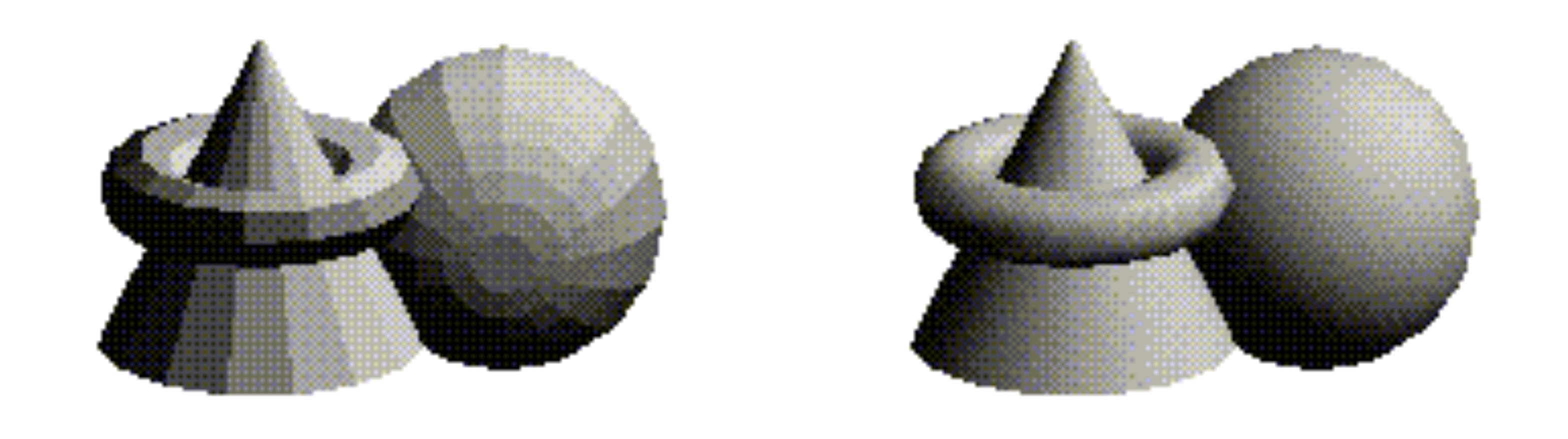
```
mat_specular = [ 1, 1, 1, 1 ]
mat_shininess = [ 50 ]
mat_ambient = [ 1, 0, 0, 1 ]
light_position = [ 1, 1, 1, 0 ]
glClearColor(0, 0, 0, 0)
glShadeModel(GL_SMOOTH)

glMaterialfv(GL_FRONT, GL_SPECULAR, mat_specular)
glMaterialfv(GL_FRONT, GL_SHININESS, mat_shininess)
glMaterialfv(GL_FRONT, GL_AMBIENT, mat_ambient)
glLightfv(GL_LIGHT0, GL_POSITION, light_position)

glEnable(GL_LIGHTING)
glEnable(GL_LIGHT0)
glEnable(GL_DEPTH_TEST)
```



Normal Vectors



Polygon Normals vs. True Noramls

(OpenGL Redbook)

Lab 10 Demos

-
  ```
  light_position = [math.cos(angle/360), 0, math.sin(angle/360), 0]
  ```

-
  ```
  glutSolidSphere(1.0, 50, 50)
  glRotate(angle,0,1,0)
  glLightfv(GL_LIGHT0, GL_POSITION, light_position)
  ```

-
  ```
  ambient_color = [0, abs(math.cos(radians)), abs(math.sin(radians)), .5]
  diffuse_color   = [0, abs(math.cos(radians)), abs(math.sin(radians)), .5]
  ```

Perspective in a different way

- Will see in Lab 11

gluFrustum vs. gluPerspective

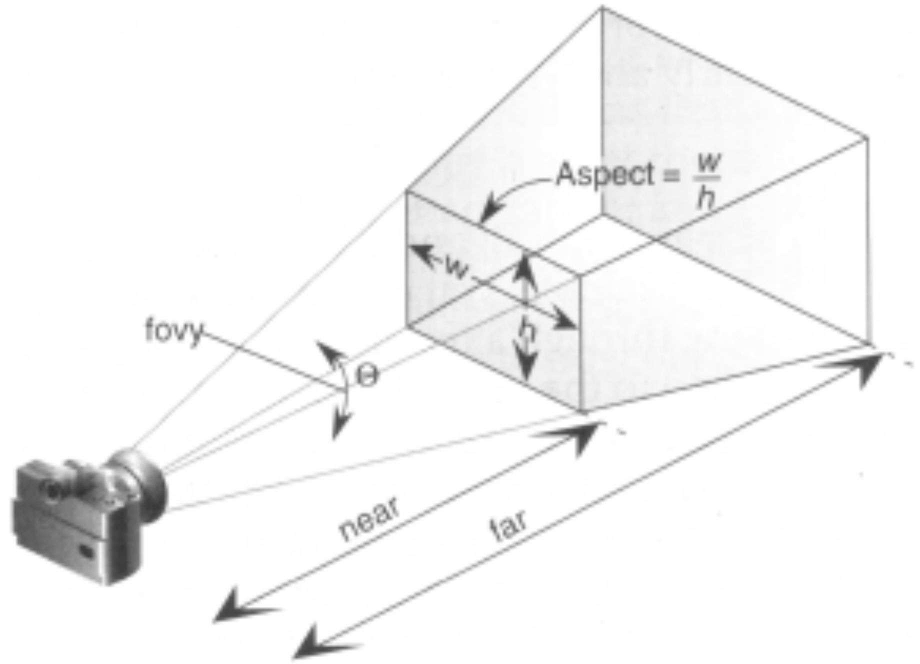


Figure 3-14 Perspective Viewing Volume Specified by gluPerspective()

gluPerspective(fovy, aspect, zNear, zFar)

glFrustum(left, right, bottom, top, zNear, zFar)

what-when-how.com

Relationship

- aspect = w/h = (right-left)/(top-bottom)

- fovy = field of view angle (y-direction)
- fovy = $\sin^{-1}$[(top-bottom)/(2*zNear)]

- Example: gluPerspective(65.0, w/h, 1.0, 20.0)

gluLookAt

gluLookAt(eyeX, eyeY, eyeZ,

centerX, centerY, centerZ,

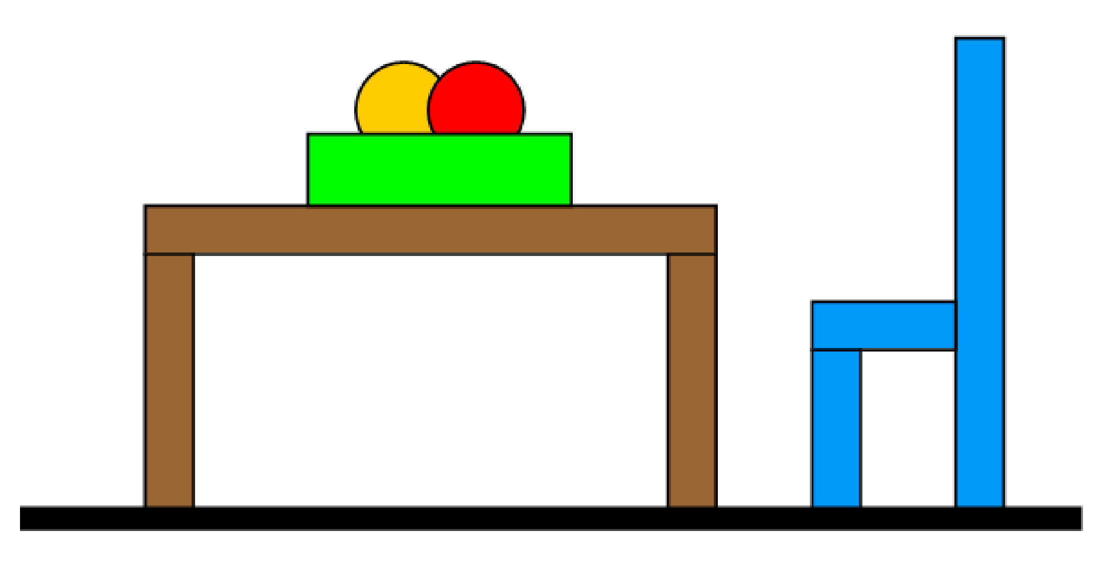
upX, upY, upZ)

- Example: gluLookAt(1,2,8, 0,0,0, 0,1,0)
- Camera/eye at (1,2,8)
- Look at origin (0,0,0)
- Y-axis (0,1,0) is “up”

Why Group?

- Scene Organization

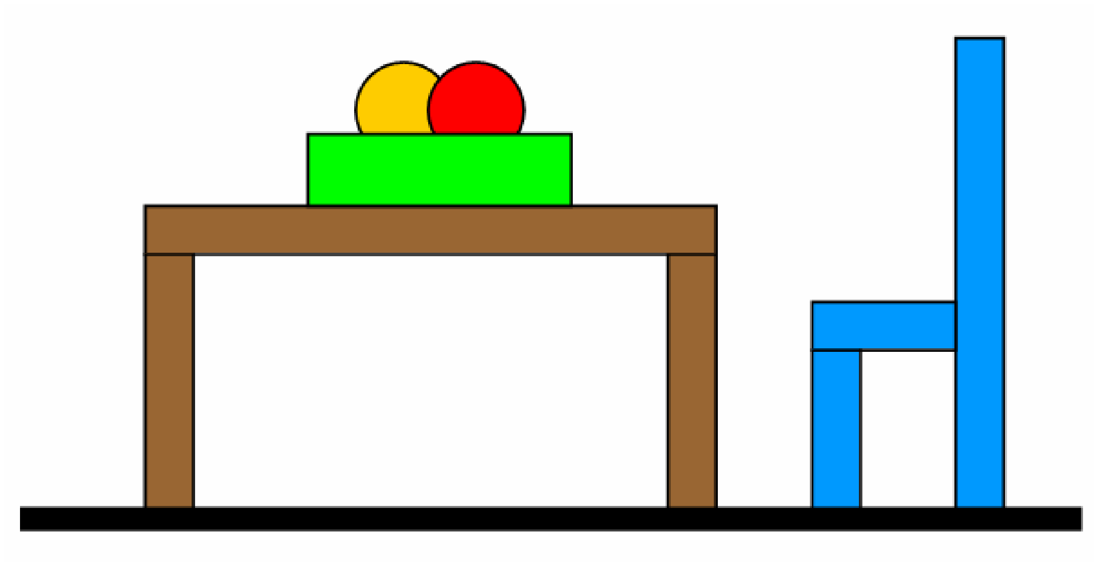
Room
  - Floor
  - Table
  - Chair



Why Group?

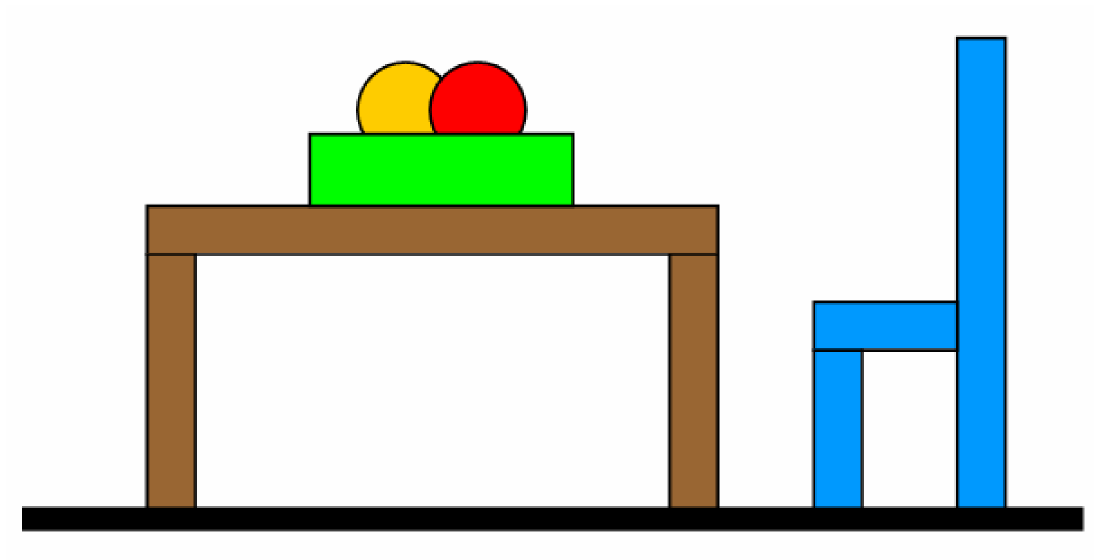
- Scene Organization

Room
    Floor
        Plane
    Table
    Chair



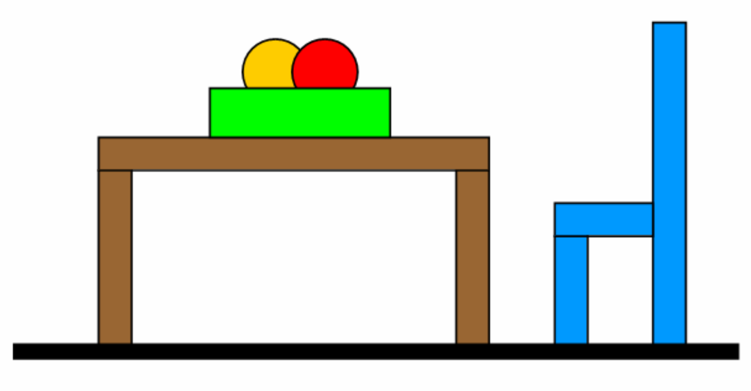
Why Group?

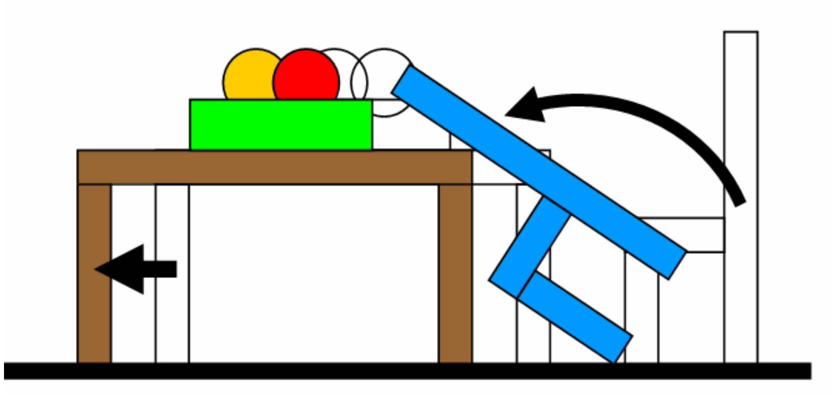
- Scene Organization



- Room
  - Floor
    - Plane
  - Table
    - Bowl
      - Sphere
      - Sphere
    - Box
    - Box
    - Box
  - Chair

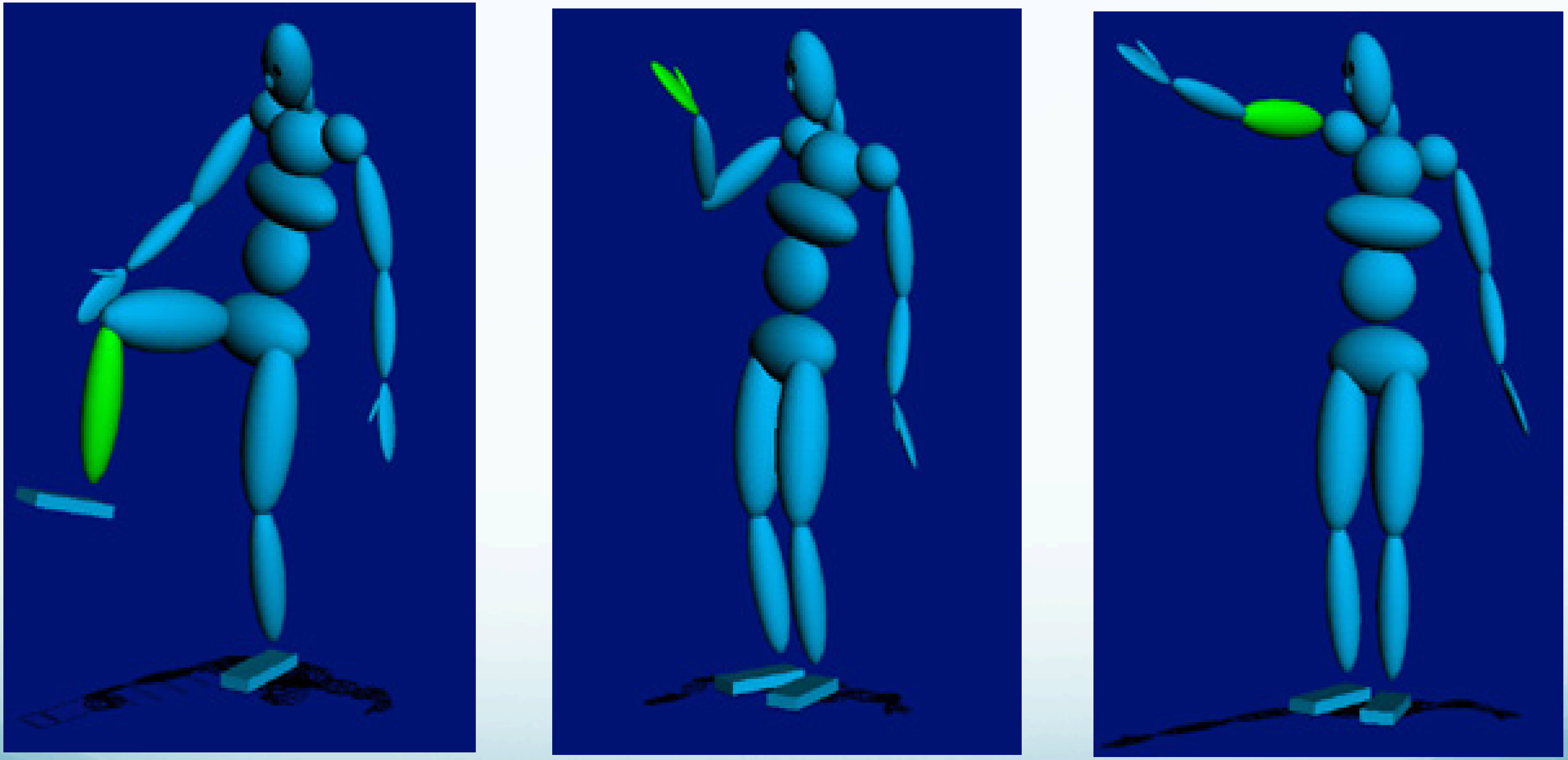
Add Transforms to Group





```
bowl = group()
bowl.addObject(Sphere(…))
bowl.addObject(Sphere(…))
table = group()
table.addTransform(Translate(-2,0,0))
table.addObject(bowl)
table.addObject(Box(…))
table.addObject(Box(…))
table.addObject(Box(…))
chair = group()
chair.addTransform(RotateZ(45))
…
room = group()
room.addObject(bowl)
room.addObject(table)
room.addObject(chair)
room.addObject(Plane(…))
```

Useful for animation



Eitan Mendelowitz

Hierarchical Models

- Lab 9 revisited
- Demo Lab 11

Lab 11: robotic arm

- Choose a partner for pair programming!

- (If you don’t pair program, at least check in with your partner and discuss what’s going on.)

HW 4 Demos