

LEI / LCC
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# Lighting and Materials in OpenGL

# OpenGL - Materials

- Color components:
  - Diffuse
  - Specular
  - Ambient
  - Emissive

# OpenGL - Materials

- Pure Blue Teapot

Pure White light

Pure Red light

# OpenGL - Materiais

- Blue Teapot (0.3,0.3,1.0)

White light
(1.0,1.0,1.0)

Pure Red Light
(1.0,0.0,0.0)

Mainly a red light
(1.0,0.3,0.3)

# OpenGL - Materials

- Setting materials:

```
glMaterialfv(GL_FRONT, componente, array);
glMaterialf(GL_FRONT,GL_SHININESS,valor);
```

0..128

Component:

```
GL_DIFFUSE
GL_AMBIENT
GL_SPECULAR
GL_EMISSION
GL_AMBIENT_AND_DIFFUSE
```

- Example: define the diffuse component as red

```
float red[4] = {0.8f, 0.2f, 0.2f, 1.0f};
glMaterialfv(GL_FRONT, GL_DIFFUSE, red);
```

# OpenGL - Lighting

- Light Properties

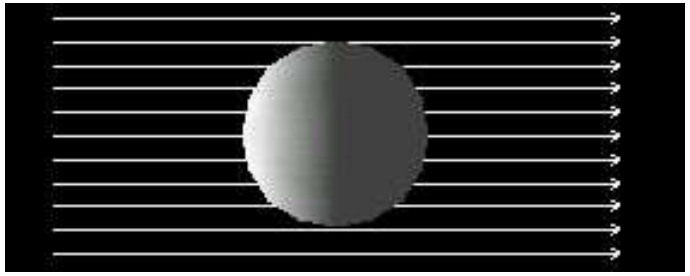
```
glLight{if}(GL_LIGHTi, param, value1,value2, ...);
glLight{if}v(GL_LIGHTi, param, array_values)
```

# OpenGL - Lighting

- Directional light

Attributes: direction, color

```
GL_POSITION
GL_DIFFUSE
```



# OpenGL - Lighting

- Directional light

```
GLfloat amb[4] = {0.2, 0.2, 0.2, 1.0};
GLfloat diff[4] = {1.0, 1.0, 1.0, 1.0};
GLfloat pos[4] = {0.0, 0.0 ,1.0, 0.0};
```

w=0.0 means the "position" is actually a direction

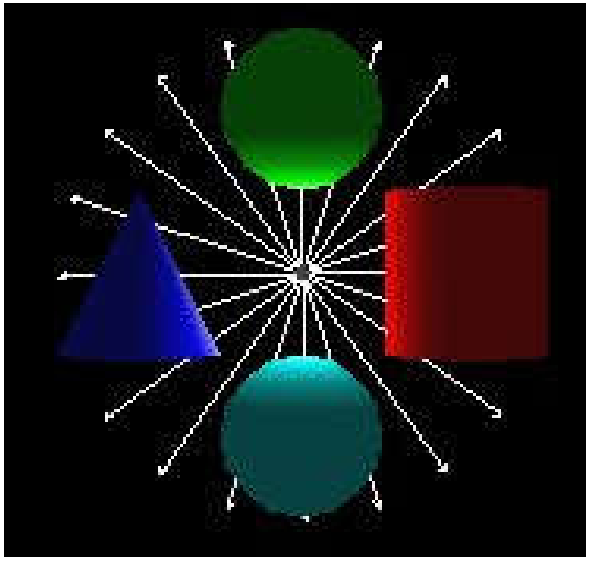
```
glLightfv(GL_LIGHT0, GL_POSITION, pos);
glLightfv(GL_LIGHT0, GL_AMBIENT, amb);
glLightfv(GL_LIGHT0, GL_DIFFUSE, diff);
```

# OpenGL - Lighting

- Point light

  Attributes: position, attenuation, color

```
GL_POSITION
GL_..._ATTENUATION
```



# OpenGL - Lighting

- Point light

```
GLfloat amb[4] = {0.2, 0.2, 0.2, 1.0};
GLfloat diff[4] = {1.0, 1.0, 1.0, 1.0};
GLfloat pos[4] = {0.0, 0.0 ,10.0, 1.0};
```

w=1.0

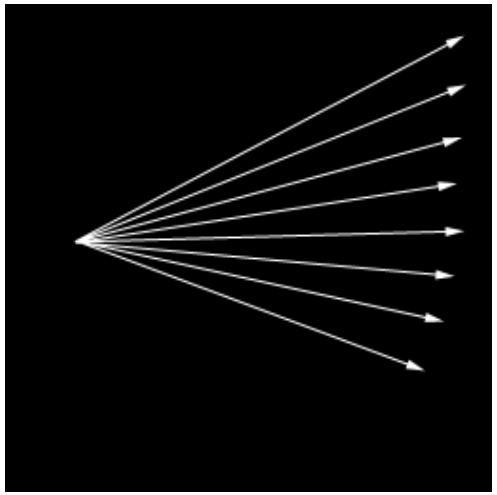
```
glLightfv(GL_LIGHT0, GL_POSITION, pos);
glLightfv(GL_LIGHT0, GL_AMBIENT, amb);
glLightfv(GL_LIGHT0, GL_DIFFUSE, diff);
```

# OpenGL - Lighting

- Spotlight

  Attributes: position, cone aperture, …

```
GL_POSITION
GL_SPOT_DIRECTION
GL_SPOT_CUTOFF
GL_..._ATTENUATION
```



# OpenGL - Lighting

- Spotlight

```
GLfloat diff[4] = {1.0, 1.0, 1.0, 1.0};
GLfloat pos[4] = {0.0, 0.0 ,10.0, 1.0};
GLfloat spotDir[3] = {0.0, 0.0, -1.0};

glLightfv(GL_LIGHT0, GL_POSITION, pos);
glLightfv(GL_LIGHT0, GL_DIFFUSE, diff);
glLightfv(GL_LIGHT0, GL_SPOT_DIRECTION, spotDir);
glLightf(GL_LIGHT0, GL_SPOT_CUTOFF, 45.0);
                                    // [0,90] or 180
glLightf(GL_LIGHT0,GL_SPOT_EXPONENT, 0.0);
                                    // [0,128]
```

# OpenGL - Lighting

- Enable/Disable individual lights (off by default)

```
glEnable(GL_LIGHTi); // i = 0..7
glDisable(GL_LIGHTi);
```

- Enable/Disable lighting

```
glEnable(GL_LIGHTING);
glDisable(GL_LIGHTING);
```

# OpenGL - Lighting

- Light Placement

  - Lights are positioned with

    ```
    glLightfv(GL_LIGHT0, GL_POSITION, pos)
    ```

  - The light position should be treated as any other object in OpenGL

  - The position is multiplied by the model view matrix, just like any vertex

# OpenGL - Lighting

- Light Placement
  - Before the camera – light is fixed in camera space

```
glLightfv(GL_LIGHT0, GL_POSITION, pos);
gluLookAt(...)
```

  - After the camera, but before any geometric transformation – light is fixed in global space

```
gluLookAt(...)
glLightfv(GL_LIGHT0, GL_POSITION, pos);
```

# OpenGL - Lighting

- Posicionamento das luzes

  – After geometric transformations to place an object – light is fixed to the object

```
gluLookAt(...);
glTranslate(...);
glRotate(...);
glLightfv(GL_LIGHT0, GL_POSITION, pos);
glBegin(...);
        ...
glEnd(...);
```