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Lighting

Elements of Graphics
CS324e

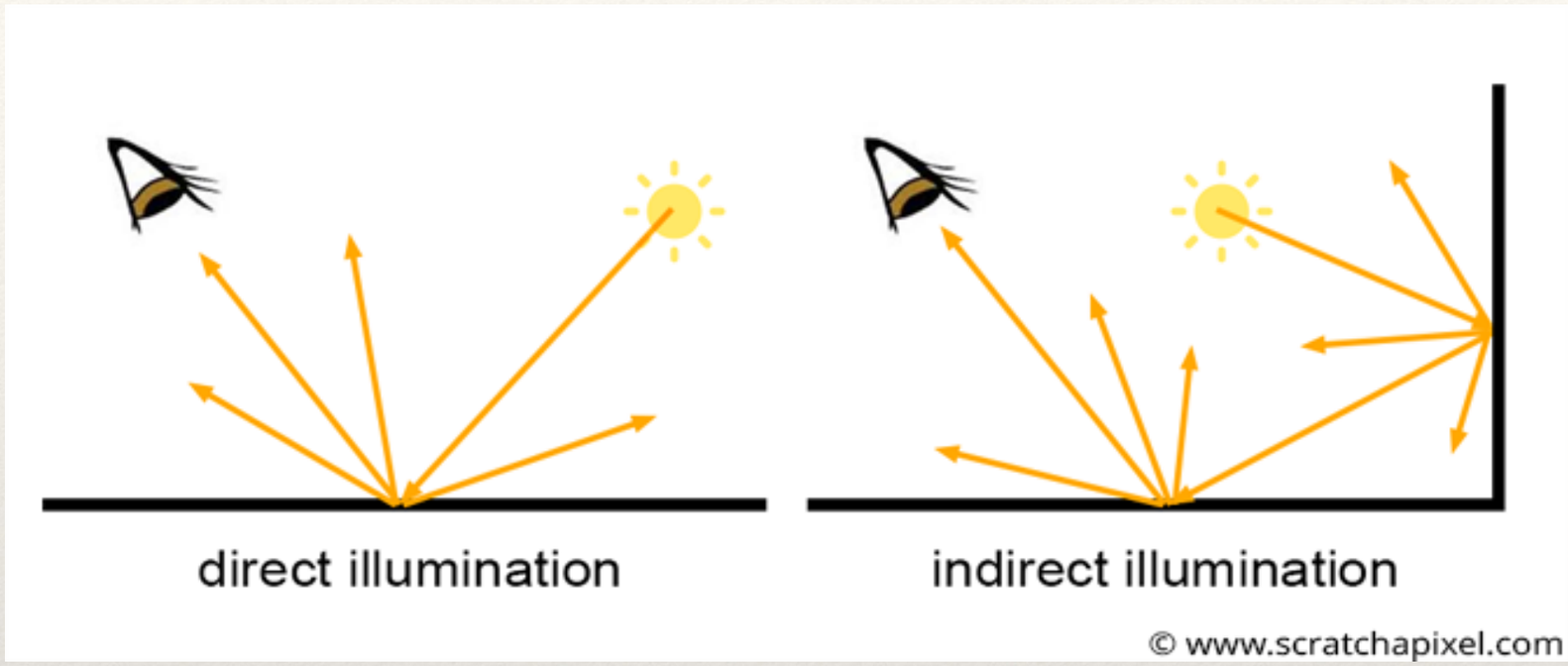
Shading

- Shading approximates the physical properties of light
  - What is the object's color/material?
  - How does light interact with the object?
  - What is the camera's position?

Toy Story (1995)

Big Hero 6 (2014)

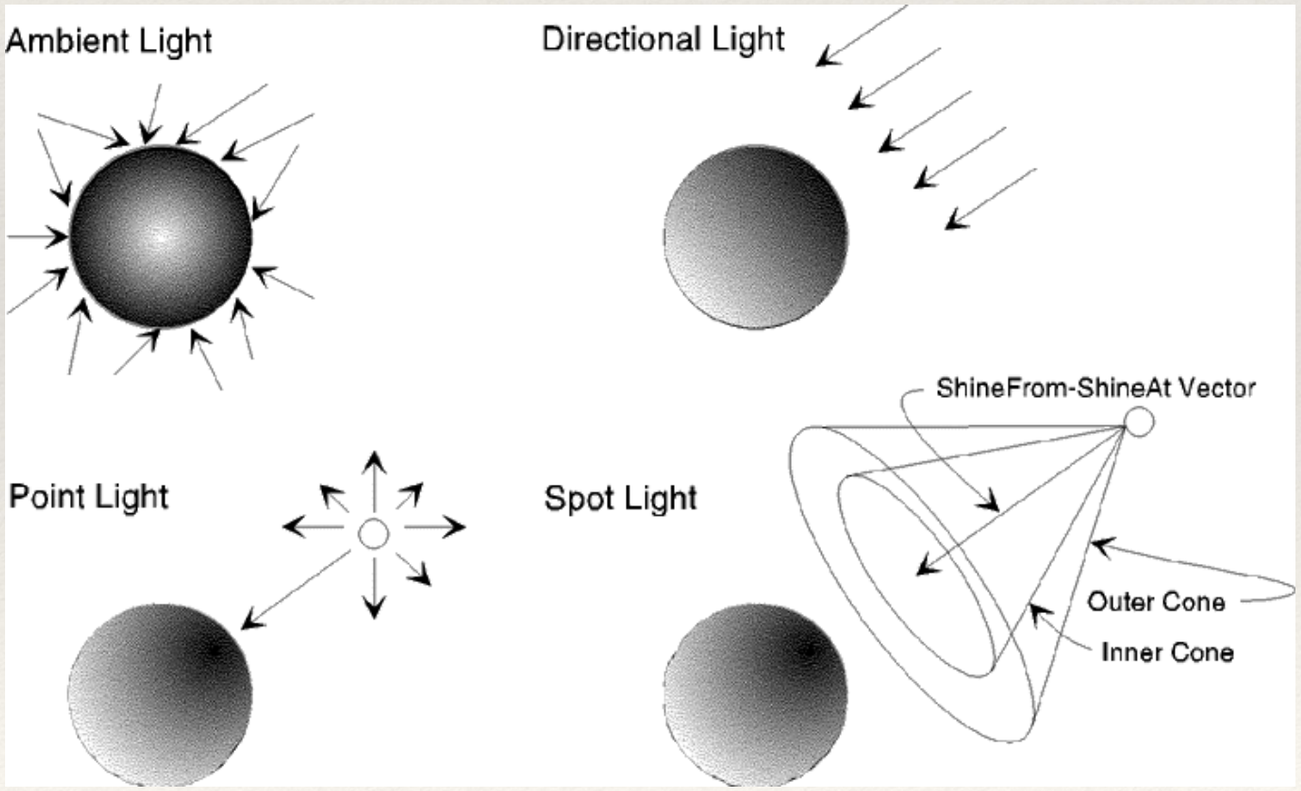
Lighting in a Scene



- Direct illumination model accounts for light that goes from the light source to an object to our eye
- Indirect illumination accounts for light bounces on neighboring objects as well
- We will focus on direct illumination

Types of Lights

- Intensity (color) and direction of light sources change what surfaces are affected
- Potential light sources:
  - Directional
  - Point
  - Spot
  - Ambient



(Okino Computer Graphics)

Directional Lights

- Directional, non-positional source of light
  - Approximate light located at infinity
  - Similar to rays of sunlight
- `directionalLight(r, g, b,`

  `dir_x, dir_y, dir_z)`
  - First three parameters define the light's color
  - Second three parameters define *direction* of light

```
void setup() {
 size(500, 500, P3D);
 noStroke();
}

void draw() {
 background(0);
 //This shines a light in the -y direction (note:
Processing defaults to a left-handed coordinate system)
 directionalLight(255, 255, 255, 0, -1, 0);
 translate(width/2, height/2, 0);
 sphere(50);
}
```

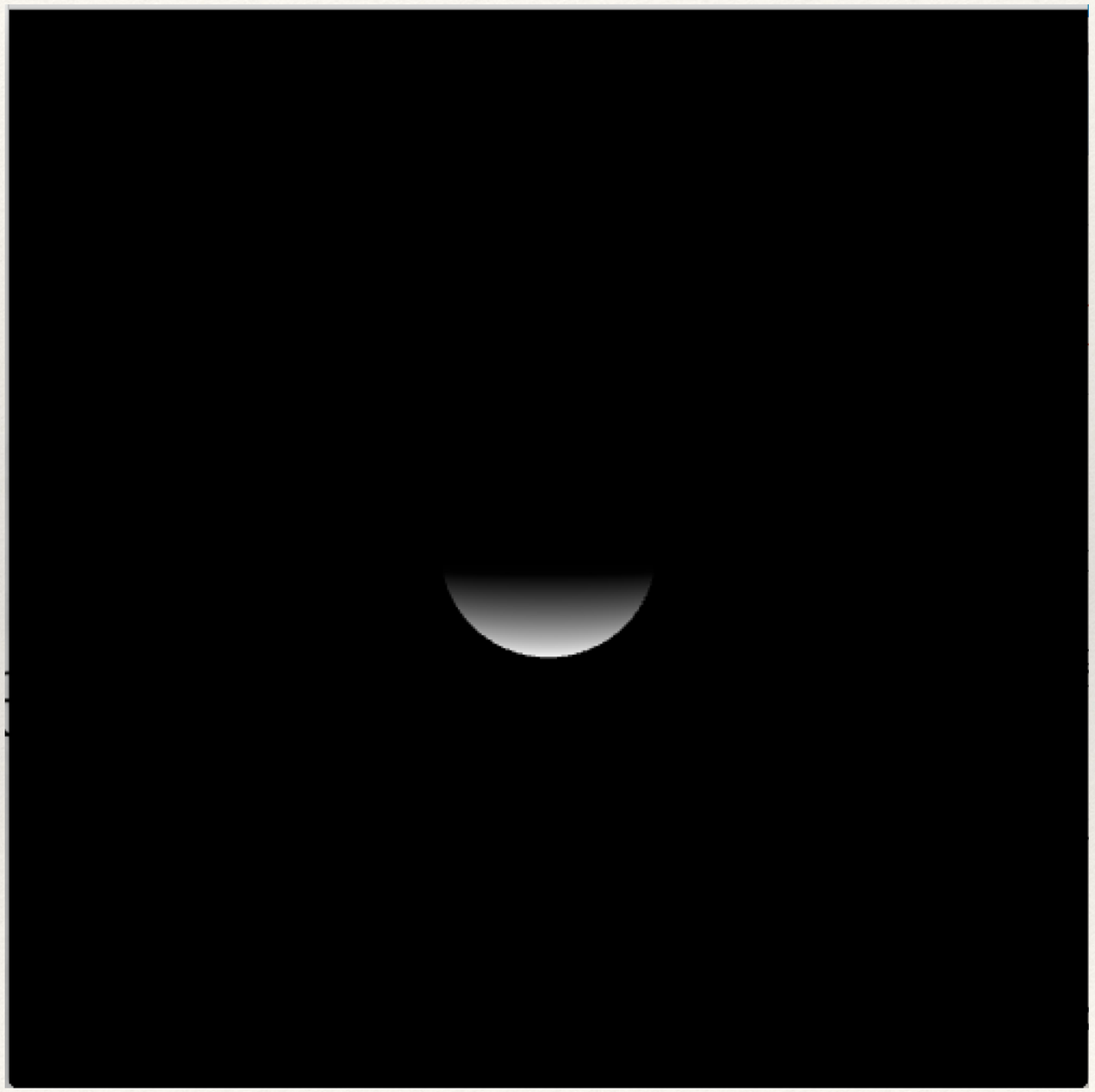
Point Lights

- Positional, non-directional source of light
  - Approximate a single source of light shining in all directions
  - Similar to a light bulb
- `pointLight(r, g, b,`

  `pos_x, pos_y, pos_z)`

Question

- What is the position of this point light?



Spot Lights

- Positional, directional source of light
  - Approximate a single source of light with direction and fall off
    - Similar to…well, a spot light!
- `spotLight(r, g, b,`

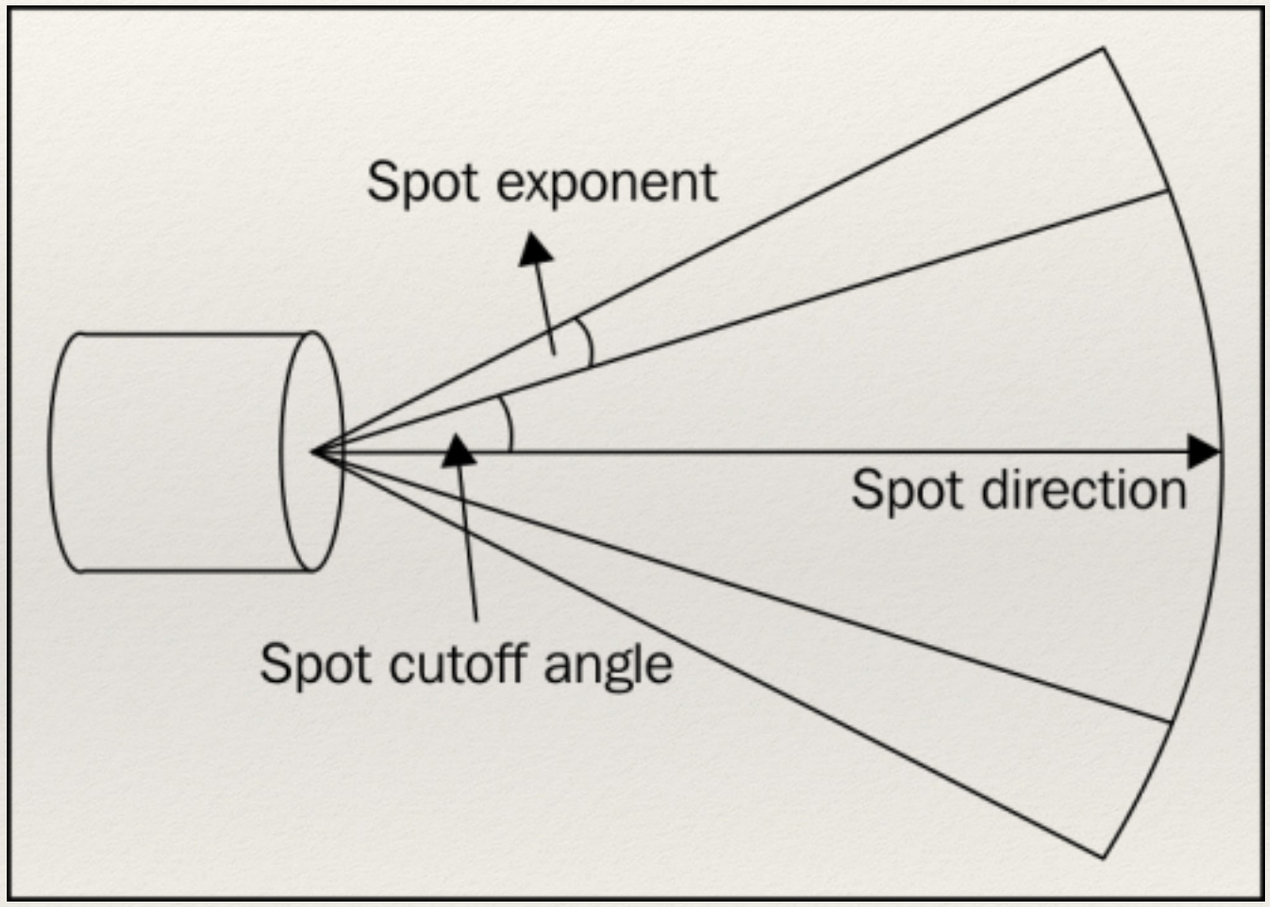
  `pos_x, pos_y, pos_z,`

  `dir_x, dir_y, dir_z,`

  `angle, concentration)`

Angle and Concentration

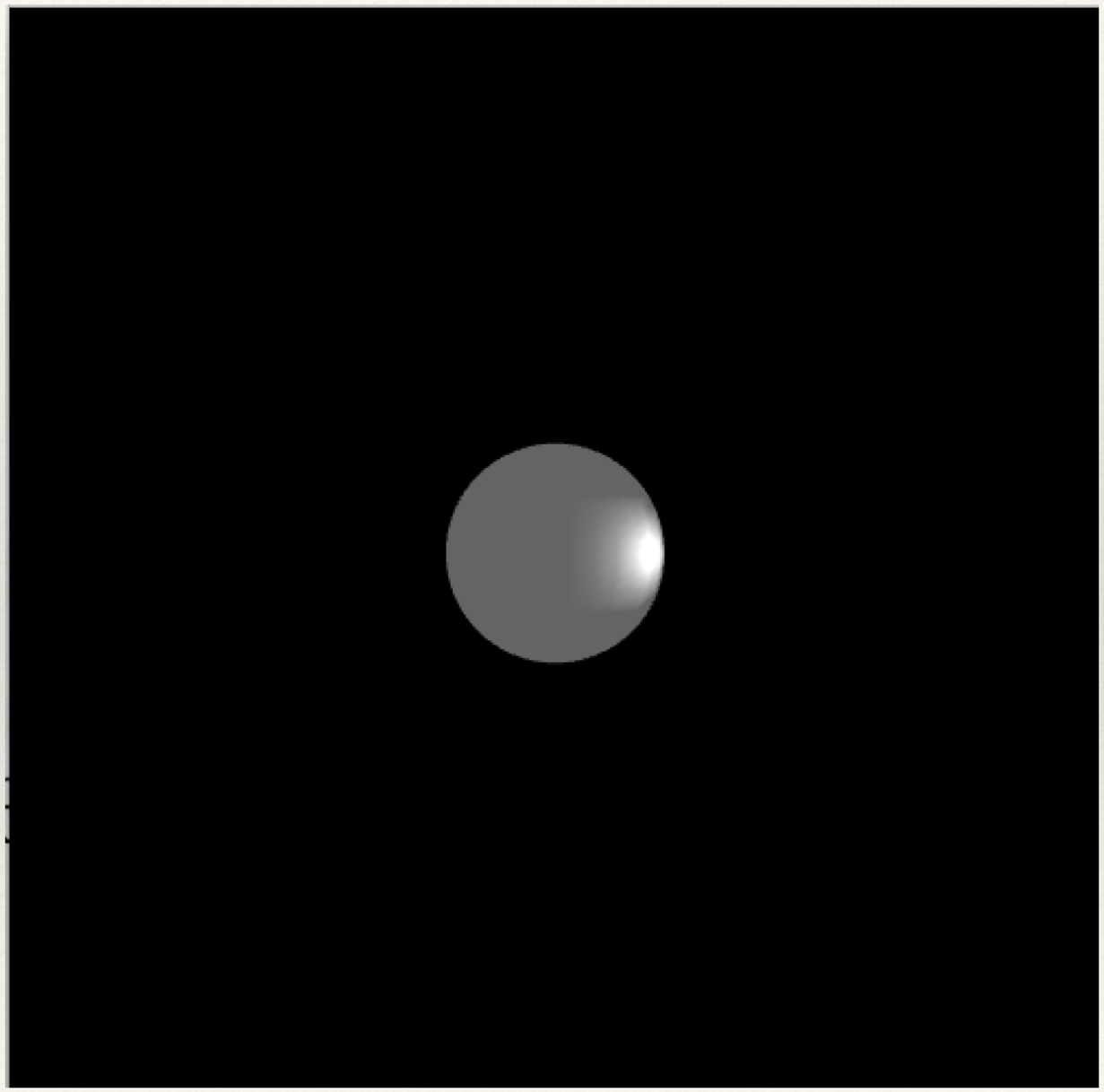
- Spot light angle is the "cut off" angle of the light
- Spot light concentration (exponent) is the adjusts the "fall off" of the light along the edge of the cone



(Safari Books, OpenGL cookbook)

Question

- Where is the spotlight that created this light on the sphere?

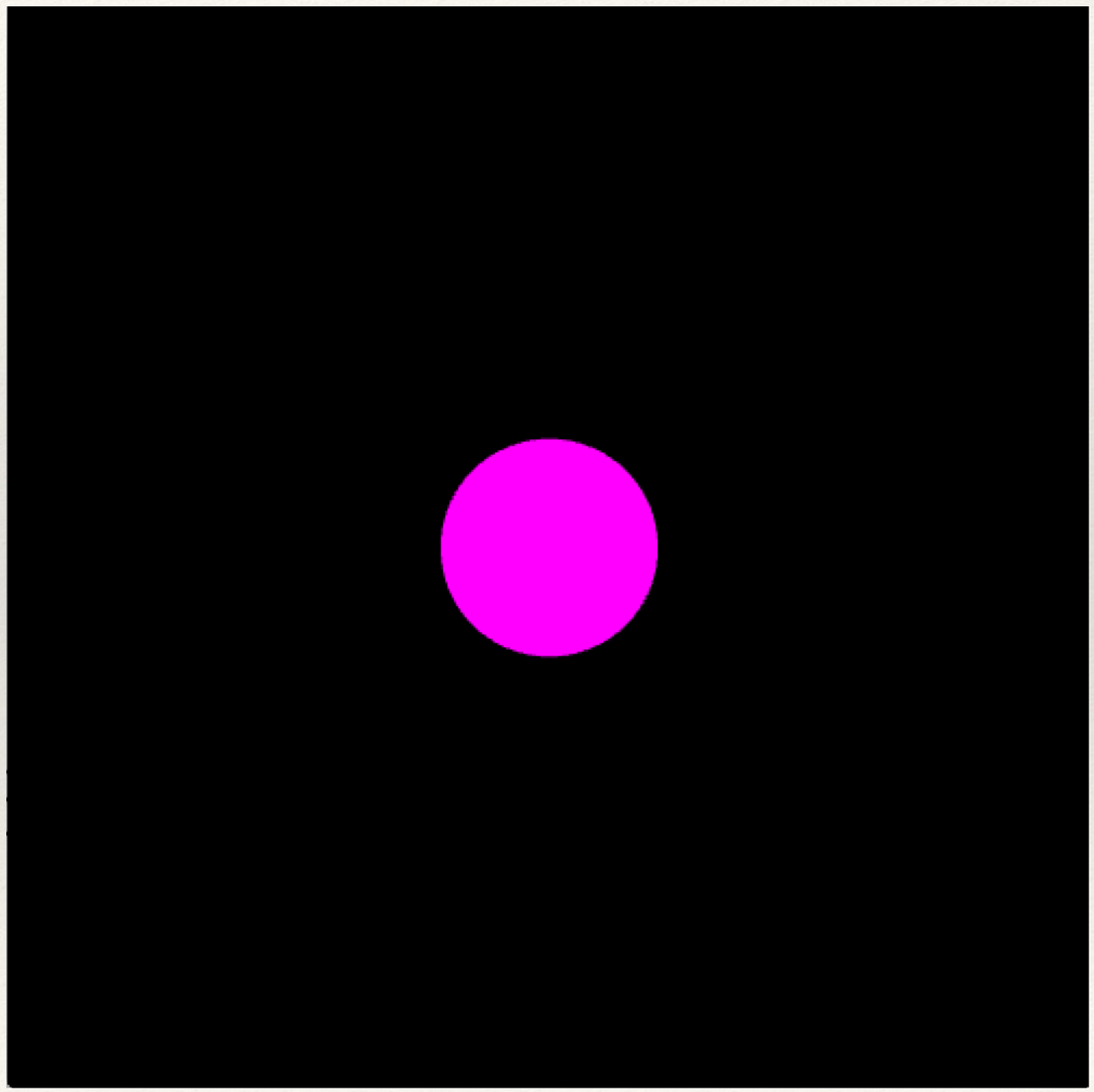


Ambient Lights

- Non-directional "general" sources of light
  - Approximate many, many light bounces within a scene
    - Similar to indirect lighting on a cloudy day
- `ambientLight(r, g, b)`
- `ambientLight(r, g, b,`
  `pos_x, pos_y, pos_z)`

Question

- What is the RGB value of this ambient light?



Lighting Demo

Hands-on: Using Lighting

- Today's activities:

1. Create 3D objects in a scene as well as a camera
2. Create one of each: a directional light, a point light, a spot light, and ambient light
3. Change each of these lights by adjusting its color, its position and/or direction, and the spot light's angle and concentration