

### Common Types of Light Sources

- Ambient Light: no identifiable source or direction
- Point source: given only by point
- Distant light: give only by direction
- Spotlight: from source in direction
  - Cut-off angle defines a cone of light
  - Attenuation function (brighter in center)
- Light source described by a luminance
  - Each color is described separately
  - $I = [I_r \ I_g \ I_b]^T$  (I for intensity)
  - Sometimes calculate generically (applies to r, g, b)

### Ambient Light

- Intensity is the same at all points
- This light does not have a direction (or... it is the same in all directions)

### Point source

- Given by a point  $p_0$
- Light emitted from that point equally in all directions
- Intensity decreases with square of distance
- One limitation of point sources
  - Shading and shadows inaccurate
  - Example: penumbra (partial “soft” shadow)

### Distant Light Source

- Given by a vector  $v$
- Intensity does not vary with distance (all distances are the same... infinite!)

### Spotlight

- Most complex light source
- Light still emanates from point
- Cut-off by cone determined by angle  $\theta$

### Spotlight Attenuation

- Spotlight is brightest along  $I_s$
- Vector  $v$  with angle  $\phi$  from  $p$  to point on surface
- Intensity determined by  $\cos \phi$
- Corresponds to projection of  $v$  onto  $I_s$
- Spotlight exponent  $e$  determines rate

### Surface Reflection

- When light hits an opaque surface some is absorbed, the rest is reflected
- The reflected light is what we see

- Reflection is not simple and varies with material
  - The surface's micro structure define the details of reflection
  - Variations produce anything from bright specular reflection (mirrors) to dull matte finish (chalk)

Resource:

Carnegie Mellon University class notes

<http://graphics.cs.cmu.edu/nsp/course/15-462/Spring04/slides/07-lighting.pdf>