Supplement to Lecture 13

Color, Light, Photorealism
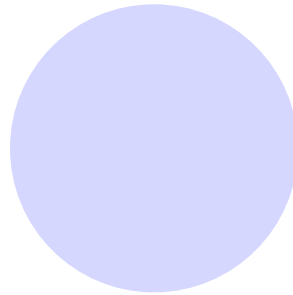
Why do we need shading

- Suppose we build a model of a sphere using many polygons and color it with `glColor`. We get something like

- But we want

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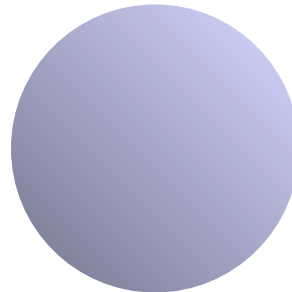Notes and figures from *Ed Angel: Interactive Computer Graphics, 6th Ed., 2012 © Addison Wesley*
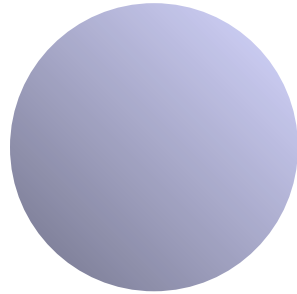
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Shading (based on Light-Material Interaction)

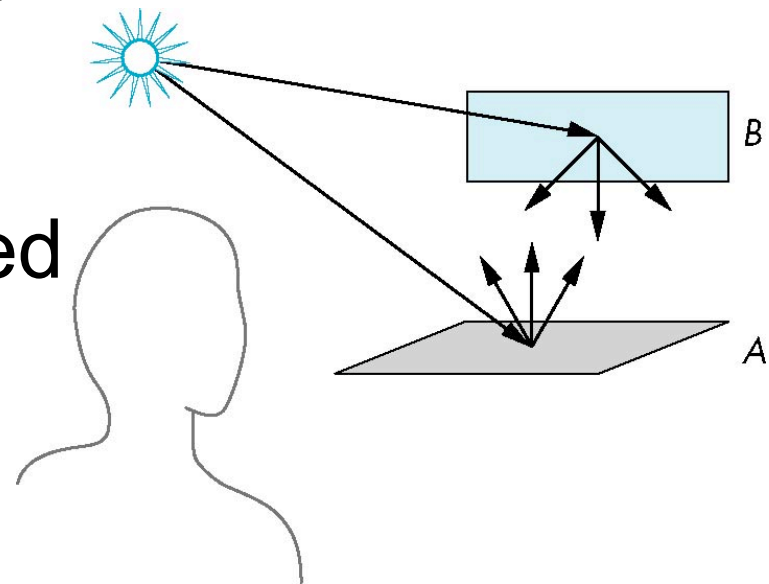- Why does the image of a real sphere look like

- Light-material interactions cause each point to have a different color or shade

- Need to consider
  - Light sources
  - Material properties
  - Location of viewer
  - Surface orientation

Light Scattering

- Light strikes A
  - Some scattered
  - Some absorbed

- Some of scattered light strikes B
  - Some scattered
  - Some absorbed

- Some of this scattered
light strikes A
  and so on

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Rendering Equation

- The infinite scattering and absorption of light can be described by the *rendering equation*
    - Cannot be solved in general
    - Ray tracing is a special case for perfectly reflecting surfaces

- Rendering equation is global and includes
    - Shadows
    - Multiple scattering from object to object

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Global Effects in Perception

shadow

multiple reflection

translucent surface

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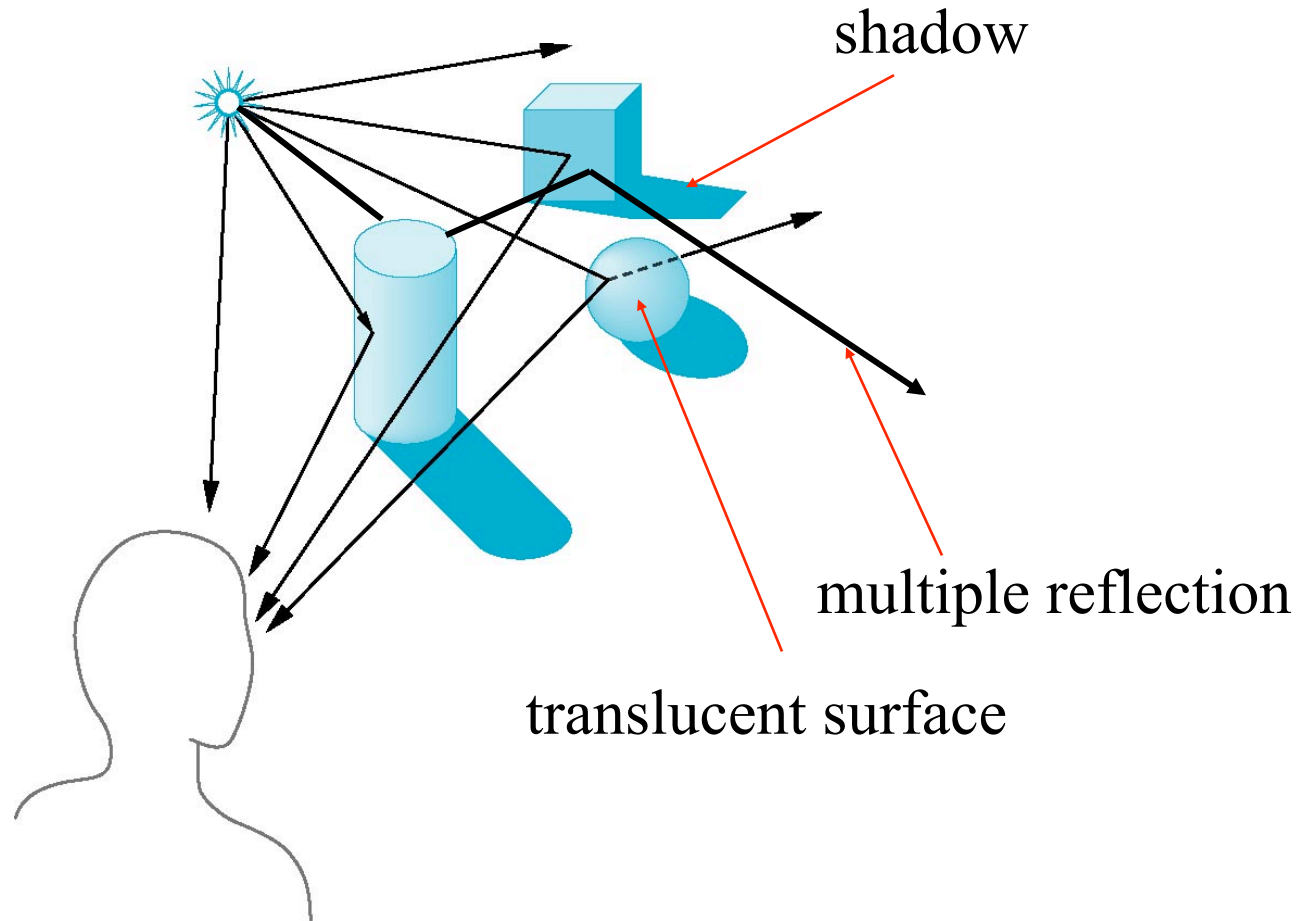
Light Material Interaction

- Light that strikes an object is partially absorbed and partially scattered (reflected)
- The amount reflected determines the color and brightness of the object
  - A surface appears red under white light because the red component of the light is reflected and the rest is absorbed
- The reflected light is scattered in a manner that depends on the smoothness and orientation of the surface

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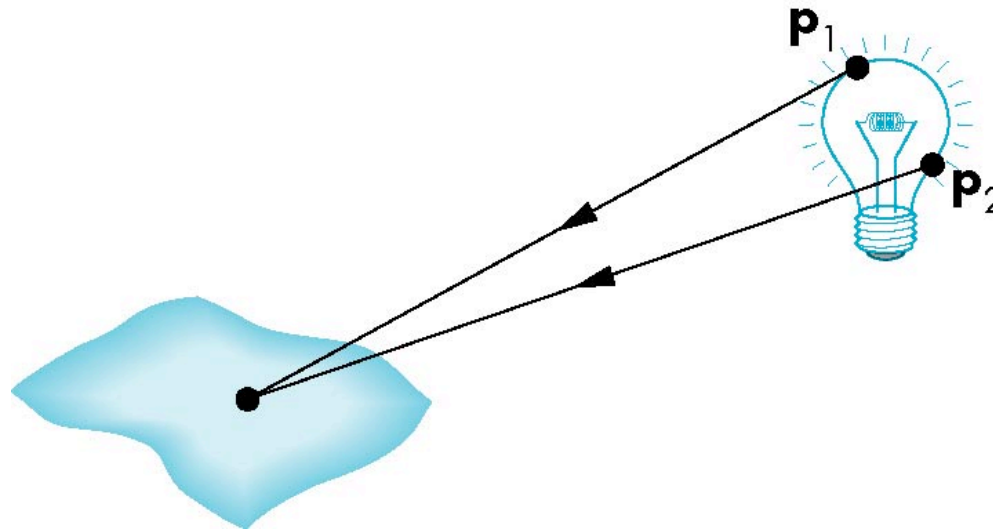University of Texas at Austin

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Local vs Global Rendering

- Correct shading requires a global calculation involving all objects and light sources
  - Incompatible with pipeline model which shades each polygon independently (local rendering)
- However, in computer graphics, especially real time graphics, we are happy if things "look right"
  - many techniques for approximating global effects

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Light Sources

General light sources are difficult to work with because we must integrate light coming from all points on the source

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Simple Light Sources in OpenGL

- Point source
    - Model with position and color
    - Distant source = infinite distance away (parallel)

- Spotlight
    - Restrict light from ideal point source

- Ambient light
    - Same amount of light everywhere in scene
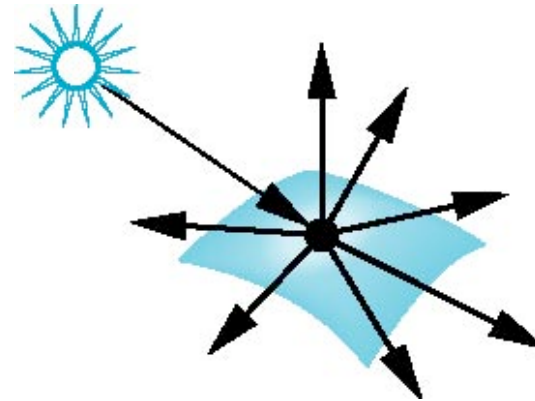   - Can model contribution of many sources and reflecting surfaces

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Surface Types

- The smoother a surface, the more reflected light is concentrated in the direction a perfect mirror would reflected the light
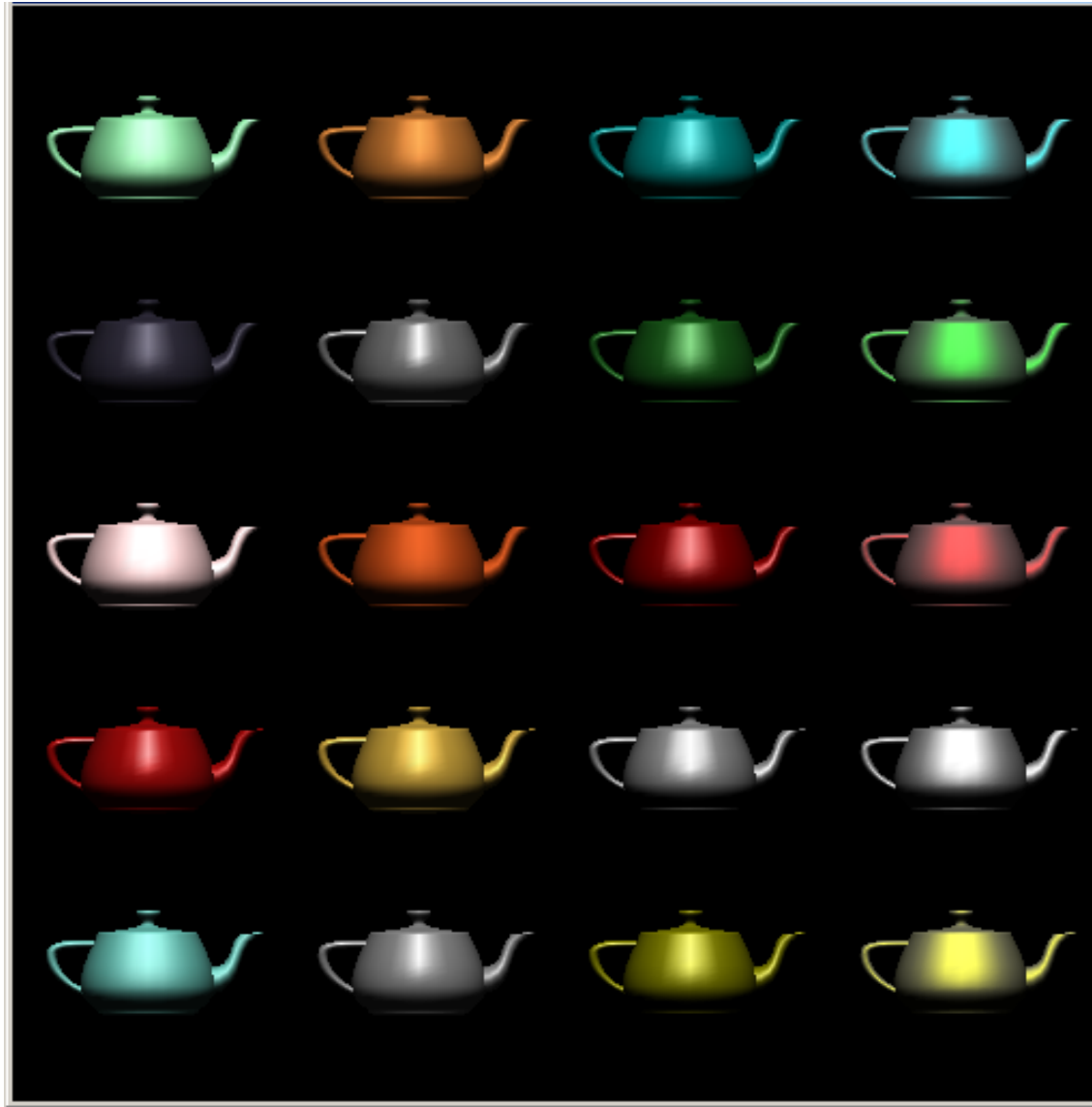
- A very rough surface scatters light in all directions
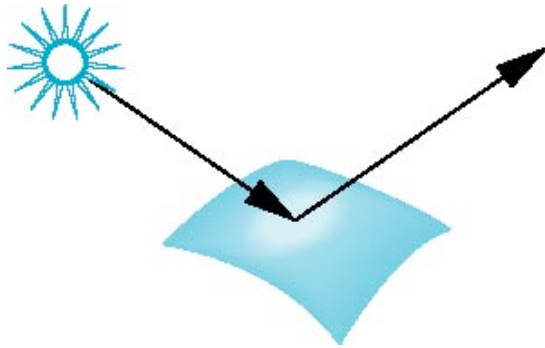
smooth surface

rough surface

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