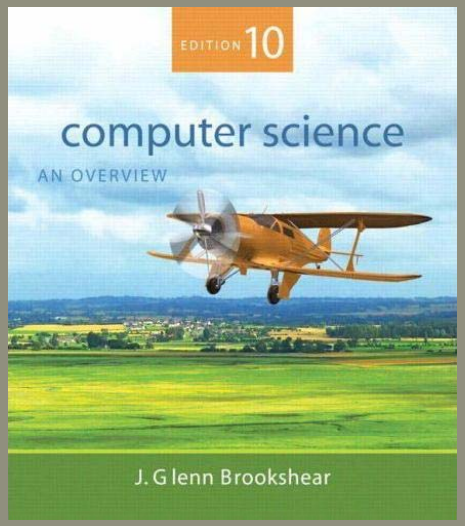
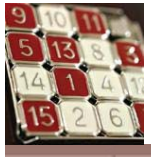
Chapter 10

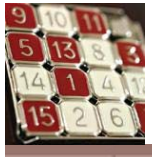
Computer Graphics





2D Versus 3D Graphics

- **2D Graphics:** Deals with manipulating two-dimensional images
- **3D Graphics:** Deals with producing and displaying images of three-dimensional virtual scenes.



Chapter 10: Computer Graphics

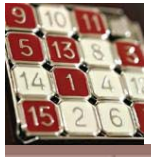
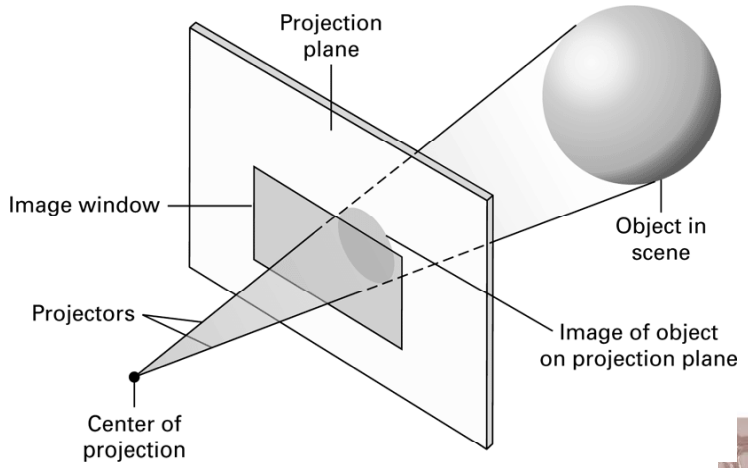


Figure 10.1 A "photograph" of a virtual world produced using 3D graphics (from Toy Story by Walt Disney Pictures/Pixar Animation Studios) © Corbis/Sygma

Figure 10.2 The 3D graphics paradigm



Modeling Objects

- Shape: Represented by a polygonal mesh obtained from
  - Traditional mathematical equations
  - Berzier curves and surfaces
  - Procedural models
  - Other methods being researched
- Surface: Can be represented by a texture map

Figure 10.3 A polygonal mesh for a sphere

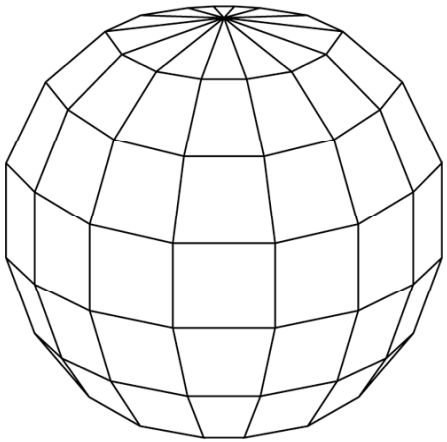
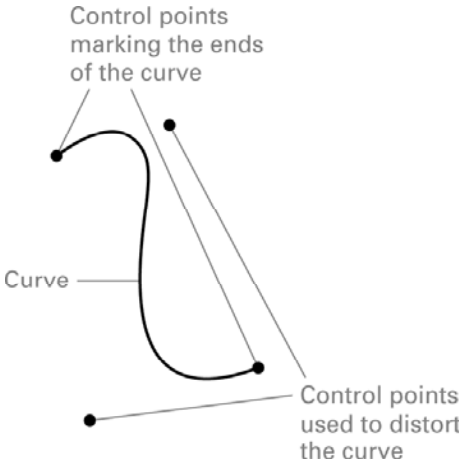


Figure 10.4 A Bezier curve



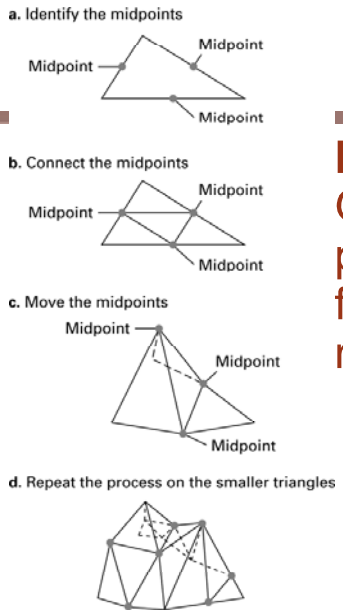


Figure 10.5 Growing a polygonal mesh for a mountain range

Reflection Versus Refraction

- Reflection: Light rays bounce off surface.
  - Specular light
  - Diffuse light
  - Ambient light
- Refraction: Light rays penetrate surface.

Figure 10.6 A scene from Shrek 2 by Dreamworks SKG (© Dreamworks/The Kobal Collection)

Figure 10.7 Reflected light

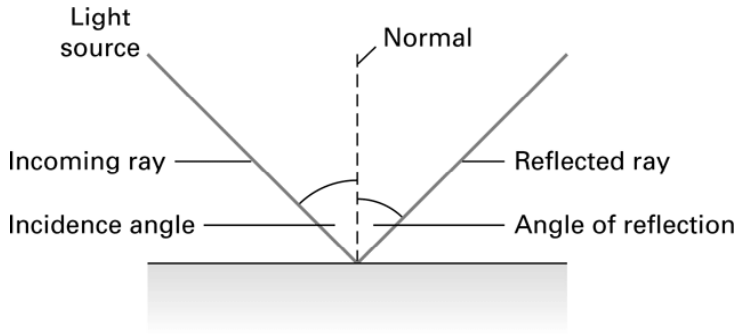


Figure 10.8 Specular versus diffuse light

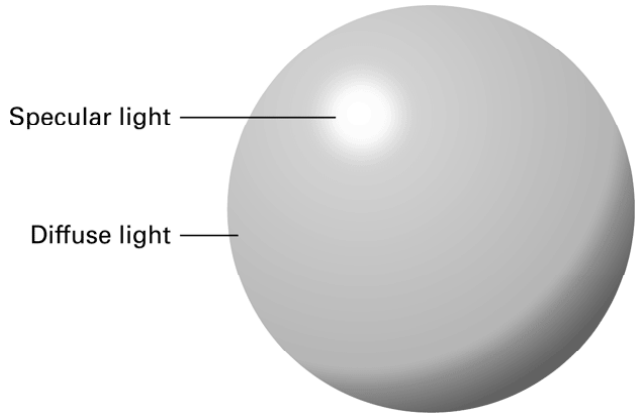
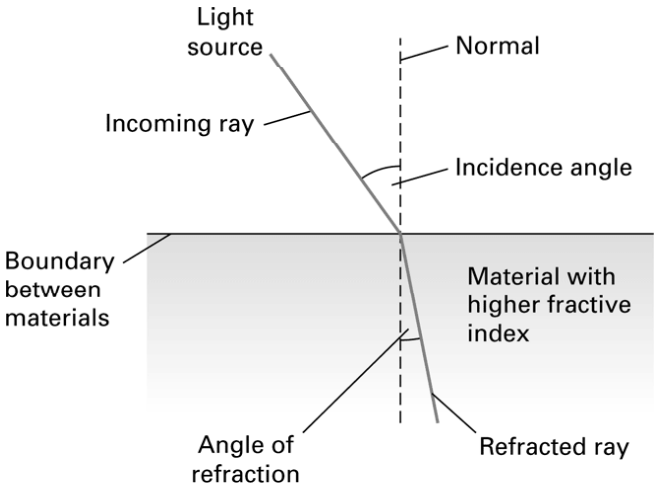


Figure 10.9 Refracted light



Rendering

- **Clipping:** Restricts attention to objects within view volume
- **Scan Conversion:** Associates pixel positions with points in scene
- **Shading:** Determines appearance of points associated with pixels

Figure 10.10 Identifying the region of the scene that lies inside the view volume

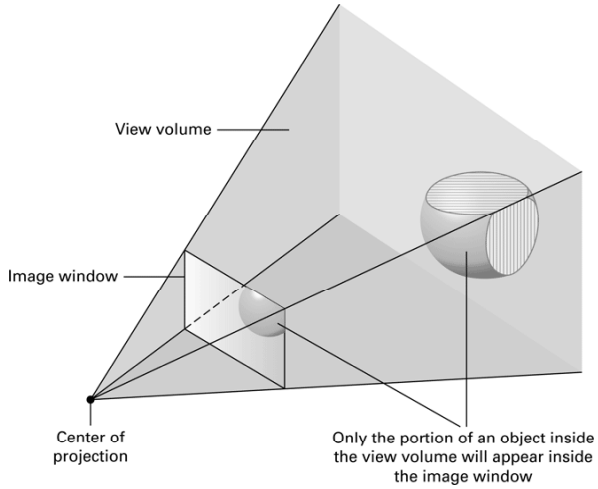


Figure 10.11
The scan conversion of a triangular patch

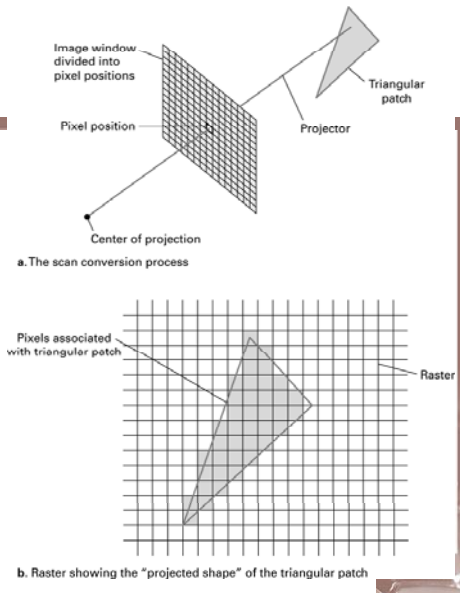
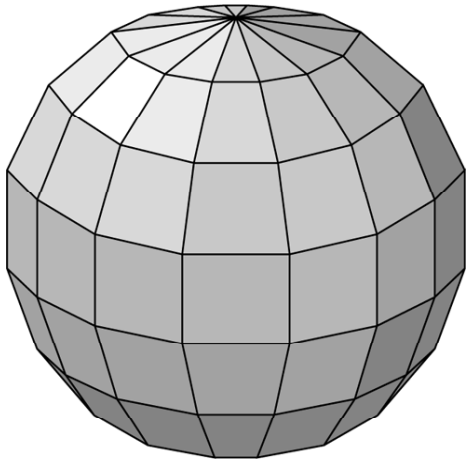


Figure 10.12 A sphere as it might appear when rendered by flat shading



Shading Techniques

- **Flat Shading:** Creates faceted appearance
- **Gouraud and Phong Shading:** Creates smooth, rounded appearance
- **Bump Mapping:** Creates bumpy, rounded appearance

Figure 10.13 A conceptual view of a polygonal mesh with normal vectors at its vertices

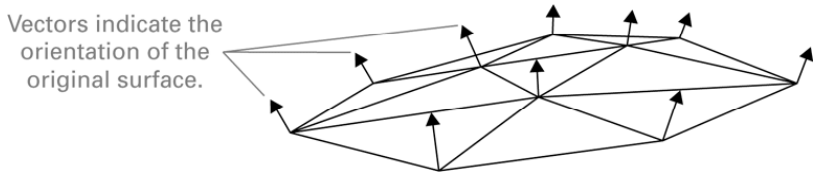


Figure 10.14 A sphere as it might appear when rendered using bump mapping

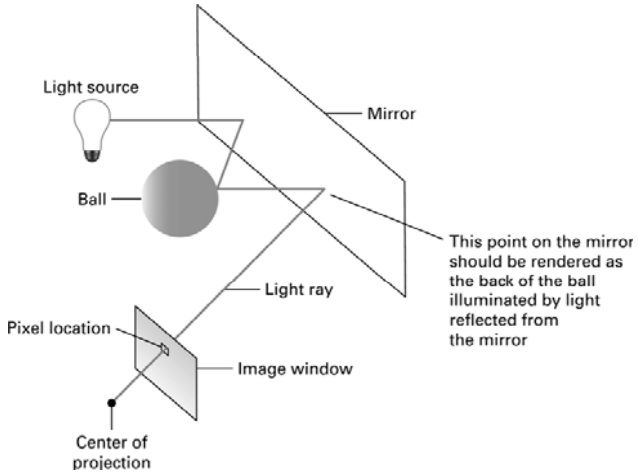
Rendering Pipeline

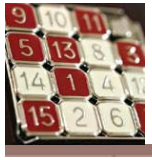
- Consists of traditional algorithms for clipping, scan conversion, and shading
- Often implemented in firmware
- Used as an abstract tool in graphics applications

Local Versus Global Lighting

- Local Lighting Model: Does not account for light interactions among objects
- Global Lighting Model: Accounts for light interactions among objects
  - Ray Tracing
  - Radiosity

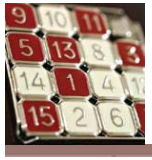
Figure 10.15 Ray tracing





Animation

- **Storyboard:** A sequence of sketches summarizing the entire animation
- **Frame:** One of many images used to create animation
- **Key Frames:** Frames capturing the scene at specified points in time
- **In-betweening:** Producing frames to fill the gaps between key frames



Simulating Motion

- **Dynamics:** Applies laws of physics to determine position of objects
- **Kinematics:** Applies characteristics of joints and appendages to determine position of objects
  - Avars
  - Motion Capture