Rendering, Shaders, & Textures in Maya
Main Components

• Renderers
  – Panels, Maya software, Mental ray, etc

• **Shaders (Materials)** – surface properties
  – Lambert, Blinn, etc

• **Texture Maps & UV Coordinates**
  – Images or procedurally generated

• **Lights**
  – Point, Directional, Spot

• **Quality**
  – Anti-aliasing
A renderer is the *computational engine*: It takes the entirety of the parameters (modeling, lighting, animation, ...) and generates the 2D image.

- **Maya Panels**: low quality, very fast, intended for interaction with user.
  - Options: wireframe, shaded, etc

- **Maya Software**: high quality
  - Scanline (no reflections or refractions)
  - Can turn on Ray Tracing (for reflections and refractions)
Renderers (cont)

• **Mental Ray**: professional quality, very slow!
  – Uses both Scanline and Ray Tracing
  – **Indirect Lighting:**
    – *Global Illumination (GI)* for capturing indirect lighting.
    – *Final Gathering (FG)* – more subtle indirect lighting effects.
  – **Caustics**
  – **Ambient Occlusion (AO)** (requires special mental ray shaders and settings)
Shaders (Materials)

Defines surface properties. Determines color and light & surfaces interactions.

- Types: Blinn, Lambert, Phong, mia_material, etc
- Material properties (diffuse, ambient, transparency, etc)
- Properties can be constant or map to a texture.
Texture Maps and UV Coordinates

• Default surface properties (diffuse, transparency, bump, etc) are constant for all points on a given surface.

• Textures make it possible for properties to vary across a given surface.

• Textures are
  – 2D images, e.g. jpg, photoshop files
  – 2D or 3D procedural textures, e.g. fractal, wood, marble

• **Mapping**
  – Textures are “wrapped” or mapped around surface.
  – UV coordinates determine how textures are mapped.
2D Texture Mapped to Sphere

- UV coordinates
- Texture mapped to color channel
- Texture mapped to color and bump channel
- Maya Texture Editor – unwrapped faces
- 2D image texture
Anti-Aliasing

- **Aliasing**
  - “jaggies” caused by under sampling.

- **Anti-aliasing** techniques.
  - Pixel color is sampled at multiple points and then averaged.

- In Maya Software Renderer, “Production Quality” applies anti-aliasing techniques to smooth out images.
Shadows

• Associated with a light.
• Depth-mapped
  – Faster, lower quality but often just fine.
  – May be easier to produce softer shadows
• Ray Traced
  – Slower, higher quality
  – Can be used with transparent or refractive surfaces
Depth Mapped Shadows

• Sharp: high resolution, small filter size
• Soft: lower resolution, larger filter size
Ray Traced Shadows

- Must turn on Ray-Tracing in Render Settings as well as in the light settings.
- Sharp: 0 Light Radius, 1 shadow ray
- Soft: non-zero Light Radius, many shadow rays

Light Radius = 0, Shadow Rays = 1

Light Radius = 1, Shadow Rays = 40
Mental Ray Renderer

• Direct Lighting: Scanline and/or Ray Tracing
• Indirect lighting:
  – Global Illumination (GI)
  – Final Gathering (FG)
• Ambient occlusion (AO)
• Caustics
Mental Ray – Global Illumination

Multi-step process:

• Photon Map: Simulate photons bouncing off geometry to create a “photon map”
• Illumination of a surface is based on number and intensity of photons on that surface and value of diffuse coefficient.
• Rendering – “Energy” values are averaged and interpolated.