# Rendering, Shaders, & Textures in Maya
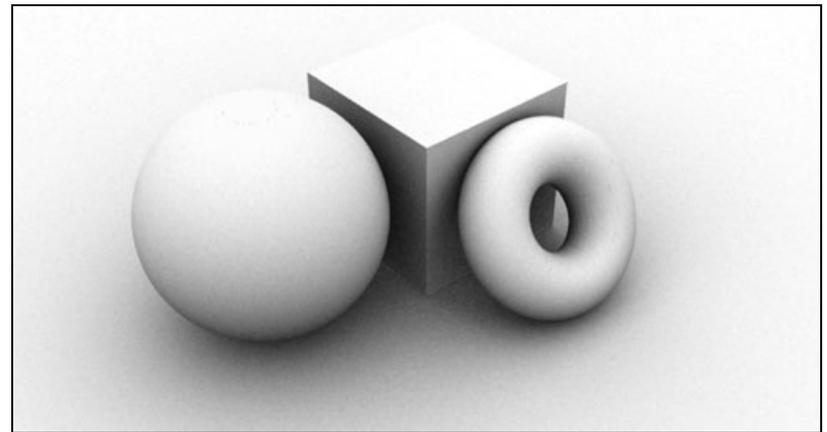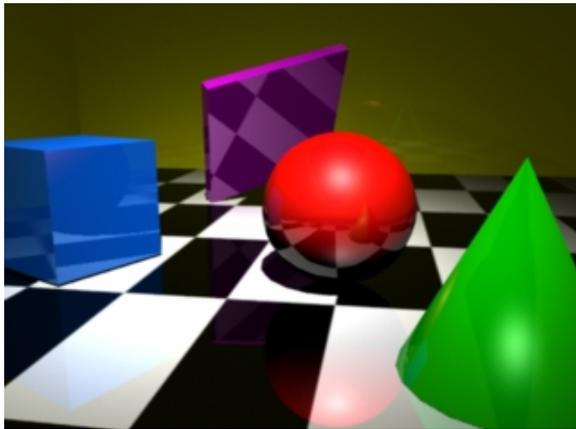
Main Components

- **Renderers**
  - Panels, Maya software, Mental ray, etc
- **Shaders (Materials)** – surface properties
  - Lambert, Blinn, mia_materials, etc
- **Texture Maps & UV Coordinates**
  - Images or procedurally generated
- **Lights**
 - Point, Directional, Spot, Area
- **Quality and Color Management in Maya**
 - Gamma correction
  - Anti-aliasing

Renderers

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
  - Viewport 2.0, Legacy High Quality Viewport

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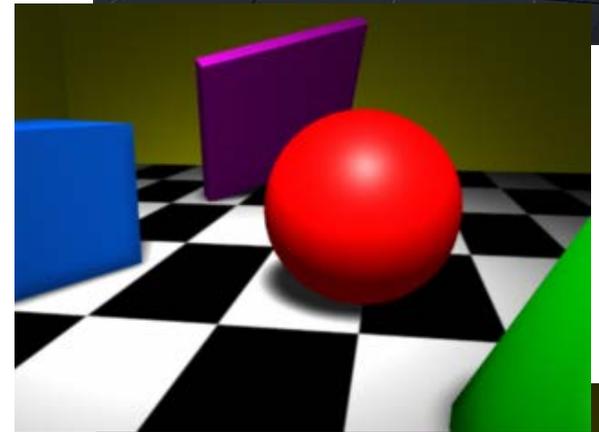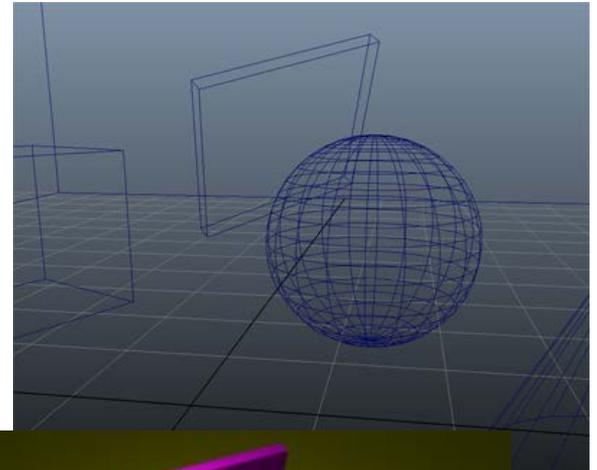
Renderers (cont)

- **Mental Ray**: professional quality, but slower!
  - 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)
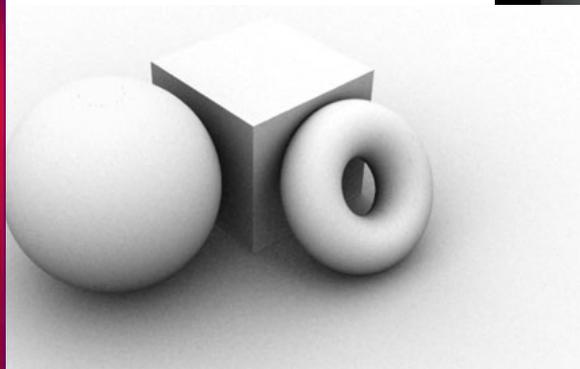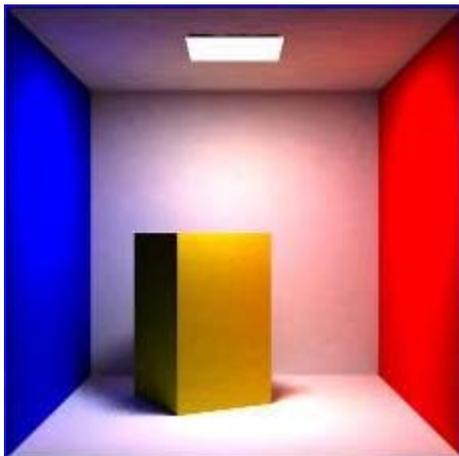
Shaders (Materials)

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.
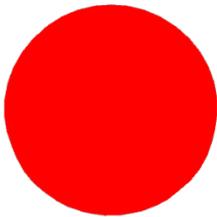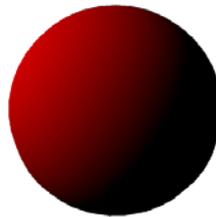
Ambient   Diffuse   Specular   All
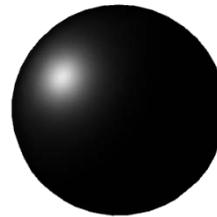
Texture Maps and UV Coordinates

- 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.
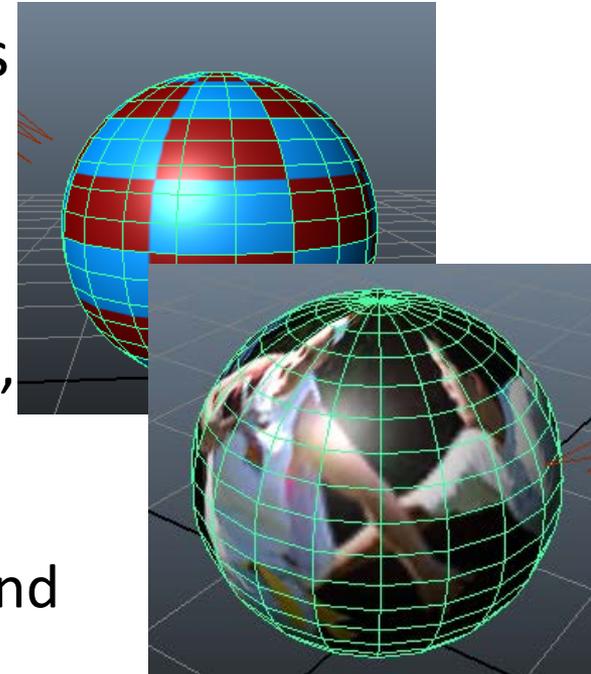
2D Texture Mapped to Sphere

uv coordinates

Texture mapped to color channel

Texture mapped to color and bump channel

Maya Texture Editor – unwrapped faces
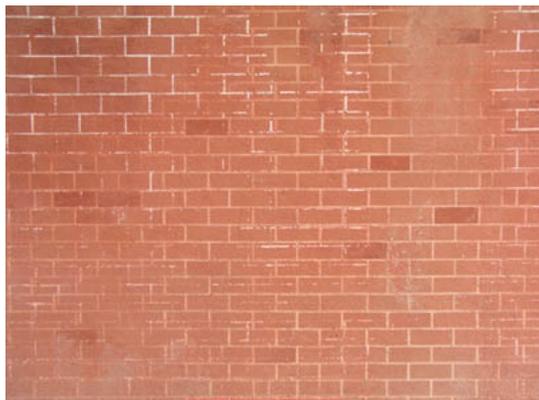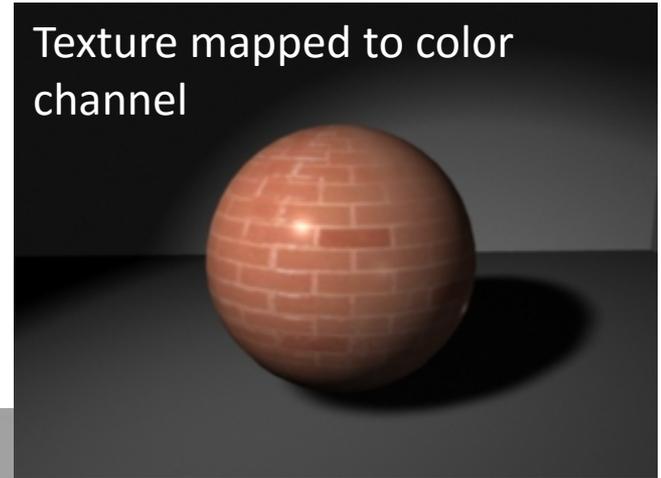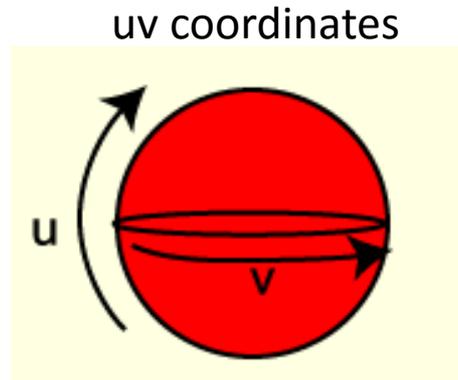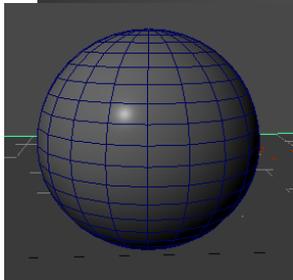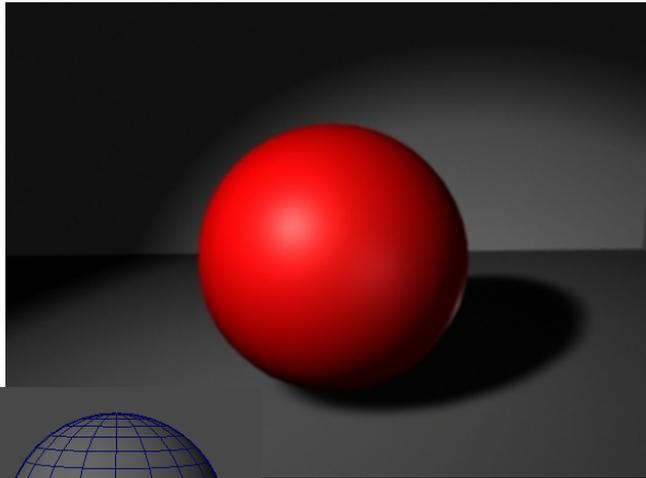
2D image texture
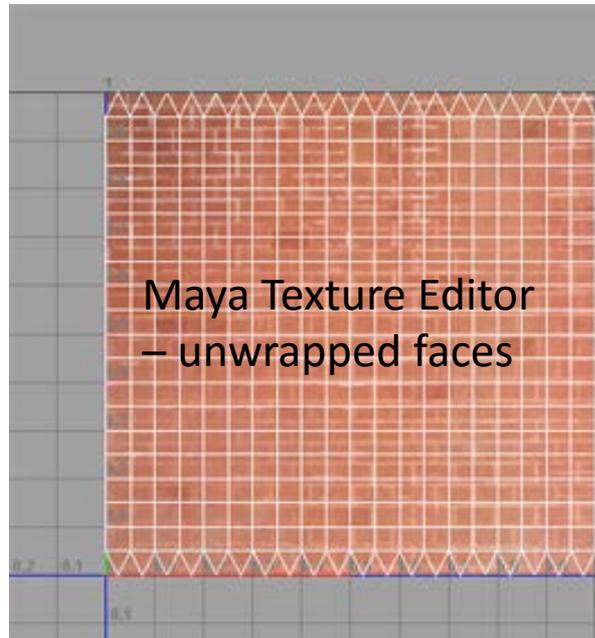
Anti-Aliasing

- Aliasing
  - "jaggies"caused by under sampling.
- Anti-aliasing techniques.
  - Pixel color is sampled at multiple points and then averaged.
- **Maya Software Renderer**: "Production Quality" applies anti-aliasing techniques to smooth out images.
- **Mental Ray**: default is pretty good but can also increase "overall quality".
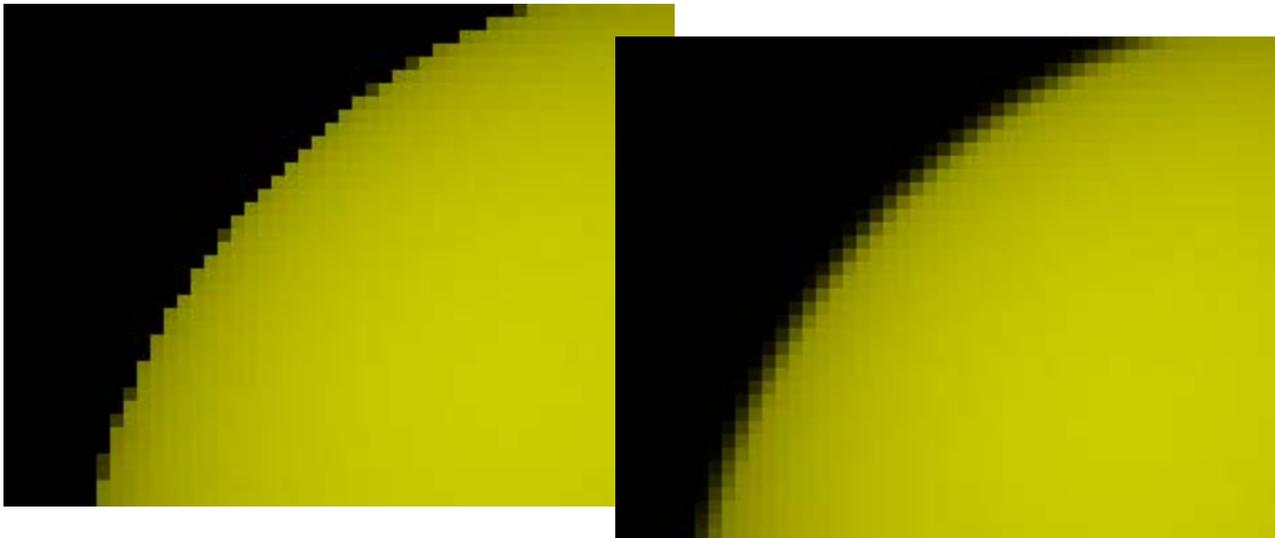
Shadows
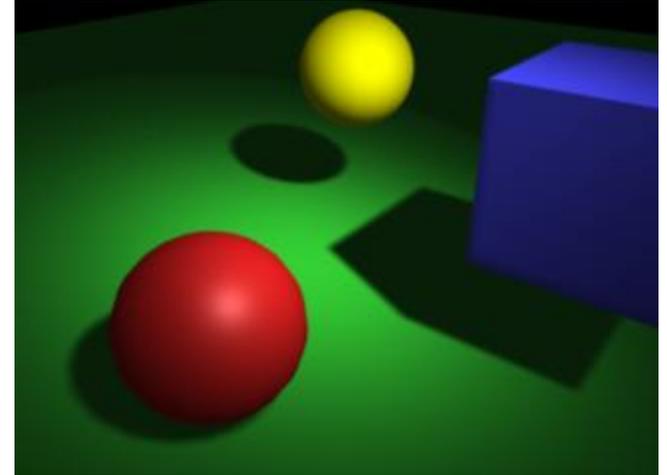
- Associated with a light.

- 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
  - May need to increase the shadow rays to improve quality (under a light's properties)

Depth Mapped Shadows

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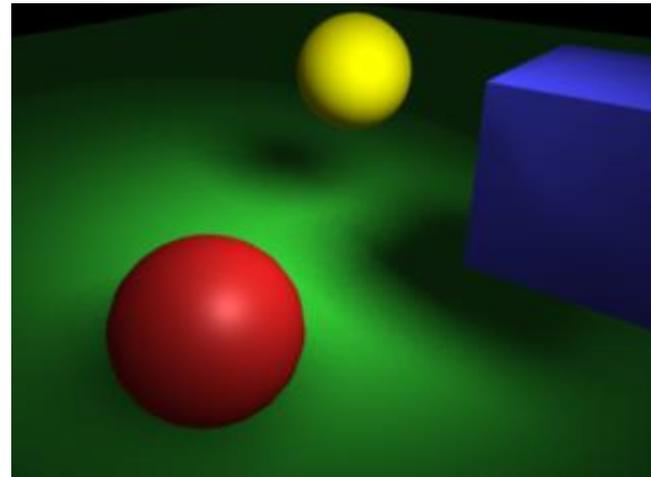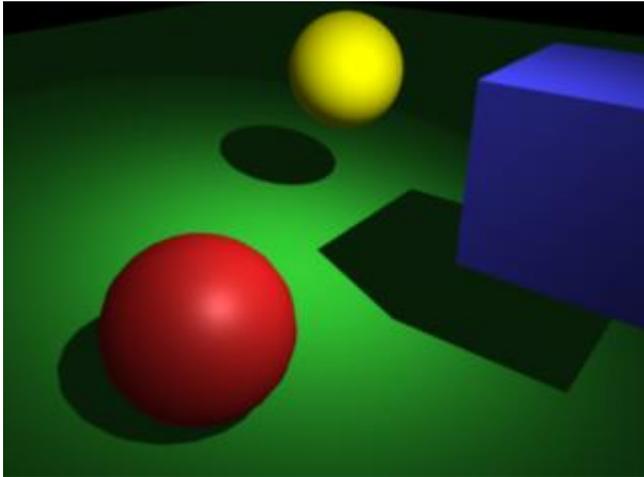
Ray Traced Shadows

- 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
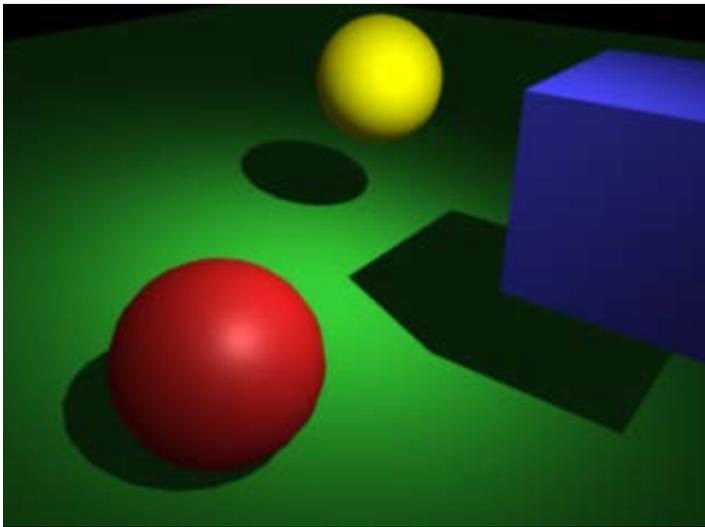
Light Radius = 0, Shadow Rays = 1
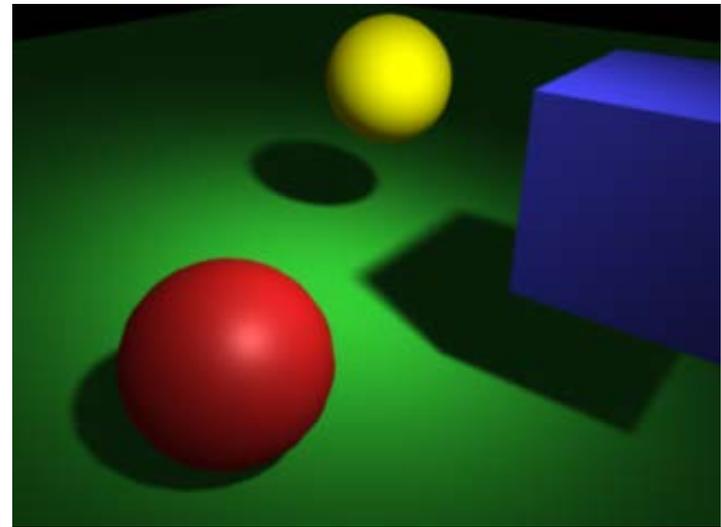
Light Radius = 1, Shadow Rays = 40

Mental Ray Renderer

- Direct Lighting: Scanline and/or Ray Tracing
- Indirect lighting (really slows rendering):
    - Global Illumination (GI), Final Gathering (FG)
    - Inside Scene - can use both GI & FG)
    - Outside Scene - use FG only
- Ambient occlusion (AO)
- Caustics
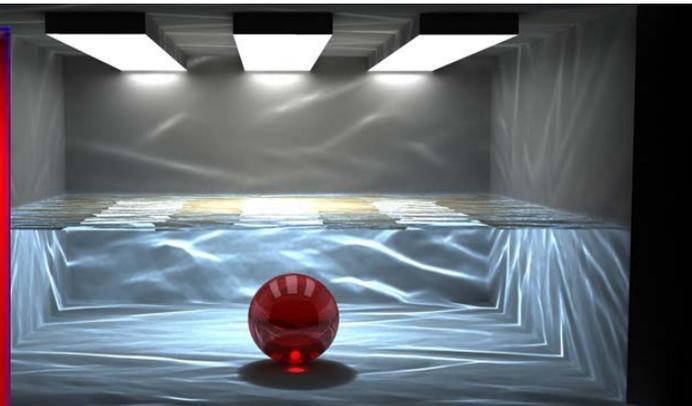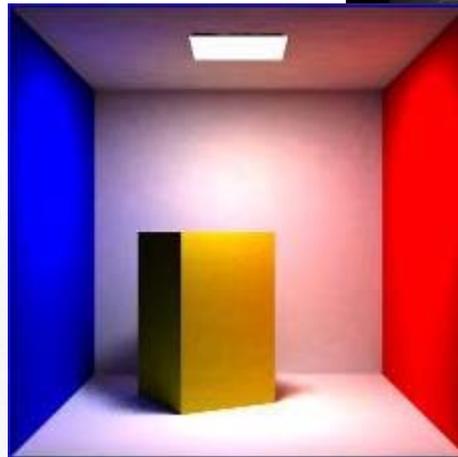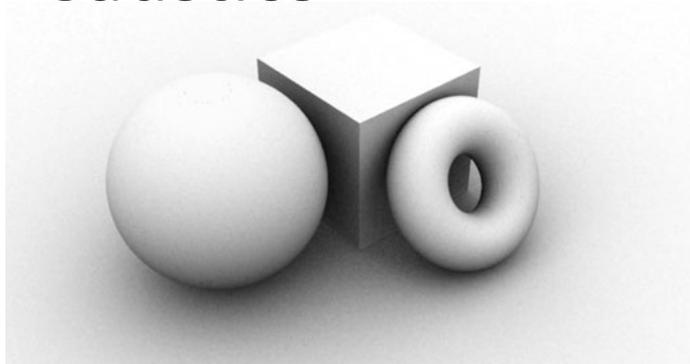
Mental Ray Renderer

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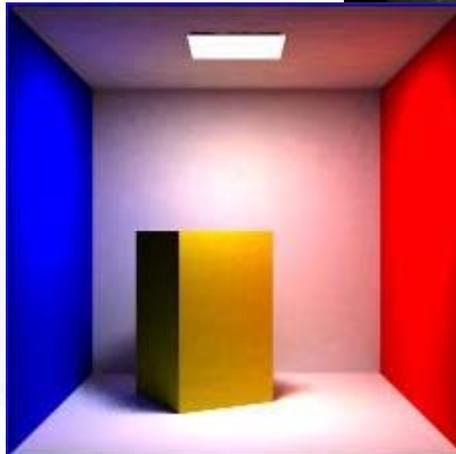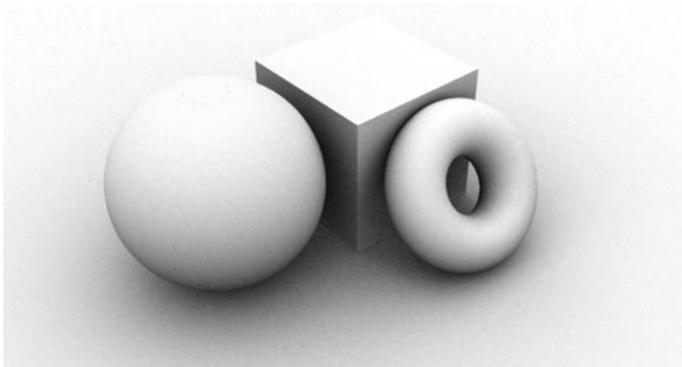
Mental Ray – Materials

- Use materials made for mental ray, e.g. mia_material_x which has many presets available

- Global Illumination (GI)
  - Use only for inside scenes.
  - Generally is used with Final Gather

- Final Gather (FG)
  - Ok for inside and outside scenes. Can also use Mental Ray Physical Sun & Sky for outside.
  - Can be used without GI
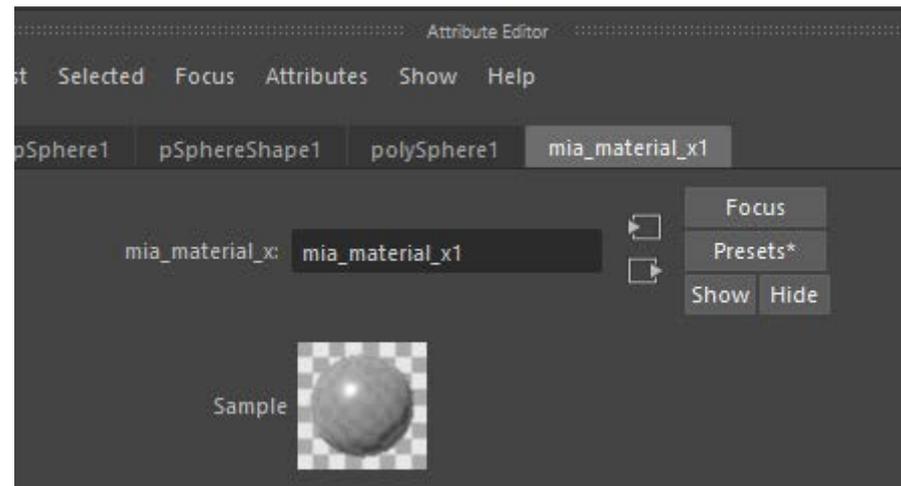
Color Management –
Gamma Correction and Maya
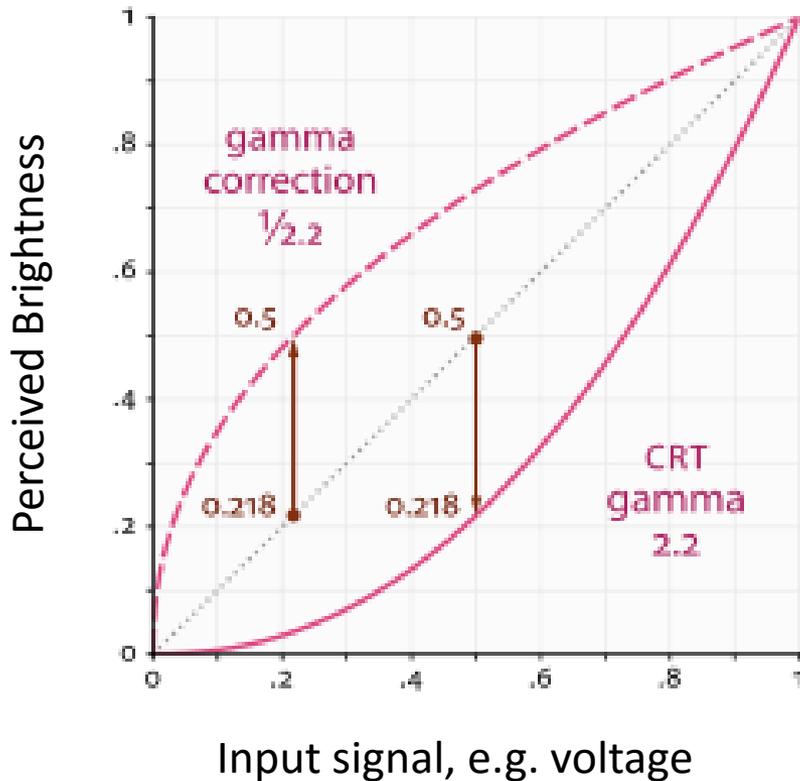
Doubling the signal to the display does not double the perceived brightness.

Images must be transformed (gamma corrected)
In order for the perceived brightness to
be correct.

Color Management inMaya
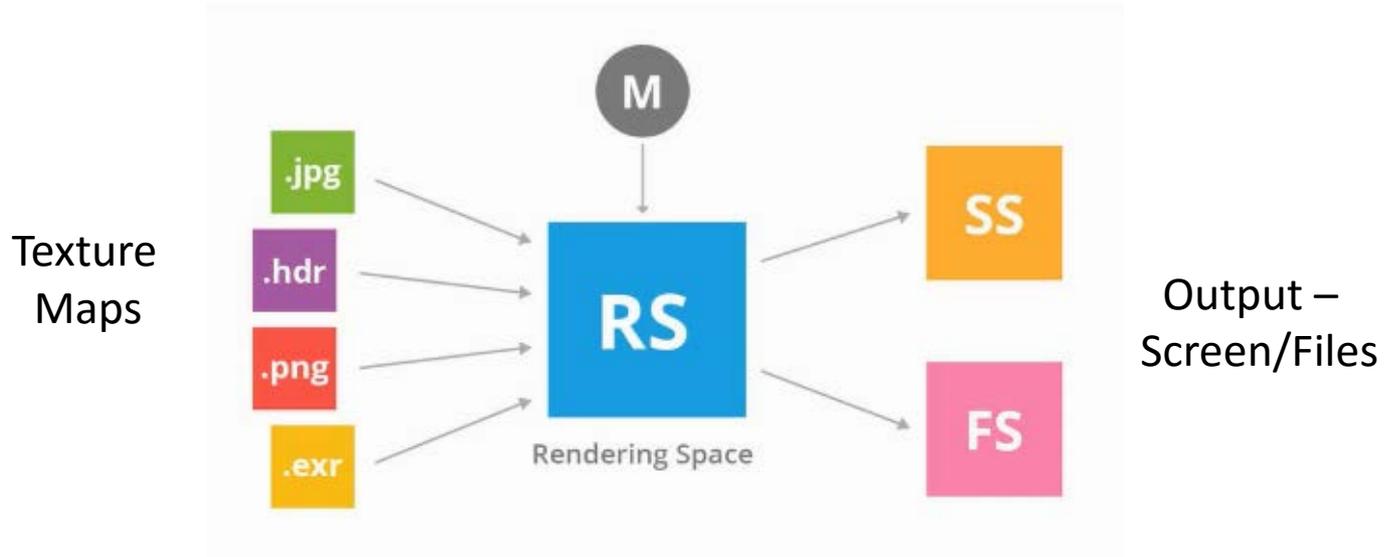
RS: Maya renders in linear space.

SS, FS: Must be gamma corrected when displayed on screen or saved to a file.

Texture Maps - jpg, png: Color maps are already gamma corrected and so must be reverse transformed when brought Maya's into linear rendering space.
But bump and reflection maps have not been gamma corrected and so must not be reverse transformed

Color Management

- Maya's Color Management handles of the transforms.

- Must make sure Color Management is enabled in the Render Settings.