AH | Introduction:

As most of you would already presume, lighting a scene in Maya is much like that of the real world, many elements from situations like studio or natural lighting can be adapted, then replicated for use within Maya. Ensuring the scene lighting is done effectively is pivotal when trying to make your character belong within a scene. The default lighting of Maya is only used when there are no other lights within the scene.

AH | Getting Started

Many peoples' first experience with lighting is, let's just stick any light in and hope it looks alright. Normally followed by playing with additional lights, moving them around, or using ridiculous settings until you get bored.

We want to venture into various types of lighting, take you through a couple of techniques and teach you some workflows that can be used for any piece of work.

AH | Lighting Types:

Ambient

This is used to replicate a scattered or non-directional light that you see all around you on a daily basis.

Area

This light source replicates the realistic distribution of a soft light source like that emitted by a florescent tube.

Directional

A singular large light source (like that of the sun), that creates very little effect on surface shading due to its magnitude.

Point

As the name suggests this light source originates at a point and has an omnidirectional luminosity like that created by a standard bulb or a candle.

Spot

As you may guess the spot light emits rays in a cone like fashion, and would be used to replicate things like car headlights or a lamp.

Volumetric

Lights objects within a desired area, good for replicating a closed environment like that inside a car.

AH | Lighting Terminology

Intensity

Simply put is how bright the light source is.

Drop-off

This is where the light fades perpendicular to the axis rather than along it; creating a feathered effect around the edge.

Specular Highlight

This is the bright spot of light that a light has on an object, most noticeable on the rounded edges of an object.

Decay Rate

Is the effect distance has on a light source, the further away the light from the source the less intense are the effects. Decay regions are used to

Penumbra angle

This relates to the area of lessening strength around the outer edge of the beam of light:

PC | Shadows

Shadows play in extremely important part in creating scene depth and it's important you put some thought into how you want your scene to look as a difference in light source could make all the difference.

Depth maps

Depth map shadows are a quick and efficient method of adding shadows to your scene. It consists of projecting a map of a certain resolution from the light source to calculate the shadow that should be cast.

Samples:

The greater the number of samples, the smoother the shadow will be (but the longer it will take to render).

Softness:

Defines how soft the shadow will be at the edges.

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Depth map filter size

A similar result to that of the penumbra angle but on the edge of a shadow as opposed to a light source.

Motion-Blur Shadows

Even with motion blur enabled, Maya is unable to calculate it for shadows so you need to perform a workaround.

There are two ways to do this. The first would be to switch to Mental Ray® Shadow Maps, which do calculate the motion blur (but will also increase render time, and will change the look of your scene somewhat because you are using a different renderer).

The Second would be to create a separate Shadow Pass and use compositing software to blur it and put it together in post.

Volumetric lighting effects

The ability to cast shadows through fog can exert some beautiful results. This is key to atmospheric shots such as the shadow of a window through a dusty church.

Ray-traced Shadows

An increase in render time will be noticed but Ray Tracing provides key advantages to those of Depth maps.

Because it is a more accurate method of calculation, Maya can render transparency and colour through an object, a stained glass window through Ray tracing will show the colour and density difference of the glass in each pane.

Ray tracing also allows you to set a degree of attenuation, so that the shadow 'blurs' the farther it is from the base of the object. This is most applicable to object that need to look like they are being lit softly, by a light box for example.
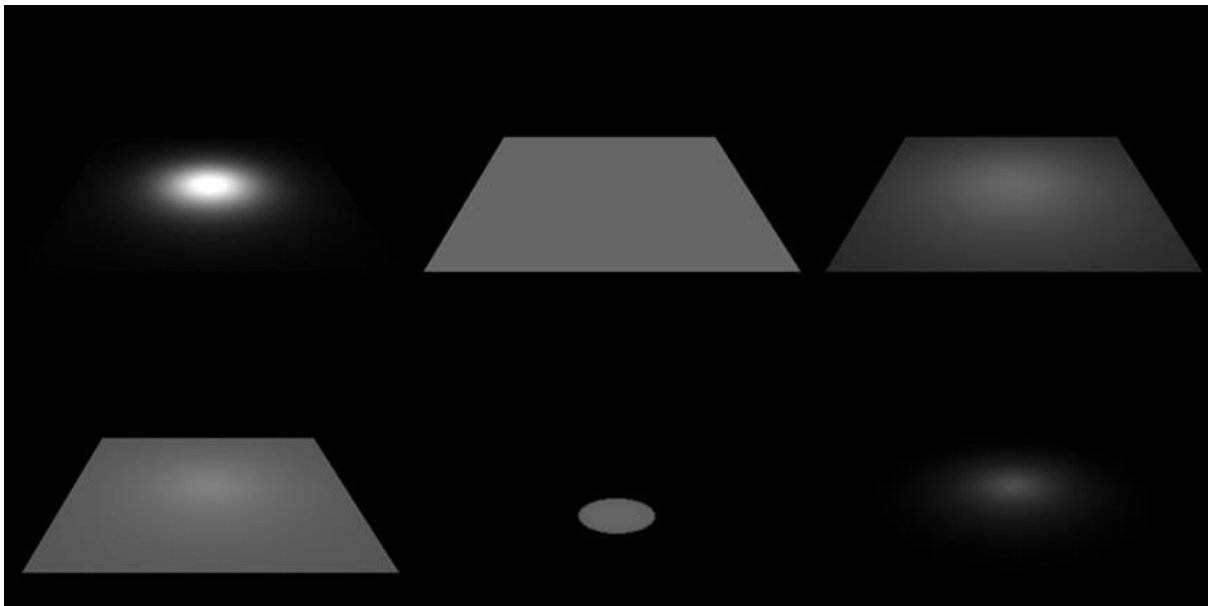
Mental Ray® Shadow Maps

Re-using shadow maps for static items can help decrease render times

*Mental Ray > Render Settings > Shadows > Rebuild Mode > (set to) Reuse Existing Maps*

Light Source > Attribute Editor > Mental Ray > Shadows > (enable) Use Mental Ray Shadow Map Overrides

## AH | Lighting Examples (Rendered using Mental Ray)

(Left - Right: Area, Directional, Point, Ambient, Spot, Volumetric)

We will opt to use the Area Light as it has natural decay so let's see what this looks like when it's put on the side of a scene.
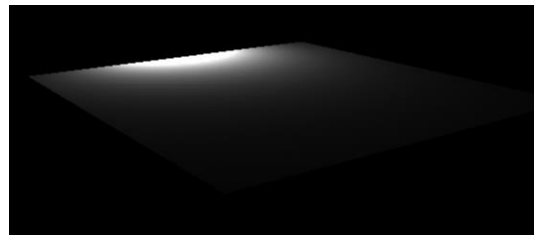

As you can see we're not getting an awful lot of light onto the image plane. At this point some people have a tendency to increase the intensity and/or move the source. So let's have a look at what those people would see if they popped the intensity up from 1 to 3.5.
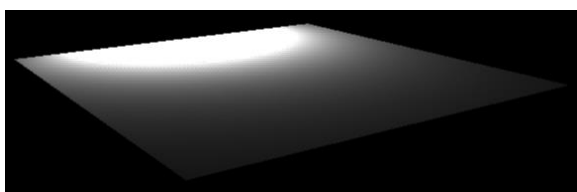
Looking at the image on the left we now have more light in the scene but have also acquired a large hotspot. Let's move back the source back a little bit and crank up the intensity to compensate for the move.

There is now more light and less of a hotspot, but in reality this is an awful way of lighting a scene and should be avoided at all costs.

AH | Lighting Examples (Rendered using Mental Ray)
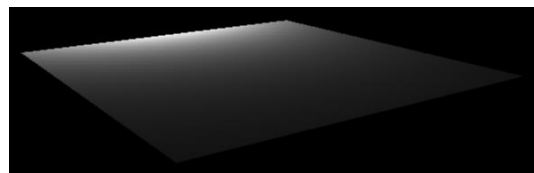
AH | Gamma Correction

Now we're going to backtrack slightly, what you're actually seeing in that first image is a raw format without any Gamma correction. Gamma correction is required to compensate for the properties of human vision specifically in relation to luminance. All images you interact with on a daily basis, whether it's through your TV, Magazines, or even a computer are subject to some form of gamma correction.
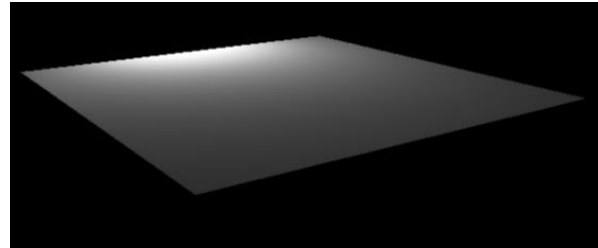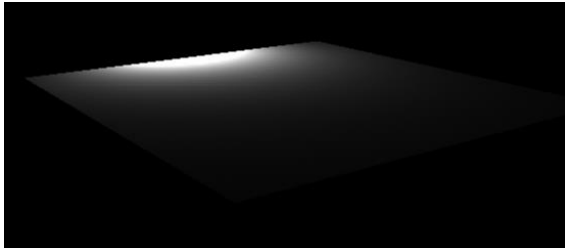
Same image, but the image on the right has a gamma corrective lens applied to the camera.

Setup a gamma correction lens

Firstly we would recommend creating a new camera (leaving the perspective camera with its default settings) *Create > Cameras > Camera.*

Next select your scene camera (not Perspective, easiest way is to navigate to *Windows > Outliner* select new camera), Open the *Attribute Editor > camera shape tab > Mental Ray > Lens Shader (press the chequered box)> Lenses > mia_exposure_simple*

It will jump to the lens shader and you will see some additional features that we will come back to a little later on:

- Pedestal – Blackness control
- Gain – Brightness
- Knee – Helps to lower hotspots in the scene
- Compression – Provides intensity for the Knee
- Gamma – Darkness

AH | Physical Sun and Sky

We will be creating a very quick environment setup, that Maya has nicely provided for us
Render Settings (ensure you are in mental ray) > Indirect Lighting > Environment > Physical Sun and Sky > Create

Now you can have a little play. Open the outliner and look for the "sunDirection" light, make it bigger using the scale attribute (r) so you can actually see it in you (to scale) scene and you will notice it's rotated down at approximately 75 degrees, from that angle would make it around mid-afternoon.

Now here's the cool part, it doesn't matter where a directional light is positioned within your scene it's purely based on its angle, so if you rotate the direction directional light down to around 10 degrees, all your shadows will change and the horizon should begin to appear more "orangey". If you also drop your camera to somewhere near the horizon, and towards the source you should see the sun spot, and if you continue rotating the "sunDirection" you will see a sunset.

Now it doesn't get any easier than that. But if you would like to delve a little further into the settings here's what has been done. You will notice two new additions in the windows **> rendering editors > Hypershade > Utilities**

Physical Sky

- Multiplier – Intensity of the sun
- R,G,B – Won't be used
- Haze – Adds a "haze" to the horizon and creates a more yellow scene
- Red, Blue Shift – Intensify the feeling of scene temperature or compliment a sunset scene
- Saturation –
- Horizon Height – Moves the horizon up/down
- Horizon blur –
- Ground Colour – Changes the ground colour (drastically alter scene appearance – final gather etc.)
- Night Colour
- Sun Direction – Not really used as we will be using "sunDirection" object within the scene to move the sun around.
- Sun Disc Intensity - If you have a shot that incorporates the sun disc
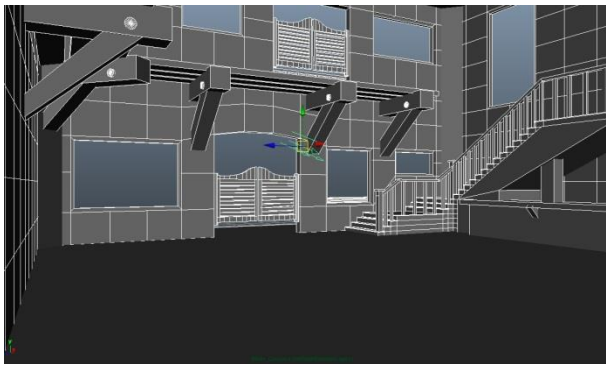- Sun Disc Scale – Size of the sun

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Physical Sun

You will notice that the main settings are mapped to the physical sky node. For our purposes they will remain linked but you can always have a play around if you wish.
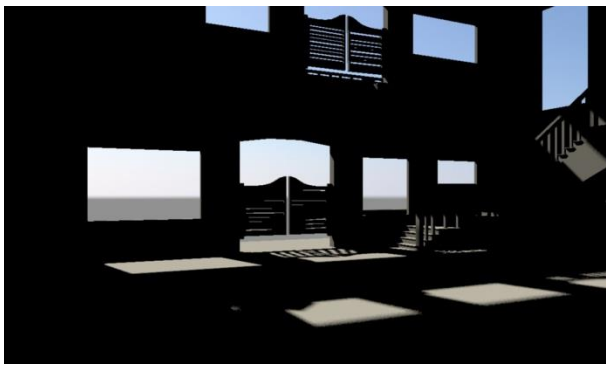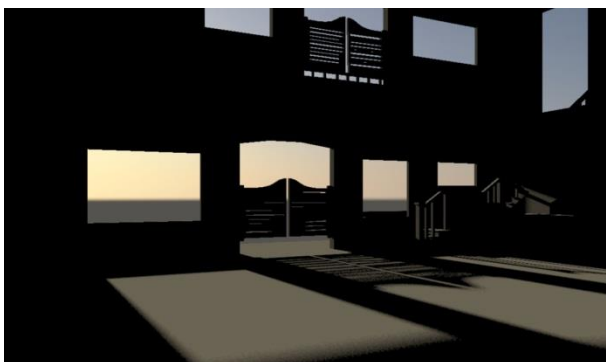
Examples

Scene

A very basic low geometry scene with a physical sun and sky node you can see in the centre.

Mental Ray Render: Day

Rendered with a gamma corrective lens and a physical sun and sky, with default settings only

Mental Ray Render: Dusk (Rotated the sunDiretion)

Same as above only with the sunDirection rotated to a lesser angle, creating longer shadows and a time that would imply dusk is approaching.

Render Settings

- ***Indirect Lighting > Final Gathering***
  - o Point density : Reduce from 1 to 0.5
  - o Interpolation: Increase 10 to 20

- ***Quality > Raytrace/Scanline Quality***
    - Max Sample Level: From 0 to 2
- ***Quality > Sample Options***
    - Jitter: Tick the box

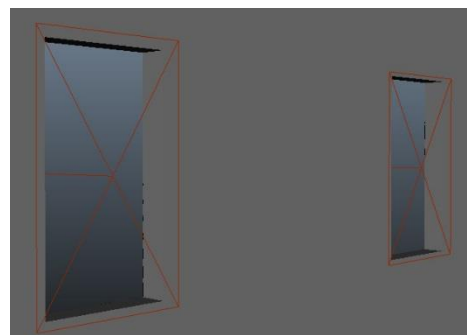You will notice an increase in render times but with dramatic effect

Portal Lights

A portal light helps to brighten the scene by bleeding exterior light such as the sun and sky into the scene. Portal lights need to cover all "holes" in your scene where light could escape as their purpose is to bounce the final gather rays back into the room.

- Create an area light
- ***Attribute editor > Light shape > mental ray***
    - ***Area Light***
        - ***Tick Use light shape***
        - ***Tick Visible***
    - ***custom shaders > Light Shader (chequered box) > mental Ray > mia_portal_light***

Next step is to repeat the process covering all windows and doors. It is best practice to have one area light per hole, however if you have a few holes in close proximity then you may opt to cover them with one area light.

A greater degree of control, meaning you can increase light intensity from a specific window however this level of control isn't always required.

Map the same portal light shader to many/all of the area lights

This is my preferred method and I usually map one portal light to every area light on that side of the building. This way you control all of the light on one side of the building via one setting and room lighting can be adjusted quickly. To do this simply open the **Hypershade window > utilities** and selecting each area light in turn and MMB click and drag mia_portal_light into the Light Shader.
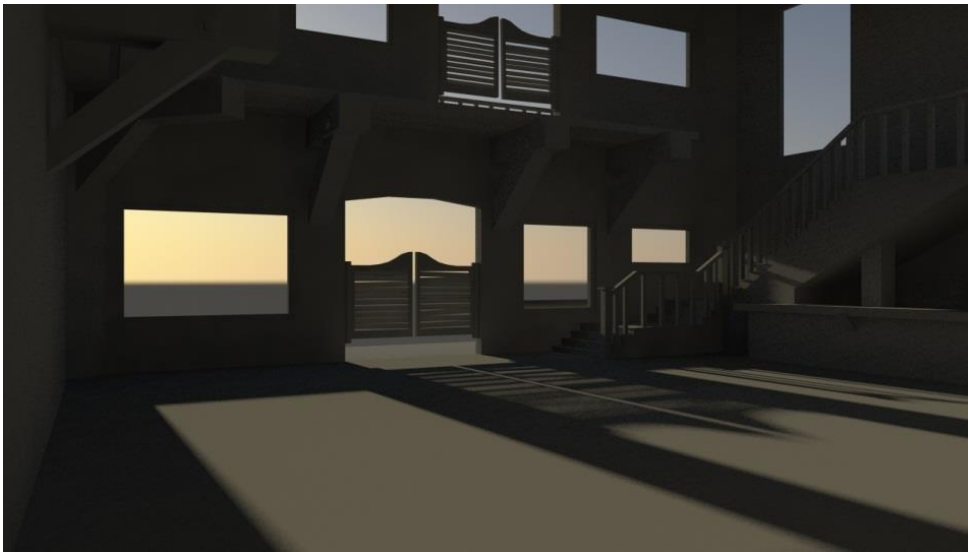
AH | Adding Textures

Depending on the availability of light within your scene you may find it still rendering a little dark. If you haven't already the next step would be to add in some textures as these can have a dramatic upon the final result.

Textures added:

- Wood – Floor, Banister, Beams, Balcony, and Window Frames
- Glass – Windows, Tumbler, Whisky Bottle, Chandelier
- Backing Plate & Wallpaper

Ah | Adding additional light into your scene

There is no right or wrong way to do this so we will address a few techniques. Take note that when we are referring to light bounces these can be drastically changed by adding textures into your scene, bouncing the default grey lambert is going to create a darker scene than a beige wallpaper.

Chapter 4: Lighting

Increase the portal light intensity

Not our preferred, method however by increasing the portal light intensity will subtly increase the light into your scene, however if you're having to use considerably high values (bearing in mind 1 is usually an accurate representation of natural light), I would possibly return the default value (1) and try another method.

Final Gather

The "secondary diffuse bounces" is the field you need to increase. This is the number of times the light source will bounce of a surface. The higher the number the more light is bouncing around your scene but you will notice a considerable increase in render times as this number increases

Global Illumination

When using global illumination to calculate secondary diffuse bounces its best to ensure the final gather secondary diffuse bounces are returned to "0". You will also need to emit photons into your scene for this to work.

Jump back into your Portal light(s), and go into the attribute editor

- ***Caustic and Global Illumination > Emit photons (tick)***
- ***Custom Shaders > Photon Emitter >*** Either
  - ***Create relationship to the existing portal light*** *(i.e. copy and paste content from* ***Custom Shaders > Light Shader*** *then press enter) Or*
  - For greater control you can create an additional Portal light (refer to above process) to control the photon emitter however for most circumstances mapping it to the same one will be sufficient.

AH | Reducing render times

The easiest way to reduce your render times whilst maintaining the improvements we have just made is to take a final gather map. This is for convenience, and works best with a static camera. If you wish to make changes to your scene i.e. lighting, camera angle, textures etc. it's advisable to repeat the below process.

- Set a camera bookmark or key your camera in position
- ***Render Settings > Indirect Lighting > Final Gather***
  - ***Rebuild > ON***
  - ***Primary Final gather File -*** *Add file name (i.e fgMap)*
- Render your Scene (keep the image)
- ***Render Settings > Indirect Lighting > Final Gather > Rebuild > Freeze***
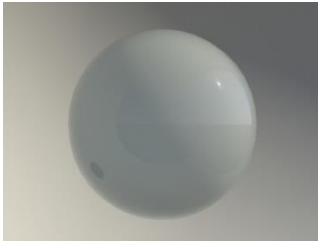- You should notice an increase in render times of around 30-50%

AH | Interior Lighting

The sun position would imply it's fairly late in the day so our lighting setup needs to be warm but not too overpowering.

To achieve this effect you need two primary elements:

- The light itself
- The glass material where it originates

Glass Material

A very simple *mia_mater_x > presets* > FrostedGlass*.

Here is an example of the preset when it is applied and rendered in an empty scene.
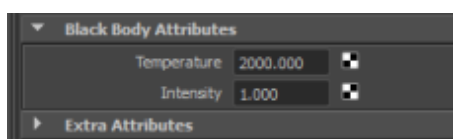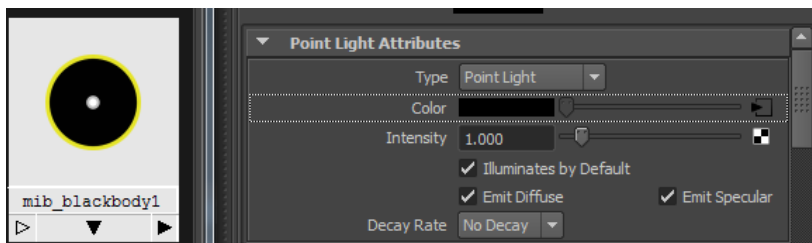
Light

First off we need to:

- *Create > Lights > Point Light*
- Point light *attributes > Decay Rate > Quadratic* (Light fades with distance)

Note: When applying decay in models that are to scale the intensity value needs to be very high. In our scene we will be applying values of 4,000 – 11,000.

- *Raytrace Shadow Attributes > Use Raytrace Shadows (tick)*

Now we are going to open up the *Window > Rendering Editors > Hypershade* and in the *MentalRay Lights* create an *mib_blackbody*. MMB click and drag the *mib_blackbody* onto the *colour* attribute of your *Point Light*.
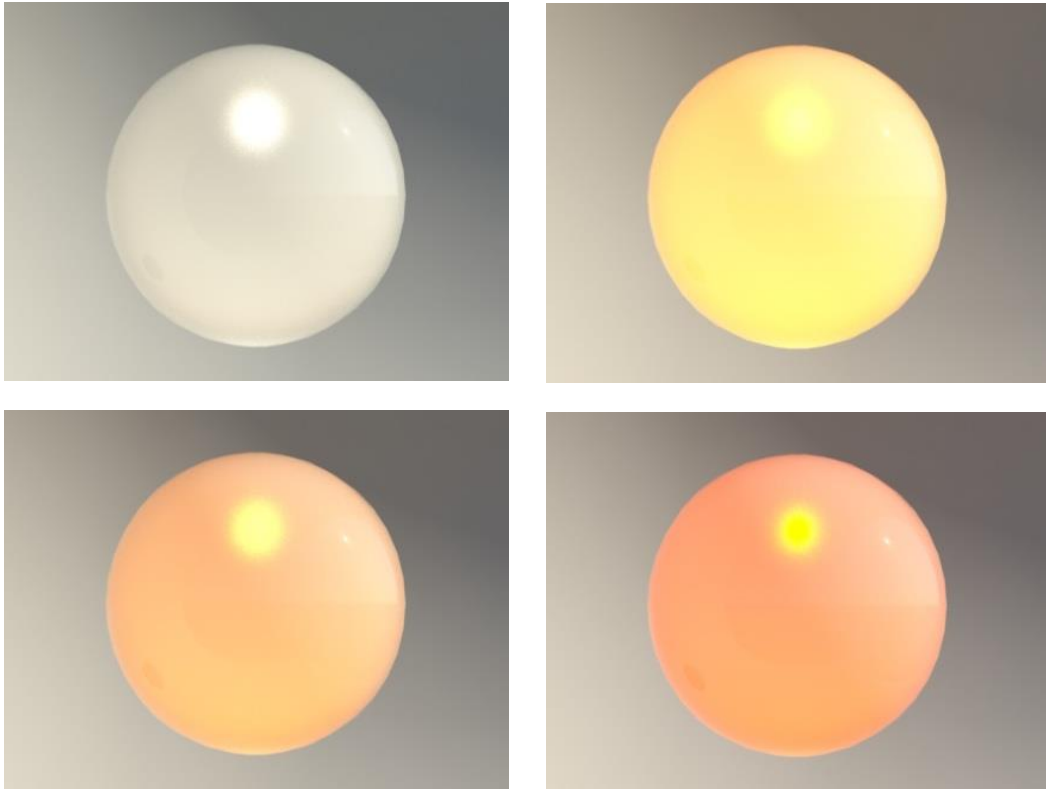

Click the square with an arrow going into it after the colour and you will be taken to the Black Body Attributes.

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Have a play with the Intensity value of the Point Light and the temperature of the mib_backbody to cycle through a range of lighting for your environment.


We have used a temperature value of 2000 and intensity values of between 4,000 -11,000 on different lights in the following render.

PC | More advanced lighting techniques:

Ambient Occlusion:

Ambient Occlusion is a shading method based on the proximity of nearby objects. This results in a faster (albeit less realistic) Global Illumination effect, and is usually combined with a fast Maya Software render to give a very efficient compromise between image quality and speed.
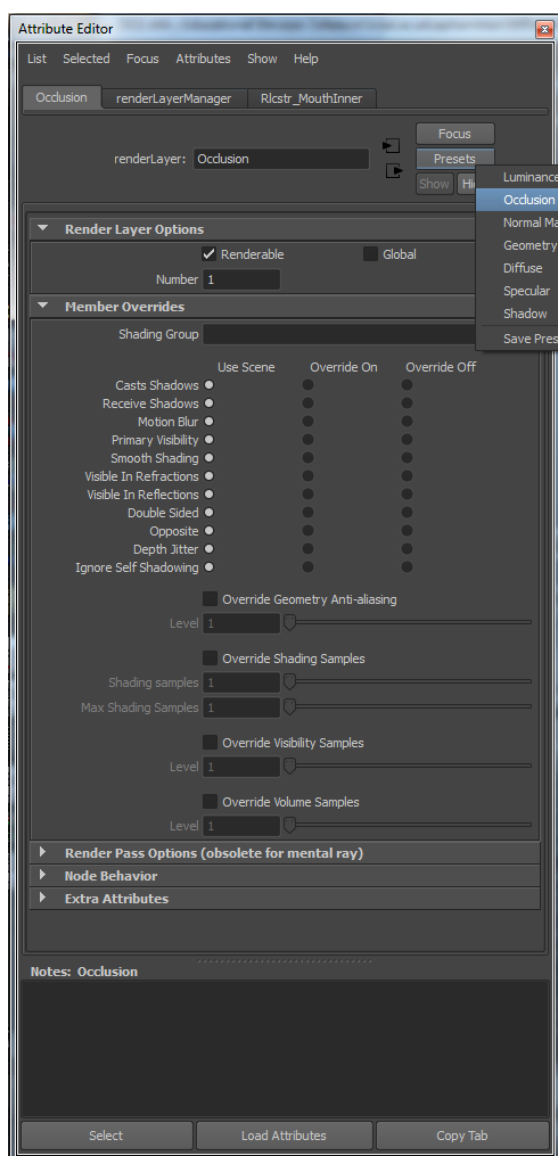
That is not to say that Ambient Occlusion is fast however, despite taking much less time that full Global Illumination, large scene can still take 10mins or more to complete.

Setting up an Ambient Occlusion pass in Maya is very quick. In the renders tab, create a new layer and call it 'ambientOcc' or similar. Right click on the layer and select the 'attributes' option at the bottom of the menu.

Under the presets button, select ambient occlusion from the drop down list.

Now all we need to do is tweak the settings of the shader node. The key setting is on the 2nd tab and is named "samples", spread and distance. The 'samples' is the quality of the effect. The lower the number, the more 'grainy' the image will be, but the faster it will be rendered (and vice-versa).

The spread affects how harsh or soft the shader comes across, a setting of 0.8 is good for most objects, but lower can be useful sometimes to emphasise cracks and creases in the geometry.

The max distance determines how far away a face has to be before its 'occluding' effect is calculated. This setting is entirely dependent on the size of your scene, too small and you will not get a strong enough effect, but too great and the scene will look very dark.

When you are happy with the result of your Occlusion Pass, we want to take both the original diffuse (colour) render and the occlusion pass into Photoshop (or After Effects if you have a sequence). Lay the occlusion pass over the top of the colour render and change the blending style to 'multiply'.

There we have it. Our finished image:

Light-Linking:

You can use light-linking to control which lights affect specific objects/shaders. This can be useful to limit a certain light to a specific object, for example if you want to illuminate some of the environment, but not affect the lighting of your characters.

You can also use light-linking to stop Maya from trying to calculate shadows/reflections/etc. for objects that are out of range of certain lights, in a large scene this can go a long way to reduce render time.

You can access light-linking from *Window > Relationship Editors > Light Linking*. There are then two options, Light-Centric or Object-Centric, depending on whether you want to specify which objects are affected by specific lights, or which lights you want to affect specific objects.

Unorthodox Lighting techniques:

If you can get away with faking something, DO IT!

If there is a way to fake a complicated simulation in a fraction of the time, it's always worth looking into. The results will rarely be as good, but the small compromise of image quality can give you a huge gain in rendering times.

An example of this would be;

Use lights as shadows:

The intensity value of lights can be any value, including negative figures. By providing a strong decay, and placing the light at the base of an object (rounder objects work best, of course) you can emulate the soft shadow effect of global illumination.

AH | Raytracing:

Raytracing is how Maya simulates light traveling through your scene. Light can be reflected or refracted dependant on the properties of a material.

To enable raytracing select *Window > Rendering Editors > Render Settings > Maya Software (tab) > Raytracing Quality > on (checkbox)*.

AH | 3-Point Lighting

The technique's simplistic ideology and versatile approach have enabled it to become possibly the most popular lighting technique used across todays various media forms as well as forming the base for more complex lighting structures. The technique uses three lights, but the first stage is to create a camera you will use to render the scene:

Create a new camera

- *Create > Camera > Camera and position accordingly.*

Light 1 (Key Light)

The key light will have the strongest light source and will have the most influence upon your scene.

- *Create > Lights > Spotlight*
- Set approximately 45° around from the camera, raise it above your object and angle it down accordingly.
  - To look through the light whilst you position it *select light > Panels > Look through selected*
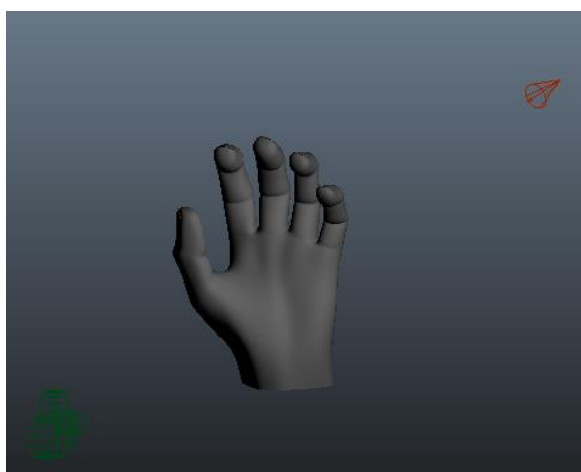
**Note:** *to see how your scene is using lights (above), within your image view go to Lighting > Use All Lights.*

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Light 2 (Fill light)

A secondary light which is positioned on the opposite side of the camera from the key light. Ideally this will cast little or no shadows.


- *Create > Lights > Directional Light*
- 50% light intensity and below is a recommended starting point as this helps to soften lights and shadows, but you can tweak these at your discretion.
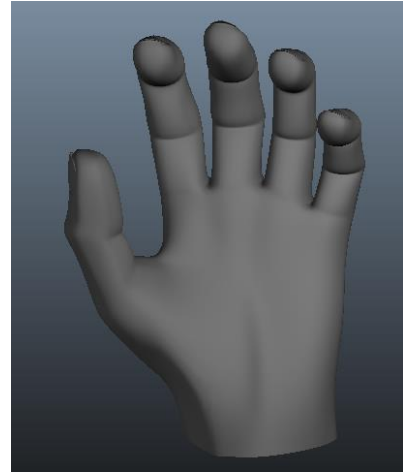
Light 3 (Back Light)

Positioned behind your object and can be situated either side for varying effects. The purpose is to separate the object from its foreground, to provide definition and add a 3D look.

- *Create > Lights > Directional.*
- Rotate so it creates a very thin light rim around the edge of your object
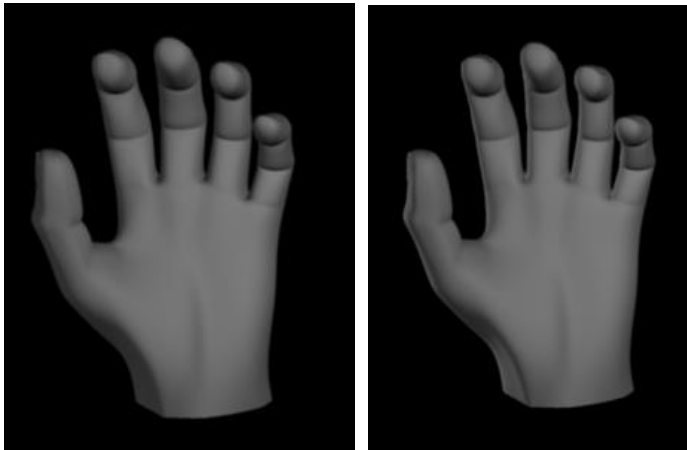
More often than not you will require shadows to be cast, however this may cause you to have multiple shadows being on the ground. To counteract this effect you will need to perform a light link.

Note: Alternate Lights can be added at your discretion and if you feel a light type we have used doesn't look correct for your scene you can replace it with a suitable alternative.