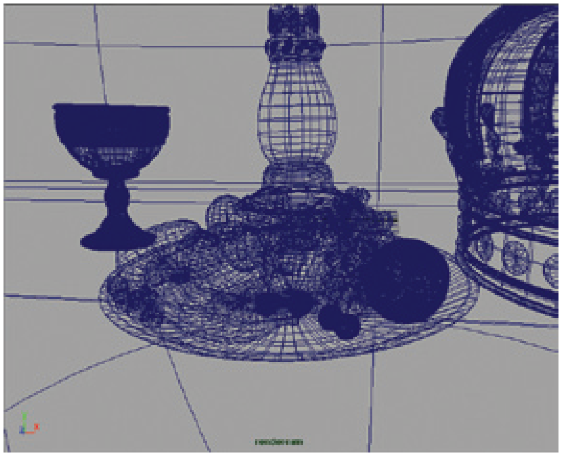

Figure 1.3 Wireframe preview gives little information as to how the scene will look once it is rendered.

Figure 1.4 Previewing with shaded, lit mode, with the camera's border displayed gives a much better idea of how the scene will look.

Displaying the borders of the rendering area in the rendercam's panel will also help when composing and lighting the image. The width and height of the panel is generally different than the width and height of the rendered image. I like to know exactly what is going to be in my render, and displaying the borders helps me to know exactly what is in frame and what isn't. This feature is available in most packages. It's generally an option in the camera itself and may be called something like "display resolution" or "show camera reticle."

PANEL SETUP FOR THE RENDER CAMERA:

✓ Use shaded mode

✓ Display the effects of the lights

✓ Display the borders of the rendering area

And remember: While positioning almost any light, keep an eye on the shaded render camera's panel.

1.2 BASIC COMPUTER-GENERATED LIGHT TYPES

Almost every package has six basic light types: point light, spotlight, directional light, area light, ambient light, and volume light. You will want to be familiar with each of these light types. Most artists with even a small introduction to 3D lighting have learned about at least some of CG (computer-generated) light types in order to add lights to their scenes. The topic of light types is deceptively simple, however. It's very common for new and intermediate lighters to use the various light types incorrectly, either using a light not well suited for the situation or not using it to its full advantage. This section not only defines the various light types, but even more importantly discusses situations for which the light type is best suited and tips on usage. Both beginning and intermediate users will likely find useful information here. This section ends with a comparison chart.

Two other light types that are increasingly common are *environment lights* and *light-emitting geometry*. Being more advanced in usage, these lights are covered in Chapter 16, "Global Illumination."

1.2.1 Point Light

Point lights cast rays outward radially in all directions from an infinitely small central source. The digital point light source has zero dimensions (0D); it has no width, or depth, or height. Since the origin of the light rays is infinitely small, the light rays produced are perfectly radial, emanating outward like the spokes from a wheel with no criss-crossing or intersecting (Figure 1.5). Point lights cast illumination in all directions (Figure 1.6 and Figure 1.7). For this reason, the rotation of the light is irrelevant. Only the location in space determines how the light will shine into the scene.

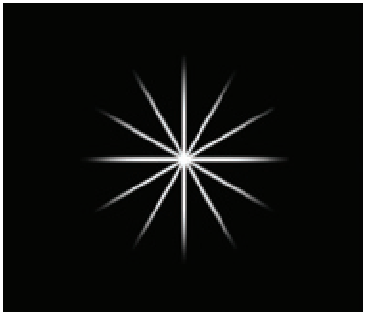

Figure 1.5 Point light.

Point lights imitate light sources that shine radially in all directions, like a star or a bare bulb. However, *not all lights that shine radially in all directions in the real world are best imitated by the CG point light*. For example, even though the sun is a star, it's imitated best by a directional light rather than a point light, and a bulb that resides in a shaded lamp or wall scone is better imitated with one or two spotlights rather than a point light (for why, read the section in this chapter that discusses each type of light).

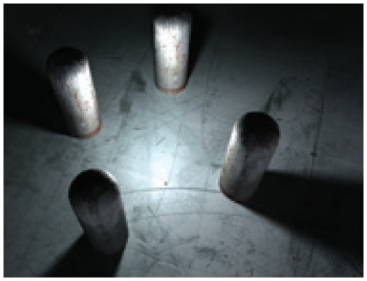

Figure 1.6 A render using a point light illustrating light and shadows in all directions.

Point lights are often overused by new lighters. There is a tendency to simply plop point lights into the scene and to turn on their shadows. However, unless you need light radiating in all directions, you don't need a point light. For example, if illumination is needed only on one side of the light (for example, a light that is placed over the scene), then a point light isn't the best option; a spotlight is a better choice (Figures 1.8 and 1.9). Why *not* just use a point light? Unless light is needed in all directions, casting it in all directions results in unwanted render calculations. This is especially true when shadows are turned on.

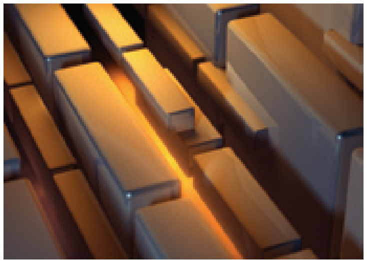

Figure 1.7 This abstract image uses a point light to illuminate behind the gold bars. (*Image by Luke Heathcock*).

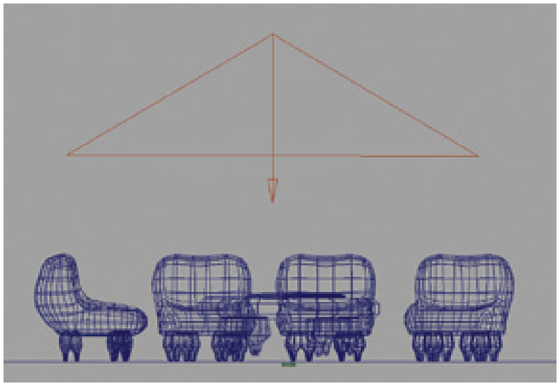

Figure 1.8 In this scene, a point light isn't the best choice, as light isn't needed in all directions.

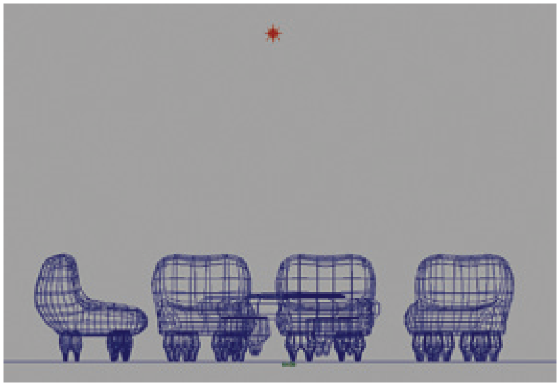

Figure 1.9 A spotlight is the better choice for this scene.

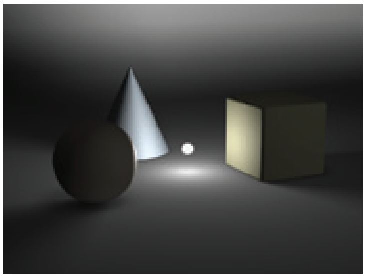

Figure 1.10 Image of a hotspot created by a point light.

When using point lights, you will want to eliminate unwanted shadow calculations. If a point light has shadows turned on, it will by default calculate shadows in all directions. In some cases, light is needed in all directions but the shadows are only needed in one or a few directions. Point lights can turn shadow calculations off in certain directions with some types of shadows. When possible, it's good to turn off unnecessary calculations to speed up render times. How to optimize point light shadows is covered in the next chapter, Section 2.5.2, "Optimizing Depth Map Shadows."

Point lights are prone to creating hot centers of illumination, called *hotspots*, on surfaces to which they are very near. Hotspots (Figure 1.10) crop up especially if the light has attenuation (decreases in intensity with distance). A simple and obvious fix is to move the point light away from the surface a bit.

WHEN AND HOW TO USE POINT LIGHTS

When Is Using a Point Light a Good Choice?

✓ When you need to see light cast radially in *all directions* in the scene.

For other lighting situations, you can generally substitute another light type like a spotlight or directional light.

Tips for Using Point Lights:

- If shadows aren't needed in all directions, turn off unnecessary shadow calculations (Section 4.5.3) if possible.
- Watch for and eliminate hotspots.
- In many cases, a point source can be imitated with a spotlight or spotlights instead.

1.2.2 Directional Light

Figure 1.11 Directional light.

***Directional* (sometimes called linear or distant) lights cast parallel rays in a specified direction throughout the entire scene.** The rays are perfectly parallel and never intersect (Figure 1.11). By default, the illumination from a directional light will cover the entire scene, regardless of the light's position. (See Figures 1.12 and 1.13 for examples of directional light.) The icon of the light could even be underneath the subjects being lit. Only the rotation of the light is important.

The distinctive features of the directional light are

- the light rays are perfectly parallel and
- the light floods the entire scene.

Figure 1.12 Render showing the parallel light and shadows from a directional light.

Figure 1.13 Directional lights can be good choices for clear sunlight as illustrated in this image by Bryce Stine.

Directional lights are sometimes called "distant lights" because they imitate light that is coming from very far away. When a light source is extremely far away, the rays finally reaching the subject are near parallel. Rays pointing in other directions than directly at the subject have scattered off long before reaching the subject (see Figure 1.14). While the rays aren't in fact perfectly parallel, they are so close that for all intents and purposes we can consider them so. A real-world example of a distant light is the sun. While the sun is spherical in nature and massive like an area light, the light reaching the earth comes from so far away that the rays reaching us look parallel. A directional light can be a good choice to imitate light that is distant and uniform, such as sunlight on a clear day.

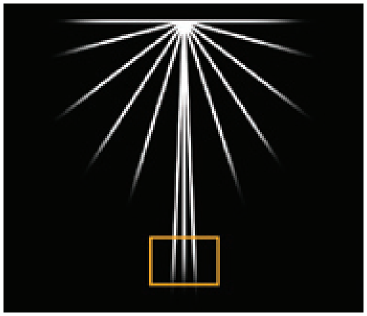

Figure 1.14 Lights that are very far away contribute near-parallel rays.

Directional lights are also well suited to the task of flooding the scene with a low level of illumination to brighten shadow areas. Light that brightens ("fills in") the shadows is known as *fill light*. Directional lights can make good fill lights, especially if they don't need shadows. Another situation that is a good candidate for a directional light is if you want to provide fast preliminary lighting. Directional lights can quickly light a scene because they are easy to place (only rotation is important), and they can illuminate the entire scene.

Directional lights can be problematic with some shadow types, such as depth-mapped shadows (discussed in Chapter 2, "Shadows"). When you need more shadow control, a spotlight may be a better option for you.

Because a directional light casts parallel rays, its illumination will be constant across any given plane. In some cases this may be desired, and in other cases this may be too uniform and bland. In contrast, illumination from a source such as a point or spotlight will vary across planar surfaces, due to the changing angle of the radial rays. Figures 1.15 through 1.18 illustrate the visual differences between parallel and radial rays.

Figure 1.15 A scene of planar primitives lit with one point light placed in the front and center. All geometry has the same lambert shader, and the light has no attenuation. The cubes closest to the point light darken due to the light striking them at a more glancing angle.

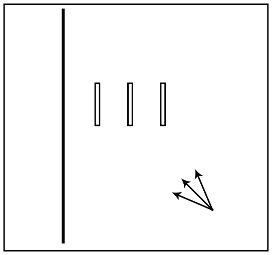

Figure 1.16 Side view diagram of Figure 1.15.

Figure 1.17 Shows the same scene, rendered from the same view, but lit with a directional light instead of a radial light. Since all front faces of the cubes are parallel and the light rays are parallel, the light intensity doesn't vary across the surfaces of the planes.

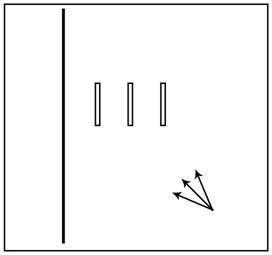

Figure 1.18 Side view diagram of Figure 1.17.

WHEN AND HOW TO USE DIRECTIONAL LIGHTS

When Is Using a Directional Light a Good Choice?

✓ When the light you are imitating is very far and…
✓ You have a large area of your scene to flood with light, or…
✓ You need a shadow-less fill which covers a large area, or…
✓ You want to quickly add light to a scene for preview purposes.

Directional lights work well when you wish to flood the entire scene with light from a certain direction.

Tips for Using Directional Lights:

- In some cases directional lights don't work well with depth-mapped shadows.
- Keep in mind the illumination from a directional light is very uniform, which may or may not be desired.

1.2.3 Spotlight

Like point lights, spotlights also cast radial rays from an infinitely small point (0D). The difference between a point light and a spotlight is that the illumination of the spotlight is confined within a conical area (Figures 1.19 through 1.21). The center of this cone is oriented down an axis representing the spotlight's direction. This axis is the z-axis of the light. Similar to point lights, spotlights contribute perfectly hard light due to the fact their source has no dimension. Position, rotation, and cone angle are all important in defining the effect of the spotlight.

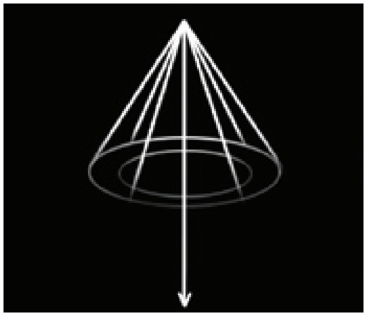

Figure 1.19 Spotlight.