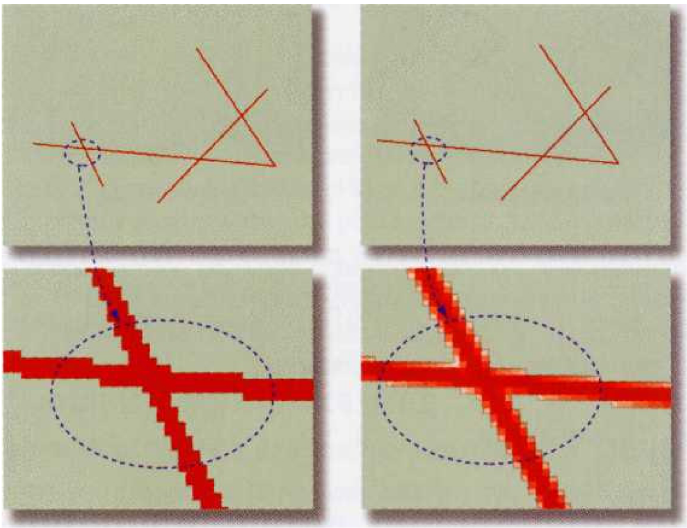
Ambient Light (see *lighting and material properties)*

Antialiasing

Antialiasing allows us to smooth out the "jaggies" that appear when we draw diagonal lines on a computer screen. An image displayed on a screen is formed from a matrix of pixels. When we try to draw diagonal lines on the screen, there often isn't a pixel exactly where we want one, so we just have to use the closest pixel available. This results in lines with a ragged "staircase" appearance, whose rough edges are called "jaggies" (Figure G-l 6a).



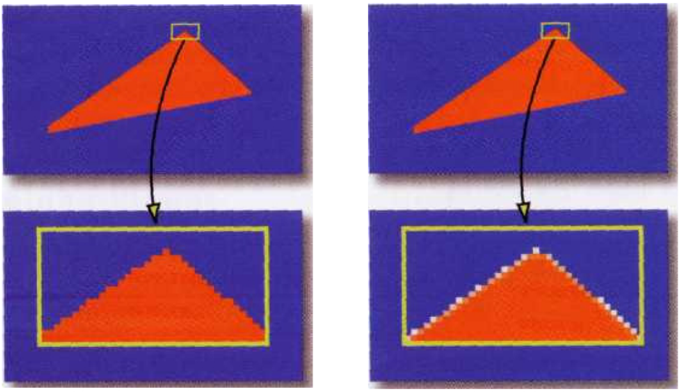
(a) Without antialiasing **(b) With antialiasing**

Figure G-16. The ragged appearance of angled lines (a) can be mitigated by the use of antialiasing (b).

Unfortunately, this effect, which is known as *aliasing,* is extremely detrimental to the perceived quality of the image. *Antialiasing* is a highly effective technique for mitigating the effect of (aggies, whereby pixels surrounding the line are colored with different shades and brightnesses derived from the color of the line. In fact, the colors of the surrounding pixels are actually determined as blends of the line's color with the background color in what is essentially an alpha blending operation. The result is that the human eye is tricked into perceiving a smooth line (Figure G-l 6b).

Similar jaggies also affect the edges of objects in 3D graphics applications (Figure G-17a). Once again, antialiasing techniques can be used to mitigate the effects of these ragged edges (Figure G-l 7b).

Figure G-17. The ragged appearance of 3D objects (a) can be mitigated by the use of antialiasing (b).



(a) Without antialiasing

(b) With antialiasing

Antialiasing can be performed in hardware or software, but implementations in hardware, such as those found in Intergraph's high-performance Intense 3D Pro and RealiZm II OpenGL 3D graphics accelerators, are much faster than their software counterparts. (See also *scene antialiasing)*

Aspect Ratios

The ratio of the horizontal and vertical dimensions of the screen on a computer monitor is referred to as that monitor's *aspect ratio.* The most common aspect ratio is 4:3 (four units across to three units high), which is a legacy handed down to us from the early days of television and which is close to being square (Figure G-l 8).

Our eyes are placed horizontally, however, and our field of view is wider than it is tall. This fact is exploited by movie-makers when they show movies on a wide screen to give cinema buffs a greater sense of immersion in the scene. Similarly, the 16:9 aspect ratio of the latest computer monitors better matches the human field of view - for example, the 28-inch monitor shown in Figure G-l 8, which is available from Intergraph Computer Systems.

Primary Colors

Primary colors are those which may be combined to form all of the other colors. In the case of light, the primary colors are red, green, and blue (RGB). These are known as the *odditive primaries* because adding different colored light results in a color that's a blend of the various sources (Figure G-66).

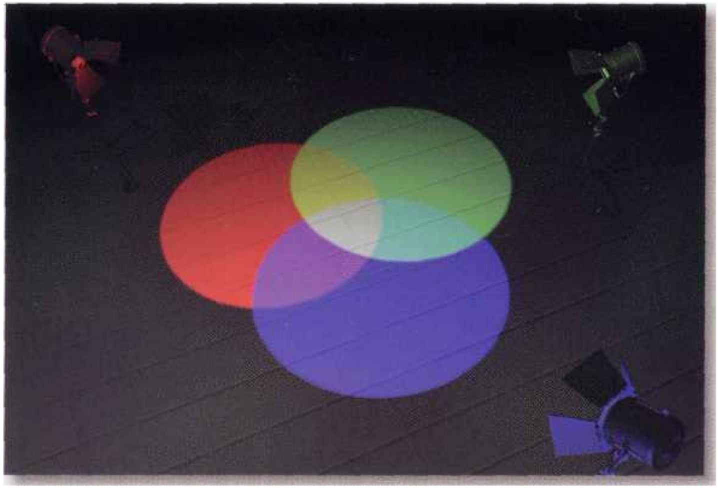


Figure G-66. The additive primaries are red, green, and blue.

Mixing red and green light results in yellow, mixing green and blue returns cyan, mixing blue and red gives magenta[3], and mixing all three of the additive primaries results in white light.

Figure G-67. The subtractive primaries are cyan, magenta, and yellow.

[3] The color magenta was christened after the dye of the same name, which was in turn named after the Battle of Magenta which occurred in Italy in 1859 (the year in which the dye was first discovered).

By comparison, if we play with different colored pigments, each of the pigments will absorb some of the colors from white light and reflect others. When we mix pigments together, they each continue to absorb the same colors they did before, so we end up seeing only those colors that were not absorbed by any of the pigments. Thus, in the case of pigments, the primary colors are cyan, magenta, and yellow, and these are known as the subtractive primaries (Figure G-67).

Mixing cyan and magenta pigments results in blue, mixing magenta and yellow returns red, mixing yellow and cyan gives green, and mixing all three of the subtractive primaries results in black (which is the absence of light).

Last but not least, it is also common to refer to red, yellow, green, blue, white, and black as being the *psychological primaries,* because we subjectively and instinctively believe that these are the basis for all of the other colors. (See also *CMYK ani color separation.)*

Procedural Textures

(see *2D textures* and *3D textures)*

Psychological Primaries *[see primary colors)*

Radiosity

Radiosity \s a sophisticated technique for rendering an image. The majority of rendering algorithms don't really account for the fact that non-shiny surfaces may reflect diffuse light. For example, consider a table in the corner of a room, upon which is a matte (non-shiny) vase. Let's assume that the room is well lit and that the walls are covered in some matte, plaster-like material. In such a case, even a sophisticated rendering algorithm like ray tracing won't fully account for all of the lighting effects in the scene (Figure G-68a).

The problem is that most surfaces are matte, not shiny, and ray tracing does not correctly depict how light reflects from non-shiny surfaces. By comparison, radiosity models the diffuse light that reflects off non-shiny objects and accounts for the way this light affects other objects in the image. For example, diffuse light reflecting off the walls will make some contribution to the light falling on the vase (and vice versa).

Radiosity rendering can produce images with highly realistic lighting, shading, and shadowing. Combining radiosity with ray tracing, however, results in the highest