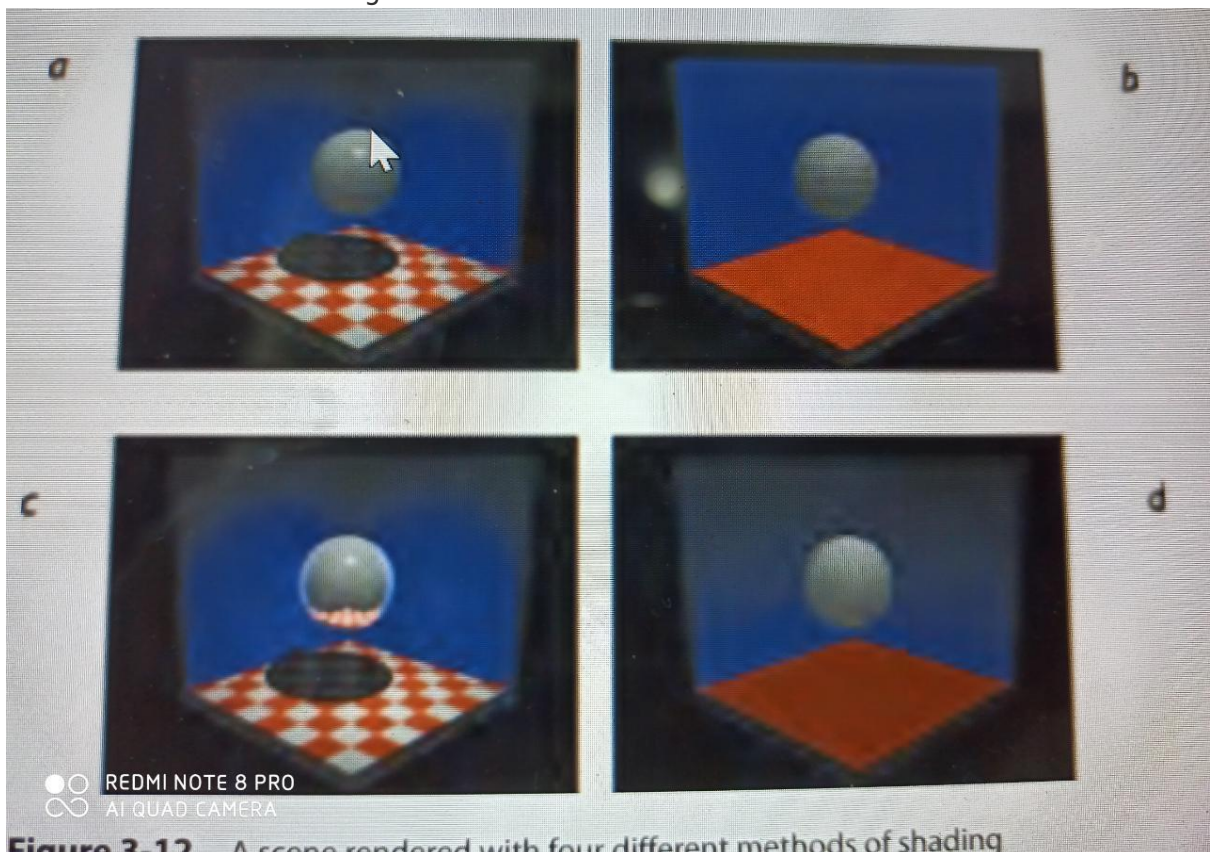


## Shading

Shading is the process in rendering that consists of computing the color of objects in the 3D scene. Shading can usually be applied in several ways.

- flat shading: In computer graphics, a technique for computing a one-tone shaded surface to simulate simple lighting.
- Gouraud shading : computes a shaded surface based on the color and illumination at the corners of every triangle.
- Phong shading :computes a shaded surface based on the color and illumination at each pixel. Phong shading is more realistic than Gouraud shading, but requires more computation.
- Ray tracing that takes longer to render but provide photo-realistic images. A rendering method that simulates light reflections, refractions and shadows. It follows a light path from a specific source and computes each pixel in the image to simulate the effect of the light.



## Rendering

- Rendering is when the computer finally uses complex algorithms to apply the effects you have specified on the objects you have created.
- Rendering an image requires great computing efforts and often takes many hours for a single image, and you will feel the strength (or weakness) of

your hardware. Indeed, some multimedia and animation companies dedicate certain computers solely for rendering.

### **Dithering**

- Dithering is a process whereby the color value of each pixel is changed to the closest matching color value in the target palette, using a mathematical algorithm.
- If you start out with a 24-bit scanned image that contains millions of colors and need to reduce it to an 8-bit, 256-color image, you get the best replication of the original image by dithering the colors in the image.
- The adjacent pixels are also examined, and patterns of different colors are created in the more limited palette to best represent the original colors.
- There are now only 256 colors available to represent the thousands or even millions of colors in the original image, pixels using the 256 remaining colors are intermixed and the eye perceives a color not in the palette, created by blending the colors mixed together. Thus any given pixel might not be mapped to its closest palette entry, but instead to the average over some area of the image; this average will be closer to the correct color than a substitute color would be.



Figure 3-13 A background and object rendered into an image with shadows and lighting effects

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- How well the dithered image renders a good approximation of the original depends upon the algorithm used and whether you allow the image-editing program to select the best set of 256 colors from the original image (called an adaptive palette) or force it to use a predetermined set of 256 colors (as,

for example, with a System palette or the browser-safe web palette). Figure 3-15 compares the same scanned image dithered from millions of colors to 256 colors, 16 colors, 16 grays, and black and white.

- Dithering concepts are important to understand when you are working with bitmaps derived from RGB information or based upon different palettes. The palette for the image of a rose, for example, may contain mostly shades of red with a number of greens thrown in for the stem and leaves. The image of your pretty Delft vase, into which you want to electronically place the rose, may be mostly blues and grays.
- A software will to generate a palette which is best for representing a particular image,

### **Heckbert's median cut algorithm.**

- a. This algorithm first builds a three-dimensional table (a histogram cube) indicating how popular any given colour in the RGB cube is in the image being converted.
- b. It then proceeds to subdivide this histogram cube (by dividing boxes in half ) until it has created as many boxes as there are palette entries. The decision as to where to divide a box is based on the distribution of colours within the box.
- c. This algorithm attempts to create boxes which have approximately equal popularity in the image. Palette entries are then assigned to represent each box.

There are other methods of generating a palette from an image, but Heckbert's algorithm is generally regarded as the best trade-off between speed and quality. Allan Hessenflow of HandMade Software, makers of Image Alchemy, describing how an 8-bit palette is made 96 Multimedia: Making It Work use a dithering algorithm to find the 256 color shades that best represent both images, generating a new palette in the process. Dithering software is usually built into image-editing programs and is also available in many multimedia authoring systems as part of the application's palette management suite of tools.

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