3.1 Graphics/Image Data Types

- Table 3.1 shows a list of file formats used in the popular product Adobe Premiere.

- We concentrate on GIF and JPG image file formats, since the **GIF** file format is one of the simplest and contains several fundamental features,

- and the **JPG** file format is arguably the most important overall.

Table 3.1 Some popular Adobe Premiere file formats

Image	Audio	Video
BMP, DIB,	AIFF, AAC,	AVI, DV,
GIF, HEIF,	AC3, BWF,	FLV, HEVC,
JPG, PICT,	MP3, M4A,	M4V, MOV, MP4,
PNG, PSD,	WAV, WMA	MPG, MTS, MXF,
TGA, TIF		SWF, WMV

3.1.1 1-Bit Images

- Images consist of pixels (picture elements in digital images).
- A 1-bit image (also called binary image) consists of on and off bits only and thus is the simplest type of image.
- Each pixel is stored as a single bit (0 or 1)
- It is also sometimes called a *1-bit monochrome (called Lena image by scientists)* image since it contains no color. See Figure in next slide.
- Monochrome
- 1-bit images can be satisfactory for pictures containing only simple graphics and text.
- fax machines use 1-bit data, so in fact 1-bit images are still important.

Monochrome 1-bit Lena image

A 640×480 monochrome image requires 38.4 kB of storage

3.1.2 8-Bit Gray-Level Images

- 8-bit image is one for which each pixel has a *gray value* between 0 and 255.
- Each pixel is represented by a single byte.
- The entire image can be thought of as a two-dimensional array of pixel values referred to as a *bitmap*.
- *Image resolution* refers to the number of pixels in a digital image (higher resolution always yields better quality but increases size)

Grayscale image of Lena

640×480 grayscale image requires 300kB of storage

3.1.4 24-Bit Color Images

- In a color 24-bit image, each pixel is represented by three bytes, usually representing RGB.

- Since each value is in the range 0–255, this format supports 256×256×256, or a total of 16,777,216, possible combined colors; which increases storage size.

- a 640 × 480 24-bit color image would require 921.6 kB of storage. (without any compression applied)
- Compression is used to decrease the image size by simply grouping pixels effectively. (chapter 7).

24-bit color image forestfire.bmp

Microsoft Windows BMP format

3.1.5 Higher Bit-Depth Images

- In some fields such as medicine (security cameras, satellite imaging) more accurate images are required to see the patient's liver, for example.

- To get such images, special cameras that view more than just 3 colors (RGB) are used.

- Such images are called *multispectral* (more than three colors) or *hyperspectral* (224 colors for satellite imaging).

3.1.6 8-Bit Color Images

- reasonably accurate color images can be obtained by *quantizing* the color information to collapse it.
- Color quantizing example: reducing the number of colors required to represent a digital image makes it possible to reduce its file size.
- 8-bit color image (so-called 256 colors. Why?) files use the concept of a *lookup table (LUT)* to store color information.
- For example,:
  - if exactly 23 pixels have RGB values (45, 200, 91)
  - then store the value 23 in a three-dimensional array, at the element indexed by the index values [45, 200, 91].
- This data structure is called a *color histogram.*
- *color histogram:* is a very useful tool for image transformation and manipulation in Image Processing.

Notice that the difference between Fig. 3.5a, the 24-bit image, and Fig. 3.7, the 8-bit image, is reasonably small.

Fig. 3.5a, the 24-bit image

Fig. 3.7, the 8-bit image

Another example for difference between Fig. 3.5a, the 24-bit image, and Fig. 3.7, the 8-bit image, is reasonably small.

Fig. 3.5a, the 24-bit image

Fig. 3.7, the 8-bit image

3.1.6 8-Bit Color Images

- Note the great savings in space for 8-bit images over 24-bit ones:
- a 640 × 480 8-bit color image requires only 300 kB of storage,
- compared to 921.6 kB for a color image (again, without any compression applied).

3.1.7 Color Lookup Tables

- The LUT is often called a *palette*.
- The idea is to store only the index, or code value, for each pixel.
- if a pixel stores, say, the value 25 (Figure 3.8), the meaning is to go to row 25 in a color lookup table (LUT).