Multimedia Technology (IT-204-F)

Section B
Image compression & standards

LECTURE 2
IMAGES - II

Acquiring Images

There are many ways to create or get digital images. We list asome of the most common ways:

- Make an image from scratch with a paint program. A good program will allow you to choose the depth, resolution and size.
- Grab an image of a screen. The depth, resolution and size is determined by the screen.
- Capture an image from a digital camera or a camcorder. The depth, resolution and size is determined by the camera or the camcorder. The popular depth is 24-bit. The commonly used resolution is 320×240, 640×480 and 800×600.
- Scan a photograph or a print using a scanner. You can select from a range of different depths and resolution. The choice should be determined by the type of original and the final output form.
- Convert from existing digital media — e.g., photoCD. The attribute is determined by the original image.
- Synthesize an image from numerical data.

FILE FORMATS FOR RASTER GRAPHICS

- **Graphic Interchange Format (.GIF)**
- **Joint Photographers Expert Group (.JPEG, .JPG)**
- **Tagged Image File Format (.TIFF, .TIF)**
- **Encapsulated PostScript (.EPS)***

FILE FORMATS FOR VECTOR GRAPHICS

- **Illustrator (.AI)***
- **Encapsulated PostScript (.EPS)***
- **PostScript (.PS)***
- **Windows Meta File (.WMF)**
- **FLASH MOVIE (.fla)**

RASTER/VECTOR---WHEN & WHY?

- If you are working with mainly solid color objects, manipulated text or many small objects, the clear answer is that a VECTOR program will save you time.
- If you are working with complicated drop shadows, or other 3D effects, texture or photographs, RASTER is the correct choice.

VECTOR GRAPHICS REVISITED

Instead of using pixels, objects can be represented by their attributes, such as size, colour, location, and so on. This type of graphics is known as *vector graphics*, or *vector drawing*. This is an abstract representation of a 2-dimensional or 3-dimensional scene.

A vector graphics file contains graphics primitives, for example, rectangles, circles, lines.

There are many languages for describing vector grphics. Three of them are very popular. They are:

PostScript was developed by Adobe as a page description language. The next page shows a graphic with its PostScript program source. (Example on next page.)

VRML stands for Virtual Reality Markup Language. It is for descripting a scene in a virtual world. An simple examle is shown on the right.

SVG stands for Scalable Vector Graphic. It is a language for describing two-dimensional graphics in XML. It allows three types of grahic objects: vector graphic shapes, images and text.

VRML sample

```
Cube {
  Width 30 Depth 30 Height 30}
Material {
  ambientColor 0.2 0.2 0.2
  diffuseColor 0.8 0.8 0.8
  specularColor 0 0 0
  emissiveColor 0 0 0
  shininess 0.2
  transparency 0
  }
```

Vector Vs Bitmaps

Bitmap

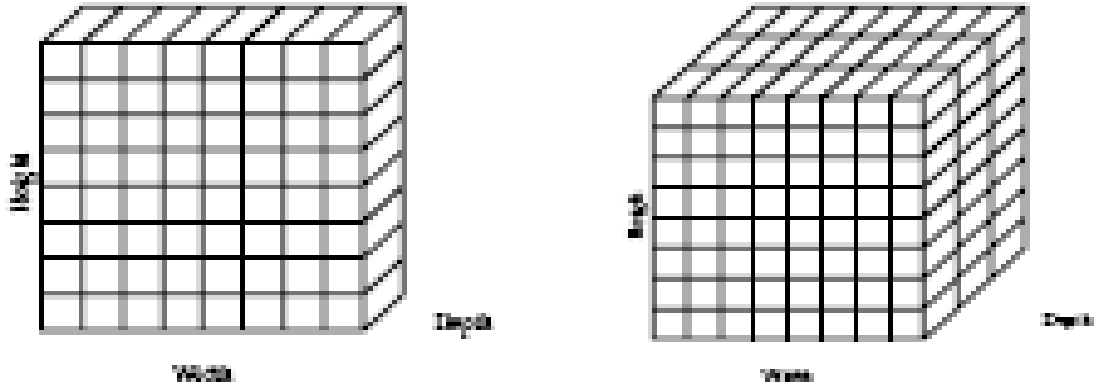
- A bitmap contains an exact pixel-by-pixel value of an image
- A bitmap file is fixed in resolution
- The file size of a bitmap is completely determined by the image resolution and its depth
- A bitmap image is easier to render

Vector graphic

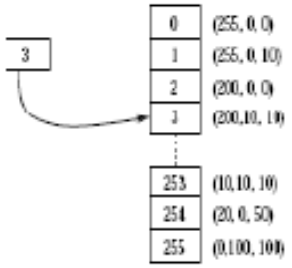
- a vector graphic contains mathematical description of objects
- a vector graphic is resolution independent
- the file size of a vector graphic depends on the number of graphic elements it contains
- displaying a vector graphic usually involves a large amount of processing

PIXELS / PALS

- Basic Concepts: The smallest element on a digital image is known as a *pixel*— a picture element. A digital image consists of a (usually rectangular) matrix of pixels.



- **Depth**: The *depth of an image is the number of bits used to represent each pixel.*
- **1-bit black-and-white image,** also called *bitmap image.*
- **4-bit can represent 16 colors,** used in low resolution screens(EGA/VGA)
- **8-bit can have 256 colors.** The 256 color images are often known as *indexed* color images. The values are actually indexes to a table of many more different colors. For example, Color 3 is mapped to (200, 10, 10).
- **8-bit grey 256 grey-levels.** The image contains only brightness/intensity data without color information.



16-bit can have 65536 colours, also known as hi-colour in Windows systems. The 16 bits are divided into 5 bits for RED, 6 bits for GREEN and 5 bits for BLUE.

24-bit $2^{24} = 16,777,216$ colours, true colour. Each byte is used to represent the intensity of a primary colour, RED, GREEN and BLUE. Each colour can have 256 different levels.

32-bit $2^{32} = 4,294,967,296$ (4G). Usually, 3 bytes are used to represent the three primary colours and the fourth byte is used as the *alpha channel*.

DIGITAL MEDIA

- For images, these files can have an extension like
  - BMP, JPG, GIF, TIF, PNG, PPM, …
- For audios, the file extensions include
  - WAV, MP3, …
- The videos files usually have extensions:
  - AVI, MOV, …

DIGITAL MEDIA CAPTURING

- To get a digital image, an audio or a video clip, we need some media capturing device such as
  - a digital camera or a scanner,
  - a digital audio recorder,
  - or a digital camcorder.
- All these devices have to complete tasks:
  - Sampling: To convert a continuous media into discrete formats.
  - Digitization: To convert continuous samples into finite number of digital numbers.
  - There are probably some further compression process.

IMAGE

- A **Raster Image** can be described by breaking the image into a two dimensional array of points, and allocating a colour to each of the points. If the points are close enough, then we believe the image to be continuous.
- **Pixel - a** picture element, containing the colour or the hue and relative brightness of that point in the image.
- **Image Resolution** - The number of pixels in the image.
- An image is a continuous thing. We aim to *sample* points across the 2 dimensions of the image at a high enough frequency so that we are at twice the frequency of the wanted textures in the picture (Nyquist Limit).

IMAGES: CONTD:

- An *image is a spatial representation of an object, a two-dimensional or three-dimensional scene or* another image. Often the images reflect the *intensity of lights.*

- Most photographs are called *continuous-tone images because the method used to develop the* photograph creates the illusion of perfect continuous tone throughout the image.

- Images stored and processed by computers, displayed on computer screens, are called *digital images although they often look like continuous-tone. This is because they are represented by a* matrix of numeric values each represents a quantized intensity values.

Resolution

Resolution measures how much detail an image can have. There are several resolutions relating to images.

Image resolution is the number of pixels in an image.

$320 \times 240 = 76800$ pixels, $700 \times 400 = 280000$ pixels

Display (Monitor) resolution — refers to number of dots per inch (dpi) on a monitor.

Windows systems usually have 96dpi resolution. Some high resolution video adapters/monitors support 120dpi. For example, a 288×216 image displayed on a monitor with 96dpi will be $3'' \times 2\frac{1}{4}''$.

Output resolution — refers to number of dots per inch (dpi) on a (hard copy) output device.

Many printers have 300dpi or 600 dpi resolution. High-quality imagesetters can print at a range between 1200dpi and 2400dpi, or higher. The above image printed on a 300dpi printer will be 0.96×0.72 inch.

1. Reduced Color Images

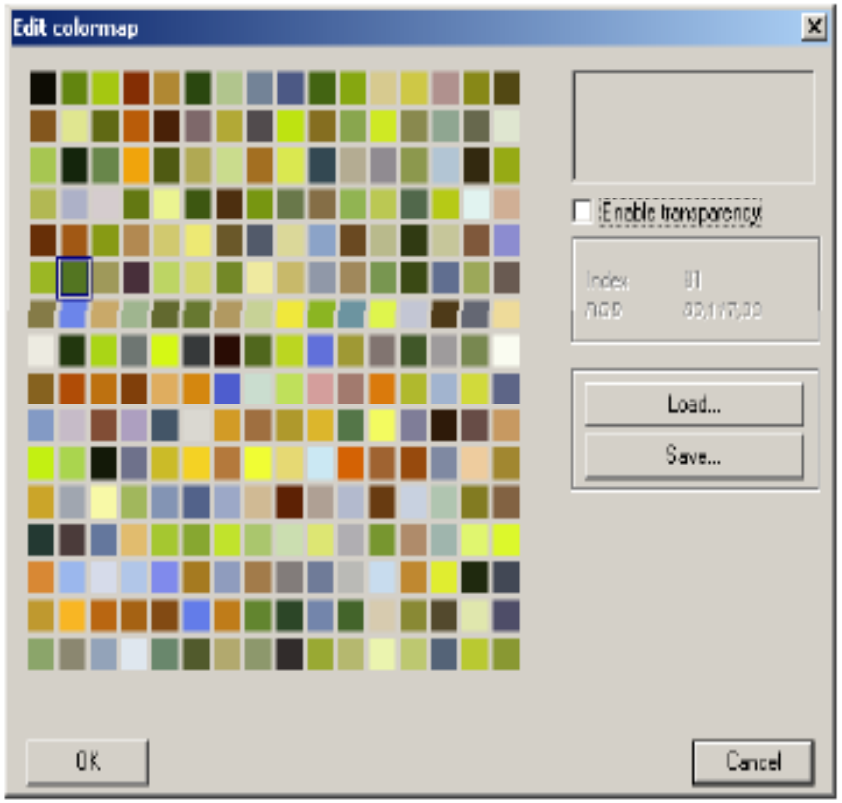
- **Monochrome Image** - Each pixel contains a single bit of information, indicating whether the pixel is light or dark.
- **Grey-scale Images** - Each pixel is stored as a byte, indicating the degree of brightness of the point. Normally interpreted as the brightness from black to white.

2. 24-Bit Colour Image - Each pixel is represented by three bytes,

RGB - Sometimes stored as a 32 bit quantity, where top byte is byte, indicating degree of transparency or other special effects. High degree of correlation between RGB values for typical images.

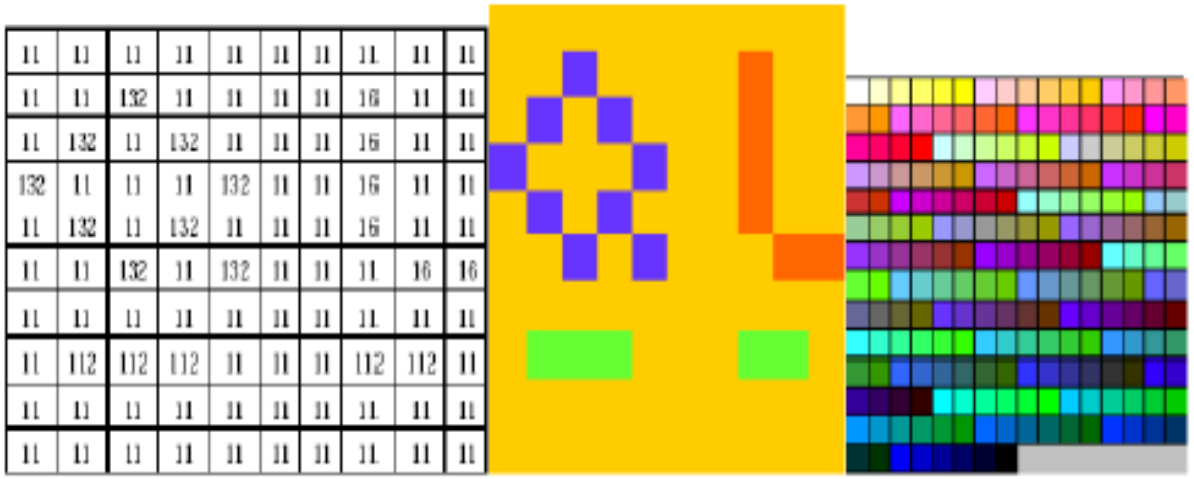
YUV,YCbCr - Transformed RGB values such that there is low corrlelation between the three bytes.

Color Palettes



Color Palette: Contd:

A *colour palette* is an index table to available colours in an indexed colour system. When working in 8-bit mode, a system can display only 256 colours out of a total of 16 million colours. The system keeps a default palette of available colours.



Palette flashing. Each program may have its own palette. It may replace the system palette with its own for the period it is active. This may cause an annoying flash of strange colours in your screen, known as *palette flashing*. This is a serious problem in multimedia applications.

DITHERING

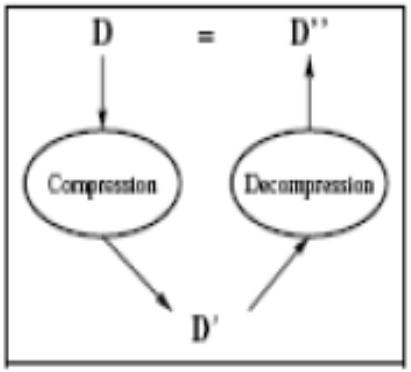
- It is a process whereby the color value of each pixel is changed to the closest matching color value in the largest palette using a mathematical algorithm.
- Using this, a scanned image that contains a millions of colors can be dithered to 256 colors image.

Coding Methods

Kinds of coding methods

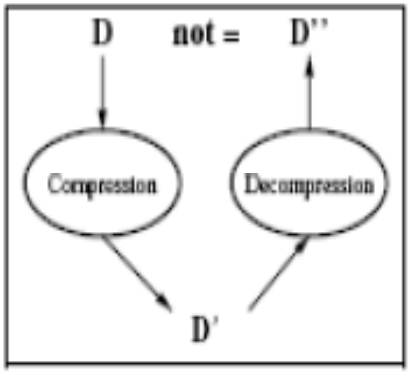
- *lossless* — the compression process does *not* reduce the amount of information.

  The original can be reconstructed exactly.

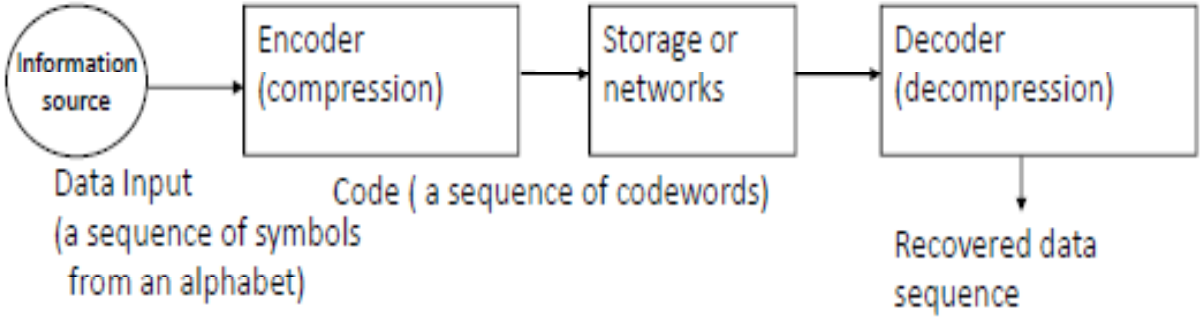


- *lossy* — the compression process reduces the amount of information.

  Only an approximation of the original can be reconstructed.



Compression: Lossless



Lossless compression: The recovered data is exactly the same as the input.

Lossy compression: The recovered data approximates the input data.

Compression ratio = (bits used to represent the input data) / (bits of the code)

APPLICATIONS

- Digital Photography
- Medical Imaging
- Digital Image Processing
- Remote Sensing & GIS
- Wireless Imaging

SCOPE OF RESEARCH

- Built-in Mechanisms in Imaging Devices for file compression and image enhancement
- Digital Photography
- 4 D, 5 D & above, the biggest application

e.g.: Movies Like Spy Kids:4D