Example of a Gray-scale Bit-map Image

- Each pixel is usually stored as a byte (value between 0 to 255)
- A 640 x 480 greyscale image requires over 300 KB of storage.

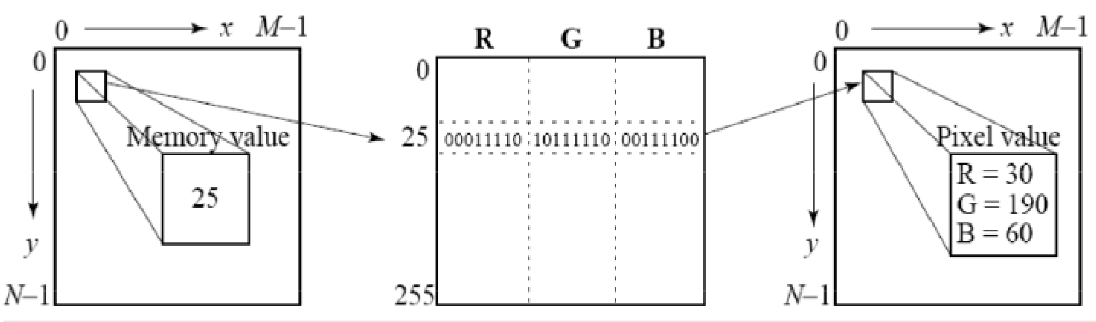
8-bit Colour Images

An example 8-bit colour image is illustrated in Fig. 6.13 where:

Fig. 6.13

Example of 8-Bit Colour Image

- One byte for each pixel
- Supports 256 out of the millions possible, acceptable colour quality
- Requires Colour Look-Up Tables (LUTs)
- A 640 x 480 8-bit colour image requires 307.2 KB of storage (the same as 8-bit greyscale).



24-bit Colour Images

An example 24-bit colour image is illustrated in Fig. 6.14 where:

Fig. 6.14

Example of 24-Bit Colour Image

- Each pixel is represented by three bytes (e.g., RGB)
- Supports 256 x 256 x 256 possible combined colours (16,777,216)
- A 640 x 480 24-bit colour image would require 921.6 KB of storage
- Most 24-bit images are 32-bit images, the extra byte of data for each pixel is used to store an ***alpha* value** representing special effect information.

Standard System Independent Formats

The following brief format descriptions are the most commonly used formats. Follow some of the document links for more descriptions.

GIF (GIF87a, GIF89a)

- Graphics Interchange Format (GIF) devised by the UNISYS Corp. and CompuServe, initially for transmitting graphical images over phone lines via modems
- Uses the Lempel-Ziv Welch algorithm (a form of Huffman Coding), modified slightly for image scan line packets (line grouping of pixels)

- Limited to only 8-bit (256) colour images, suitable for images with few distinctive colours (e.g., graphics drawing)
- Supports ***interlacing***

Note: ***Interlacing*** (also known as ***interleaving***) is a method of encoding a bitmap image such that a person who has partially received it sees a degraded copy of the entire image. When communicating over a slow communications link, this is often preferable to seeing a perfectly clear copy of one part of the image, as it helps the viewer decide more quickly whether to abort or continue the transmission.

JPEG

- A standard for photographic image compression created by the Joint Photographics Experts Group
- Takes advantage of limitations in the human vision system to achieve high rates of compression
- Lossy compression which allows user to set the desired level of quality/compression

TIFF

- Tagged Image File Format (TIFF), stores many different types of images (e.g., monochrome, greyscale, 8-bit & 24-bit RGB, etc.) -> tagged
- Developed by the Aldus Corp. in the 1980's and later supported by the Microsoft.
- TIFF is a lossless format (when not utilizing the new JPEG tag which allows for JPEG compression).
- It does not provide any major advantages over JPEG and is not as user-controllable it appears to be declining in popularity.

Graphics Animation Files

- FLC - main animation or moving picture file format, originally created by Animation Pro.
- FLI - similar to FLC.

- GL - better quality moving pictures, usually large file sizes.

Postscript/Encapsulated Postscript

- A typesetting language which includes text as well as vector/structured graphics and bit-mapped images
- Used in several popular graphics programs (Illustrator, FreeHand)
- Does not provide compression, files are often large

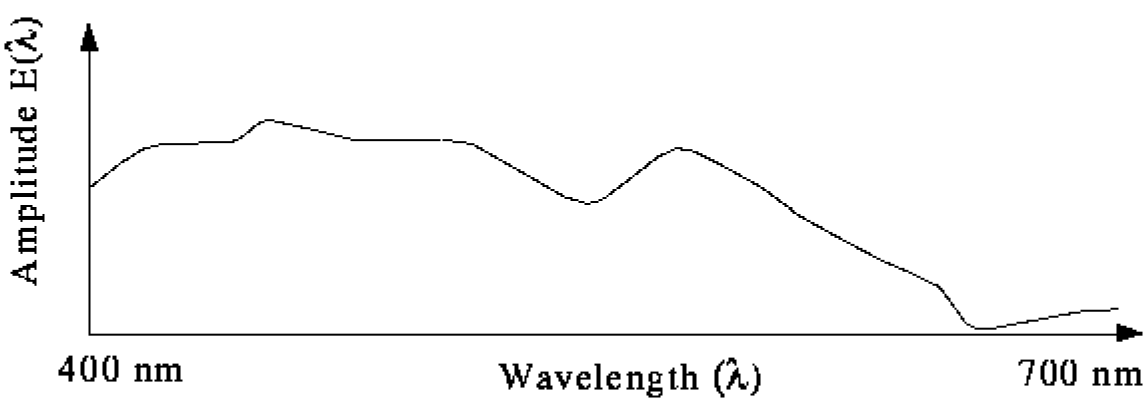
Colour in Image and Video

Basics of Colour

- Light and Spectra
- The Human Retina
- Cones and Perception

A. Light and Spectra

- Visible light is an electromagnetic wave in the 400nm - 700 nm range. Most light we see is not one wavelength, it's a combination of many wavelengths (Fig. 6.15).



Light Wavelengths

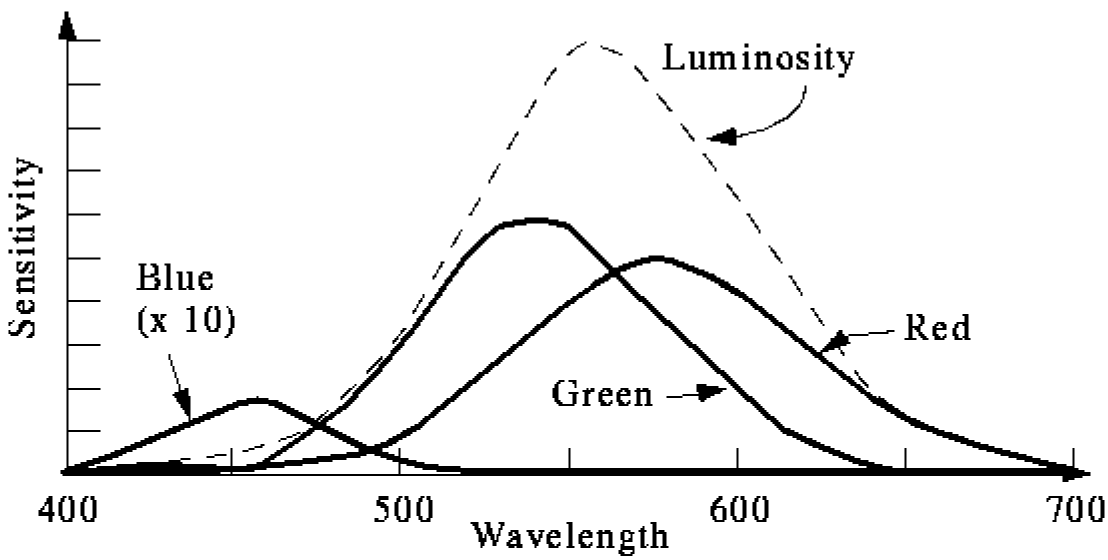
- The profile above is called a *spectra*.

B. The Human Retina

- The eye is basically just like a camera
- Each neuron is either a *rod* or a *cone*. Rods are not sensitive to colour.

C. Cones and Perception

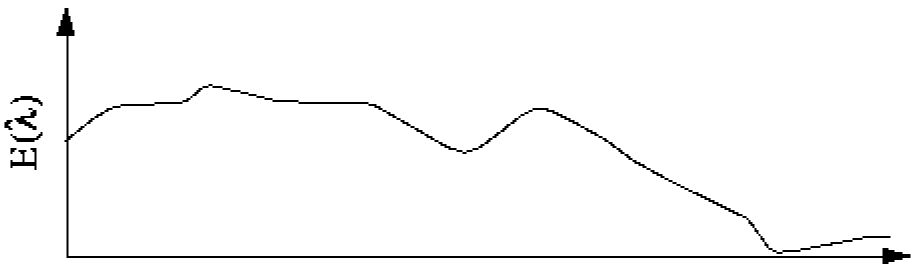
- **Cones** come in 3 types: red, green and blue. Each responds differently to various frequencies of light. The following figure shows the spectral-response functions of the cones and the luminous-efficiency function of the human eye (Fig. 6.16.



Cones and Luminous-efficiency Function of the Human Eye

- The profile above is called a *spectra*.
- The colour signal to the brain comes from the response of the 3 cones to the spectra being observed (Fig 6.17). That is, the signal consists of 3 numbers:

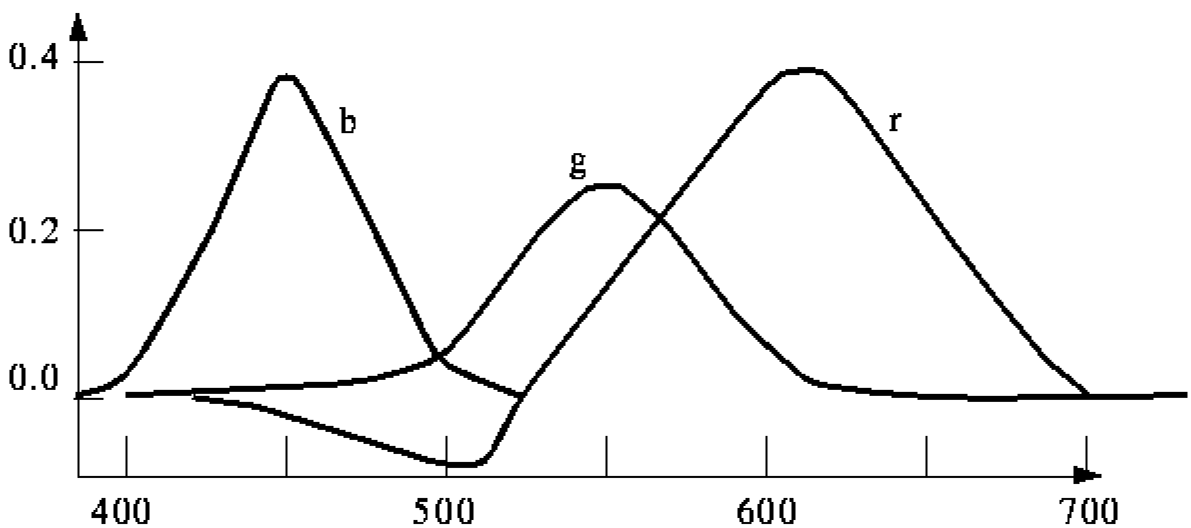
$$R = \int E(\lambda)\, S_R(\lambda)\, d\lambda$$



where ***E*** is the light and ***S*** are the sensitivity functions.

- A colour can be specified as the sum of three colours. So colours form a 3 dimensional vector space.

- The following figure shows the amounts of three primaries needed to match all the wavelengths of the visible spectrum (Fig. refspectrum).



Wavelengths of the Visible Spectrum

- The negative value indicates that some colours cannot be exactly produced by adding up the primaries.

CIE Chromaticity Diagram