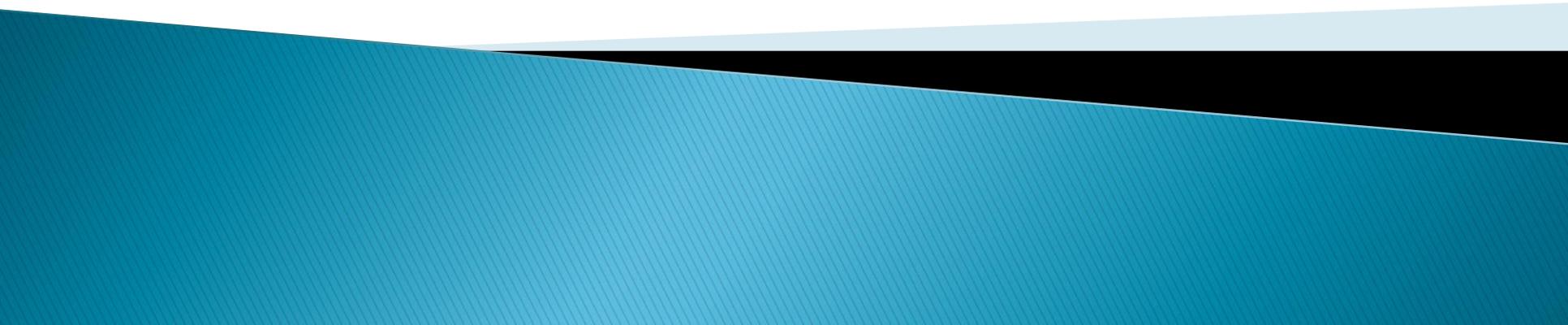


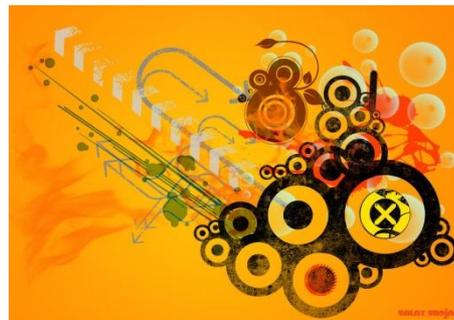
MMGD0206 Computer Graphics

Digital Imaging and Image Editing



Digital Image

- ▶ A **digital image** is a representation of a two-dimensional image as a finite set of digital values, called picture elements or pixels.
- ▶ The digital image contains a fixed number of rows and columns of pixels.
- ▶ Pixels are the smallest individual element in an image, holding quantized values that represent the brightness of a given color at any specific point.



Digital Image

- ▶ Digital images can be created by a variety of input devices and techniques, such as digital cameras, scanners, coordinate-measuring machines, seismographic profiling, airborne radar, and more.
 - ▶ They can also be synthesized from arbitrary non-image data, such as mathematical functions or three-dimensional geometric models; the latter being a major sub-area of computer graphics.
- 

Digital Imaging

- ▶ **Digital imaging or digital image acquisition** is the creation of digital images, typically from a physical object.
- ▶ The term is often assumed to imply or include the processing, compression, storage, printing, and display of such images.



Digital Imaging

- ▶ A digital image may be created directly from a physical scene by a camera or similar device.
 - ▶ Alternatively, it may be obtained from another image in an analog medium, such as photographs, photographic film, or printed paper, by a scanner or similar device.
- 

Image Processing

- ▶ Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it.
 - ▶ It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image.
 - ▶ Nowadays, image processing is among rapidly growing technologies.
- 

Image Processing

- ▶ Image processing basically includes the following three steps:
 1. Importing the image via image acquisition tools.
 2. Analyzing and manipulating the image.
 3. Output in which result can be altered image or report that is based on image analysis.
- 

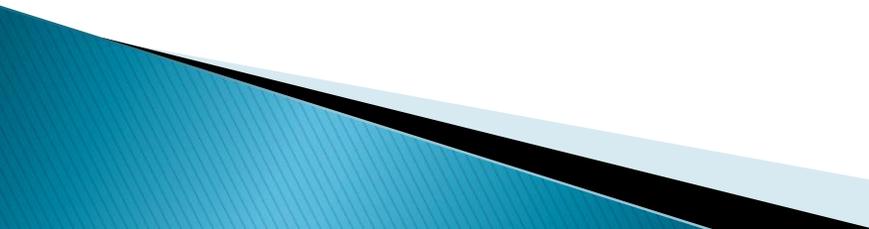
Image Processing

- ▶ There are two types of methods used for image processing namely, **analogue** and **digital** image processing.
 - ▶ Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques.
 - ▶ Digital image processing techniques help in manipulation of the digital images by using computers.
- 

Definitions and Terms

- ▶ **Resolution:** Refers to the sharpness and clarity of an image, measured in terms of ppi and dpi.
 - ▶ **PPI:** (*pixels per inch*) Measurement used for images displayed on screen.
 - ▶ **DPI:** (*dots per inch*) Measurement used in printing images.
 - ▶ **Pixel:** A word invented from "picture element" – the basic unit of programmable color on a computer display or in a computer image.
- 

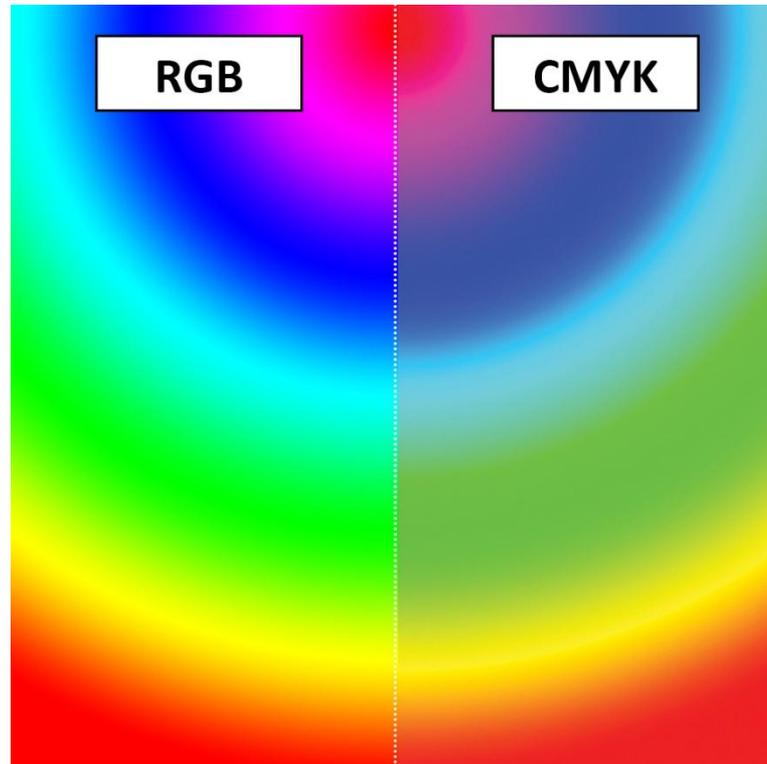
Definitions and Terms

- ▶ **Megapixel:** A megapixel (that is, a million pixels) is a unit of image sensing capacity in a digital camera. In general, the more megapixels in a camera, the better the resolution when printing an image in a given size.
 - ▶ **Lossy:** A term meaning “with losses” , used to describe image file formats that discard data due to compression.
 - ▶ **Lossless:** A term used to describe an image file format that retains all the data from the initial image file.
- 

Definitions and Terms

- ▶ **RGB:** (*Red, Green, Blue*) The color model for display devices (monitors, digital projectors, etc.) Each displayed color is determined by a combination of RGB.
- ▶ **CMYK:** (*Cyan, Magenta, Yellow, and Black*) The color model for printing. If you are printing something in color, be sure you have saved it in CMYK.

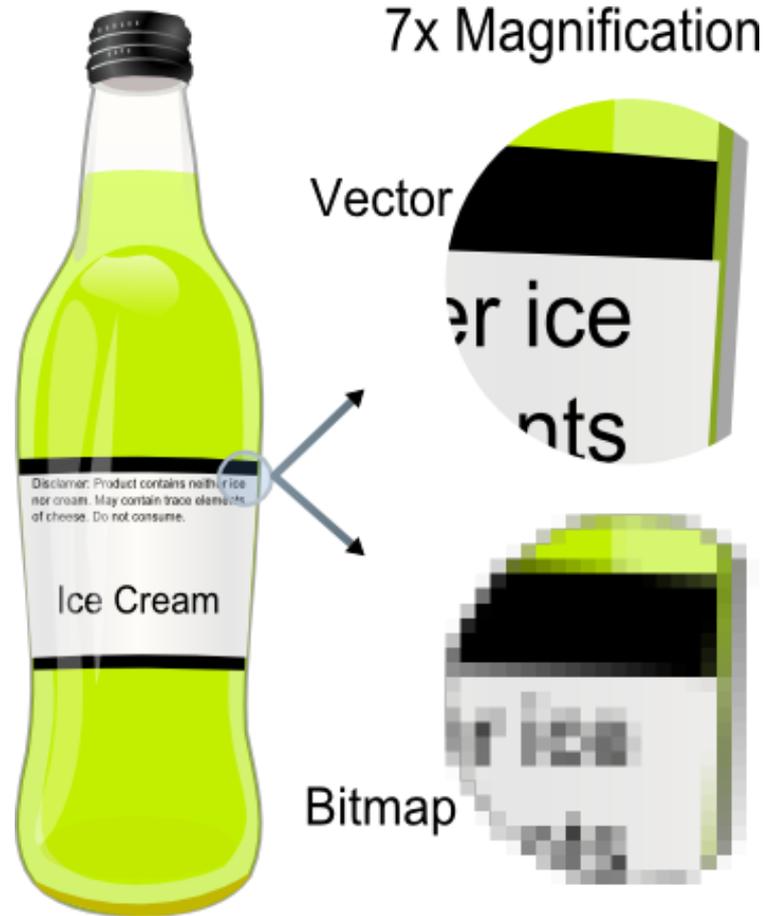
Definitions and Terms



Definitions and Terms

- ▶ **Bit-mapped (or Raster) images:** Images that have data that describe the color of each pixel. Larger display sizes equal larger file sizes in this type of image. Bitmapped images cannot be rescaled without resulting in "pixilation", or loss of definition in the details.
- ▶ **Vector images:** Vector images have data that describe lines and curves. These images can be enlarged and still maintain their smooth edges (not pixilated like bitmap images). Artists and designers will often work with vector images, and then "rasterize" the finalized version for distribution and display.

Definitions and Terms



Graphic File Formats

TIFF

A lossless file format that can be compressed. This format is widely supported across operating systems. **TIFF is the best file format for archiving high quality images.**

JPG or JPEG

The JPG file format was specifically created for photographs, and can contain millions of colors. JPGs are automatically compressed (you can choose the level of compression to match your desired image quality), resulting in a relatively small file size while still retaining quality. **For this reason, JPGs are ideal for email and Web use.** JPGs are lossy, discarding information each time that they are compressed.

GIF

The **lossless and compressed file format that is preferred for graphics**, because it keeps edges and lines sharp. GIFs are limited to 256 or fewer colors, and are not recommended for photographs, but rather for images with flat fields of color, such as clip art. GIFs can be static or animated.

PNG

Portable Network Graphics format, an open source substitute for GIFs. PNGs provide a higher lossless compression rate than GIFs, and help to reduce cross-platform differences in image display quality, among other technical advantages. PNG provides a useful format for the storage of images during intermediate stages of editing.

Graphic File Formats

BMP

Standard, non-compressed bit-mapped graphics format used in the **Windows**. Bitmap images, also called **raster images**, use a grid (the bitmap or raster) of small squares known as pixels to represent images.

PSD

Native **Adobe Photoshop** graphic file formats that takes up less memory than uncompressed TIF files. Saves masks, layers, clipping paths, and alpha channels with the graphic. Not a recognized import file for all programs.

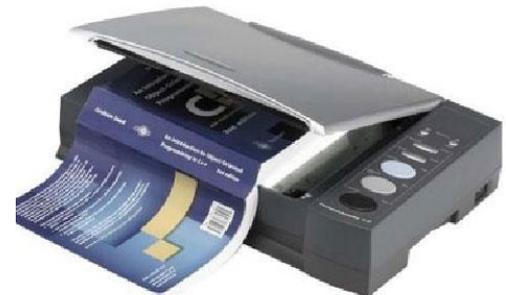
RAW

A flexible basic file format for transferring files between applications and computer platforms. This format consists of a stream of bytes describing the color information in the file.

Production of Digital Images

Scanning:

- ▶ You can take pretty much any printed material and scan it to obtain a digital copy of it. Readily available scanners make scanning images on paper, printed photos, slides, and negatives a fairly simple process. Many of these scanners are "plug and play," which means that soon after you unpack and plug your scanner into your computer, you can scan away without much delay.



Production of Digital Images

Digital Cameras:

- ▶ Digital cameras and camera phones are probably the fastest, easiest way to produce digital images. Keep in mind that there is quite a wide range of performance differences among brands, models by the same brand, and between consumer vs. professional grade equipment.



Production of Digital Images

Photo CDs:

- ▶ You may obtain a collection of digital images from your photo processor, along with your developed prints or slides. Many photo-processing services now provide photo CDs with .jpg images on them.



Image Size

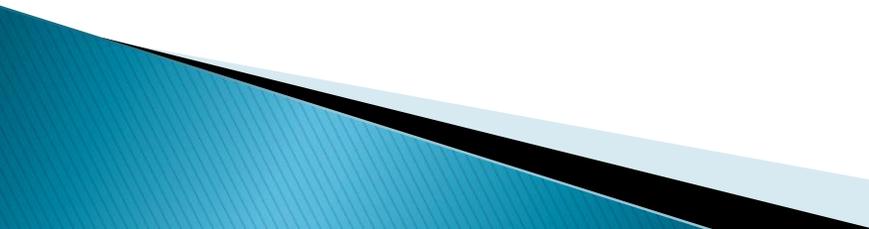
- ▶ Image size a concept that has more than one meaning.
 - ▶ The dimensions of a printed or displayed image, measured in inches or pixels.
 - ▶ The file size, or how much disk space the image file occupies, measured in KB or MB.
 - ▶ Both of these are influenced by the resolution of the image: the higher the resolution, the larger the dimensions and the more disk space occupied.
- 

Image Size

- ▶ Image dimensions are the length and width of a digital image.
 - ▶ It is usually measured in pixels, but some graphics programs allow you to view and work with your image in the equivalent inches or centimeters.
 - ▶ Depending on what you plan to use your image for you may want to change the image size.
- 

Resolution

- ▶ Resolution refers to the sharpness and clarity of your image.
 - ▶ Of course, the sharpness and clarity vary depending on the context of the image.
- 

Resolution



HIGH RESOLUTION
300dpi IMAGE



LOW RESOLUTION
72dpi IMAGE



Low Resolution



High Resolution

Resolution

- ▶ **Scanning:** When scanning your images, you are usually prompted to choose what resolution you would like your images scanned at. The intended use or display of your images will help you make this choice.

Resolution

- ▶ **Printing:** Images intended for high-quality printing should be scanned in at no less than 150dpi, preferably 300dpi. Remember, dpi is "dots per inch", and the more dots per inch, the sharper and crisper your images will look on the printed page. Many publishers have minimum resolution requirements for digital image submissions – make sure you know what's required before you start digitizing.

Resolution

- ▶ **Computer display:** Images intended primarily for display on a computer monitor (such as email attachments or images on a Web page) really only need a 72ppi to 96ppi resolution, as that is what computer monitors are capable of displaying. A higher resolution will not make your image appear any better on the screen.

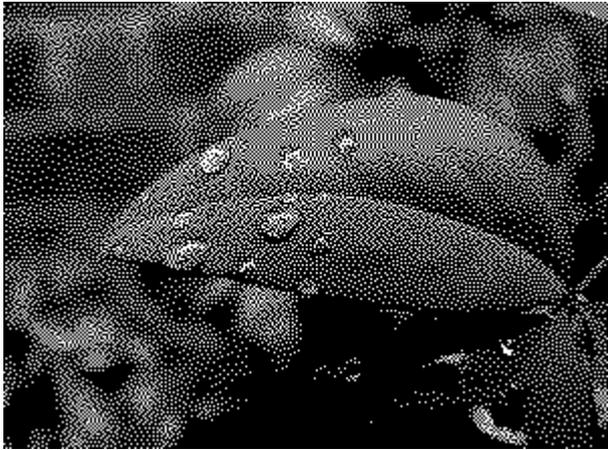
Color Depth

- ▶ **Color depth**, also known as **bit depth**, is either the number of bits used to indicate the color of a single pixel, in a bitmapped image or video frame buffer, or the number of bits used for each color component of a single pixel.
- 

Color Depth

Bits Per Pixel	Number of Colors Available	Common Name(s)
1	2	Monochrome
2	4	CGA
4	16	EGA
8	256	VGA
16	65536	XGA, High Color
24	16777216	SVGA, True Color
32	16777216 + Transparency	
48	281 Trillion	

Color Depth



1 Bit



2 Bits



4 Bits

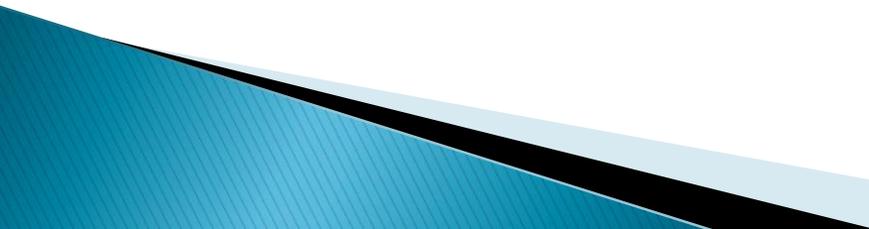


8 Bits



24 Bits

File Size

- ▶ File size is proportional to the pixel dimensions of an image, is partially determined by the file format, and it specifically refers to how much disk space your file occupies, either on the hard drive, CD, or other storage medium.
 - ▶ Image files normally range in sizes measured in Kilobytes (KB or K) and Megabytes (MB or M); extremely large files may be measure in Gigabytes (GB).
 - ▶ Images for print will have larger file sizes, since higher resolution = more data stored in the file.
 - ▶ Images for Web or computer display will have smaller file sizes.
- 

File Size

▶ Calculating Image File Size

File size = Image Height (px) x Image Width (px) x Color Depth / 8

▶ Example:

A full screen graphic resolution (640 x 480 pixels) at an 8-bit color will yield the following file size:

$$(640 \times 480 \times 8) / 8 = 307200 \text{ bytes}$$

Best Practice

- ▶ **Start Big:** When in doubt about how you might end up using your images, opt for the highest resolution possible. It is always better to start out with the most information possible, and then scale down as necessary. If you start out with low resolution, you cannot get a higher resolution without scanning or taking the picture again with higher resolution settings, and you may not get that chance.

Best Practice

- ▶ **Protect Originals:** Keep the original, high-resolution versions of your images (which should be in TIFF format, if possible) in a separate place from your working documents or optimized Web images. Back up your important documents on some kind of external storage medium (CD-Rom or fire wire drive, for example). This will help to ensure that you have something to go back to and work from should something unfortunate happen to the other files.

Best Practice

- ▶ **Name Files Accurately:** Develop a file naming convention that will help you accurately identify your files. Names that include descriptive information, version or size information, or intended use information can be helpful when managing large digital image collections.

Image Editing

- ▶ **Image editing** encompasses the processes of altering images, whether they be digital photographs, traditional analog photographs, or illustrations.
- ▶ Before digital scanners and cameras became mainstream, traditional analog image editing was known as photo retouching, using tools such as an airbrush to modify photographs, or editing illustrations with any traditional art medium.
- ▶ However, since the advent of digital images, analog image editing has become largely obsolete. Graphic software programs, which can be broadly grouped into vector graphics editors, raster graphics editors, and 3d modelers, are the primary tools with which a user may manipulate, enhance, and transform images.

Editing Program

- ▶ The more powerful programs contain functionality to perform a large variety of advanced image manipulations. Popular raster-based digital image editors include Adobe Photoshop, Corel Photo-Paint, Paint Shop Pro, GIMP, and Paint.NET.



Image Editor Features

Selection

- ▶ One of the prerequisites for many of the applications mentioned below is a method of selecting part(s) of an image, thus applying a change selectively without affecting the entire picture. Most graphics programs have several means of accomplishing this, such as a marquee tool, lasso, vector-based pen tools as well as more advanced facilities such as edge detection, masking, alpha compositing, and color and channel-based extraction.

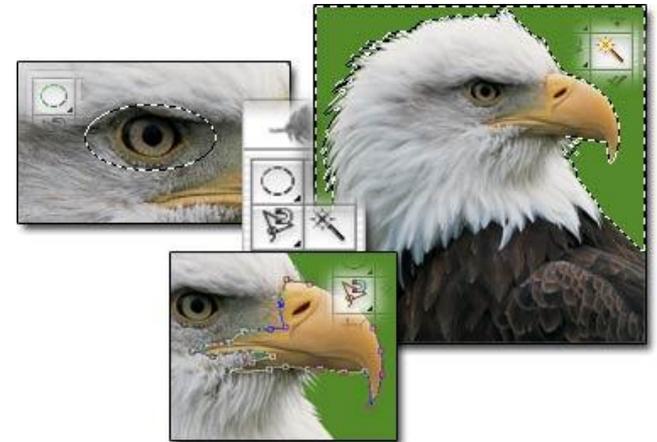


Image Editor Features

Layers

- ▶ Another feature common to many graphics applications is that of Layers, which are analogous to sheets of transparent acetate (each containing separate elements that make up a combined picture), stacked on top of each other, each capable of being individually positioned, altered and blended with the layers below, without affecting any of the elements on the other layers.



Image Editor Features

Image Size Alteration

- ▶ Image editors can resize images in a process often called image scaling, making them larger, or smaller. High image resolution cameras can produce large images which are often reduced in size for Internet use. Image editor programs use a mathematical process called resampling to calculate new pixel values whose spacing is larger or smaller than the original pixel values. Images for Internet use are kept small, say 640 x 480 pixels which would equal 0.3 megapixels.

Image Editor Features

Cropping an image

- ▶ Digital editors are used to crop images. Cropping creates a new image by removing a desired rectangular portion from the image being cropped. The unwanted part of the image is discarded. Image cropping does not reduce the resolution of the area cropped. Best results are obtained when the original image has a high resolution. A primary reason for cropping is to improve the image composition in the new image.



Image Editor Features

Removal of Unwanted Elements

- ▶ Most image editors can be used to remove unwanted branches, etc, using a "clone" tool. Removing these distracting elements draws focus to the subject, improving overall composition



Image Editor Features

Selective Color Change

- ▶ Some image editors have color swapping abilities to selectively change the color of specific items in an image, given that the selected items are within a specific color range.



Image Editor Features

Image Orientation

- ▶ Image editors are capable of altering an image to be rotated in any direction and to any degree. Mirror images can be created and images can be horizontally flipped or vertically flopped. A small rotation of several degrees is often enough to level the horizon, correct verticality (of a building, for example), or both. Rotated images usually require cropping afterwards, in order to remove the resulting gaps at the image edges.



Image Editor Features

Special Effects

- ▶ Image editors usually have a list of special effects that can create unusual results. Images may be skewed and distorted in various ways. Scores of special effects can be applied to an image which include various forms of distortion, artistic effects, geometric and texture effects, and combinations thereof.



Image Editor Features

Contrast Change and Brightening

- ▶ Image editors have provisions to change the contrast of images and brighten or darken the image. Many an underexposed image can be improved by using this feature. Recent advances have allowed more intelligent exposure correction whereby only pixels below a particular luminosity threshold are brightened, thereby brightening underexposed shadows without affecting the rest of the image.

Image Editor Features

Printing

- ▶ Controlling the print size and quality of digital images requires an understanding of the pixels-per-inch (ppi) variable that is stored in the image file and sometimes used to control the size of the printed image. Within the Image Size dialog (as it is called in Photoshop), the image editor allows the user to manipulate both pixel dimensions and the size of the image on the printed document.

Tutorial

1. Explain the definition of digital imaging.
 2. Define the following terms:
 - a. PPI
 - b. DPI
 - c. Lossy
 - d. Lossless
 3. Explain four graphic file formats.
 4. Give three examples of graphic editing programs.
 5. Give five features in graphic editing programs.
- 