Lecture 0

Graphics File Formats

Bitmap files – JPEG
MPEG

Reference: Encyclopedia of Graphics File Formats,
http://netghost.narod.ru/gff/
RECOGNIZING A GRAPHICS FILE

- Contains digital photographs, line art, three-dimensional images, and scanned replicas of printed pictures
  - Bitmap images: collection of dots
  - Vector graphics: based on mathematical instructions
  - Metafile graphics: combination of bitmap and vector
- Types of programs
  - Graphics editors
  - Image viewers

IMAGE BASICS

- Pixel
  - Picture element
  - Smallest unit that can be displayed on a screen
- Simplest graphics are black and white
  - 0 - white
  - 1 - black
IMAGE BASICS

Bit depth
+ Number of bits per image
+ 1 bit - black and white
+ 4 bits - 16 colors ($2^4$)
+ 8 bits - 256 colors ($2^8$)
+ 16 bits - 65,536 colors ($2^{16}$)
+ 24 bits - 16,777,216 colors ($2^{24}$)

Bit depth controls image file size
+ Higher the bit depth = larger file
**IMAGE BASICS**

1 bit
781 bytes

16 bits
11,982 bytes

- **RGB Color Model**
  - Red – Green – Blue
  - Additive model combines varying amounts of these 3 colors

http://en.wikipedia.org/wiki/RGB
Individual pixels represented in memory as a
+ Red value
+ Green value
+ Blue value

Values represent intensity
+ If red is more intense, the color perceived is towards the red

24-bit pixel value means
+ 8 bits for each RGB value
+ 256 possible values for each primary color
+ Values expressed as 0 – 255
**IMAGE BASICS**

- (0, 0, 0) is black
- (255, 255, 0) is yellow
- (255, 0, 0) is red
- (0, 255, 0) is green
- (0, 0, 255) is blue
- (255, 255, 0) is cyan
- (255, 0, 255) is magenta
- (255, 255, 255) is white

**Memory**
- Number of pixels times 3
- 640 x 480 pixels in size
- 640 x 480 = 307,200 total pixels
- 307,200 x 3 = 921,600 bytes
UNDERSTANDING BITMAP AND RASTER IMAGES

- Bitmap images
  - Grids of individual pixels
- Raster images
  - Pixels are stored in rows
  - Better for printing
- Image quality
  - Screen resolution
  - Software
  - Number of color bits used per pixel

IMAGE BASICS

- Bitmap
  - Grid of pixels

http://www.bergen.org/AAST/ComputerAnimation/
**IMAGE BASICS**

- **Resolution**
  + Number of pixels per unit of measurement
    - dpi = dots (pixels) per inch
  + Typical monitor is 72 dpi
  + Total sizes range from
    - 320 x 200
    - 1280 x 1024
  + Higher resolution equals sharper image

http://www.bergen.org/AAS/ComputerAnimation/

**IMAGE BASICS**

- **Raster images**
  + Collections of pixels
  + Stored as rows of pixels
  + Painted on the screen 30 times per second as individual pixels

http://en.wikipedia.org/wiki/Raster_format
IMAGE BASICS

- Vector images
  - Uses geometric primitives

- Brain
  - Handles images as vectors

- Eye
  - Captures mosaics of photons (bitmaps)
IMAGE BASICS

Example of vector data for a circle
- Radius
- Center
- Line style and color
- Fill style and color

Much less data to be stored
**IMAGE BASICS**

- Advantages of vector system
  + Smaller file sizes
  + Resizing does not change image
  + Easy modification of parameters
    - Moving
    - Scaling
    - Rotating
    - Filling


**UNDERSTANDING METAFILE GRAPHICS**

- Combine raster and vector graphics
- Example: scanned photo (bitmap) with text (vector)
- Share advantages and disadvantages of both types
  + When enlarged, bitmap part loses quality
UNDERSTANDING GRAPHICS FILE FORMATS

- Standard bitmap file formats
  - Graphic Interchange Format (.gif)
  - Joint Photographic Experts Group (.jpeg, .jpg)
  - Tagged Image File Format (.tiff, .tif)
  - Window Bitmap (.bmp)

- Standard vector file formats
  - Hewlett Packard Graphics Language (.hpgl)
  - Autocad (.dxf)

UNDERSTANDING GRAPHICS FILE FORMATS (CONTINUED)

- Nonstandard graphics file formats
  - Targa (.tga)
  - Raster Transfer Language (.rtl)
  - Adobe Photoshop (.psd) and Illustrator (.ai)
  - Freehand (.fh9)
  - Scalable Vector Graphics (.svg)
  - Paintbrush (.pcx)

- Search the Web for software to manipulate unknown image formats
UNDERSTANDING DIGITAL CAMERA FILE FORMATS

- Witnesses or suspects can create their own digital photos
- Examining the raw file format
  - **Raw file format**
    - Referred to as a digital negative
    - Typically found on many higher-end digital cameras
  - Sensors in the digital camera simply record pixels on the camera’s memory card
  - Raw format maintains the best picture quality

UNDERSTANDING DIGITAL CAMERA FILE FORMATS (CONTINUED)

- Examining the raw file format (continued)
  - The biggest disadvantage is that it’s proprietary
    - And not all image viewers can display these formats
  - The process of converting raw picture data to another format is referred to as **demosaicing**
- Examining the Exchangeable Image File format
  - **Exchangeable Image File (EXIF) format**
    - Commonly used to store digital pictures
    - Developed by JEIDA as a standard for storing metadata in JPEG and TIFF files
UNDERSTANDING DIGITAL CAMERA FILE FORMATS (CONTINUED)

Examining the Exchangeable Image File format (continued)

- EXIF format collects metadata
  - Investigators can learn more about the type of digital camera and the environment in which pictures were taken
  - EXIF file stores metadata at the beginning of the file

Figure 10-1  Identical EXIF and JPEG pictures
UNDERSTANDING DIGITAL CAMERA FILE FORMATS (CONTINUED)

Figure 10-2 Differences in EXIF and JPEG file header information

Figure 10-3 EOI marker FFD9 for all JPEG files
UNDERSTANDING DIGITAL CAMERA FILE FORMATS (CONTINUED)

- Examining the Exchangeable Image File format (continued)
  + With tools such as ProDiscover and Exif Reader
  - You can extract metadata as evidence for your case

CAN I CHANGE A GRAPHIC’S FILE SIZE?

**Cropping**
Selecting part of an image

**Change Color Depth**
The number of colors that are available for use in an image.
- Greater color depth yields better quality and larger file size
CAN I CHANGE A GRAPHIC’S FILE SIZE?

*Increase Resolution*
Pixel interpolation creates new pixels by averaging the colors of nearby pixels
- Can become “pixelated”

*Decreasing Resolution*
Decreases image quality

ARE THERE DIFFERENT KINDS OF BITMAP GRAPHICS?

- **BMP** – native bitmap graphic file format of Microsoft Windows OS
- **PCX** – one of original personal computer bitmap graphics file formats (8-bit)
- **TIFF** (Tag Image File Format) – highly flexible and platform-independent graphics file format
  - Supports True Color
  - Used by scanners and digital cameras
ARE THERE DIFFERENT KINDS OF BITMAP GRAPHICS?

- **JPG** – graphics format with built-in compression
  - You control level of compression
  - Uses True Color
- **GIF** – limited to 256 colors
- **PNG** – 48-bit True Color, compresses without losing data
  - Public domain format

HOW DO I KNOW WHICH GRAPHICS FORMAT TO USE?

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP</td>
<td>Graphical elements (e.g. buttons)</td>
</tr>
<tr>
<td>PCX</td>
<td>Not used much</td>
</tr>
<tr>
<td>TIFF</td>
<td>High-resolution scanned images and digital photos</td>
</tr>
<tr>
<td>JPG</td>
<td>Photographic or scanned images that might be on Web</td>
</tr>
<tr>
<td>GIF</td>
<td>Popular for Web graphics</td>
</tr>
<tr>
<td>PNG</td>
<td>Alternative to GIF</td>
</tr>
</tbody>
</table>
WHAT IS A VECTOR GRAPHIC?

- Consists of set of instructions for recreating a picture
- Instructions include:
  - Shape
  - Size
  - Position
  - Color
- Common Extensions:
  wmf, dxt, mgx, eps, pict, cgm
HOW DO VECTOR GRAPHICS COMPARE WITH BITMAP GRAPHICS?

- Vectors resize better than bitmaps
- Vector images usually require less storage space than bitmaps
- It is easier to edit an object in a vector graphic than an object in bitmap graphic
- Vector graphics are not usually as realistic as bitmap images

IS IT POSSIBLE TO CONVERT A VECTOR GRAPHIC INTO A BITMAP?

- **Rasterization**
  - superimposes a grid over a vector image
  - determines the color for each pixel
  - Resulting graphic no longer has the qualities of a vector graphic
CAN I CONVERT A BITMAP GRAPHIC INTO A VECTOR GRAPHIC?

- This process is more difficult
- *Tracing software*
  - Locates the edges of objects in a bitmap image
  - Converts the resulting shapes into vector graphics objects