

# Digital Image Technology Seminar Notes

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**May 2005**

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## Digital Images

- **Image Characteristics**

- Image Types: Vector / raster, Graphics / photos, Animation
- Resolution: Display, photos, scanners/ printers; DPI
- Color Depth: Monochrome, gray, indexed, full; Color spaces

- **Image Compression**

- Image File Formats
- Web, Photos, Print

- **Image / Photo Processing**

- Scanning, Printing
- Image Editing and Enhancement

# Image Types

- **Vector / object / line art**
  - PowerPoint, Adobe Illustrator
  - Graphics shapes, type, styles / attributes
  - Logos, for print, scale-independent
- **Graphics / drawings / logos**
  - MS Paint – limited colors, flat
  - GIF files
- **Full-color / photos / continuous-tone**
  - Grayscale and color
  - Adobe Photoshop
  - Scanned, digital photos, painting effects
- **Animations**
  - Animated GIF – flip-book
  - Flash – scripted, programmed



# Image Resolutions

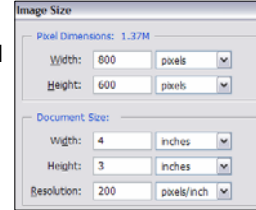
- **Resolution**
  - Pixels – width x height
  - Video – dots x lines
  - PC – Display Properties
- **Capture**
  - Sampled – Sample rate
  - Camera lens and imager
  - Scanner
- **View: Perceived Resolution**
  - Display size
  - Pixel size/structure
  - Viewing distance
- **Aspect Ratio**

Handheld / phone		160 320
PC display	VGA	640 x 480
	XGA	1024 x 768 / 800
	SXGA	1280 x 1024
	UXGA	1600 x 1200
Television	NTSC	720 x 480
High Def	720p	1280 X 720
	1080i	1920 X 1080
Digital Cam	1 mpix	~ 1024 x 1024
	2 mpix	~ 2048 x 1024
	5 mpix	~ 2500 x 1900
	7 mpix	~ 3000 x 2400
	8 mpix	~ 3264 x 2448

# Sampling: DPI vs Resolution

- **Scanner – Sampling rate – DPI – Dots Per Inch**

- 4800 x 2400, 600 x 1200, optical res vs. interpolated
- 100-200 dpi edit for web  
300-600-1200 small to full-page photos
- Desired pixels / Actual size = Scan dpi setting  
(1200 pix / 6" = 200 dpi)



(Photoshop CS)

- **Image editor – Just pixels on disk**

- Edit, Enhance – Retain full resolution as needed
- Resize on export for target output device (Web, printer)

- **Screen (Web) – Just pixels on the display ~ 72 dpi**

- Pixel size relative to target display resolution (~ 1024 x 768)
- 21" monitor at 1024 = 61 dpi, 1280 = 76/81, 1600 = 95
- 19" monitor at 1024 = 67 dpi, 1280 = 84/90, 1600 = 105

- **Printer – DPI**

- NOT printer dot size – e.g., 150-300-600-1200 dpi actual, 4800 optimized
- Set image dpi for print size: Actual pixels / Desired size
- Or layout in application: Scale to size on page (PPT)

# Pixel Depth / Sample Size

- **One-bit – Monochrome – Line art, scans**

- **Grayscale – 8 bits – 256 levels – Scans, print art**

- Black & white printing

- **Indexed color – 8-bit, 256 colors**

- Color-mapped, CLUT – Color Look Up Table
- GIF – With transparency
- Also DVD menu highlights, subtitle overlays
- Use for simple graphics (few colors)
- Compress from full-color (reduce size for PPT)
- Very effective for single images
  - Not groups of dissimilar images



(Paint Shop Pro)

- **Full-color – 8 bits each**

- 2 ^ n Colors, packed

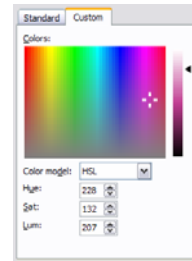
Bits	Format	Total Colors
8	Indexed	256
16	4-bit ea.	64 K / Thousands
24	8-bit ea.	16 M / Millions
32	10-bit ea.	4 B / Billions

# Color Models

- **Color Circle**
  - Hue: Red – (Yellow) – Green – (Cyan) – Blue – (Magenta)
  - Saturation: Intensity of color – Gray to Full
  - Brightness: Lightness – Black to White
  - CIE color space – All visible colors – Virtual primaries
- **Print – Subtractive – ~ Red, Yellow, Blue**
  - Start with White, Add pigments
    - Combine to make Black (no reflection)
  - CMYK – Cyan, Magenta, Yellow, black
- **Display – Additive – Red, Green, Blue**
  - Start with Black, Add light
    - Combine to make White (all wavelengths)
  - RGB – Red, Green, Blue
  - HSB – Hue, Saturation, Brightness (Value)
  - YUV / YIQ – Intensity, Color – Video
- **Color calibration – Color management**
  - Scanner / Camera – Monitor – Printer



(PowerPoint)



# Color Compression

- **Full-color – 8 bits each – RGB – Millions of colors**
  - 32-bit – 8-8-8 RGB + 8 transparency vs. 10-bit RGB
- **Grayscale – 256 levels – Print**
  - Just intensity
  - Use for print
- **Indexed color – 256 colors**
  - Best-fit, Closest-fit
  - Use for PowerPoint (!)
- **Dithered color – 256 colors, lower res**
  - Perceived color from local pattern
  - Use for color reduction for print



# Image Compression – File Sizes

- **1 MegaPixel image = 3 MB**
  - 1024 x 1024 x 24 bits (RGB)

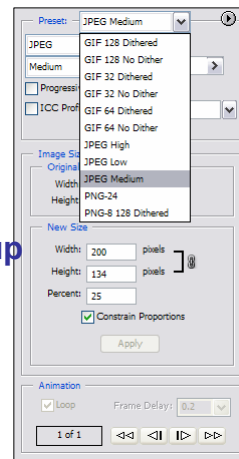
- **Reducing File Size**
  - Reduce Resolution – Resize
  - Reduce Pixel Depth – GIF
  - Compression – JPEG

Format	Size
TIFF (RAW)	3 MB
TIFF (LZW)	~ 2.7 – 2.2 MB
JPEG	~ 600 – 200 KB
GIF (Gray, 256)	1 MB
GIF (Dither)	~ 900 – 600 KB

- **Compression**
  - Lossless or Lossy
  - Lossless – Run-length encoding (RLE)
  - Lossy – Spatial (blocks), Fractal, Perceptual

# Image File Formats – Web

- **GIF – Graphics Interchange Format**
  - Indexed color: Up to 8-bit, 256-color
  - Lossless compression
  - Transparent, animated
  - Best for graphics
  - CompuServe patent
- **JPEG – Joint Photographic Experts Group**
  - Grayscale, full-color
  - Lossy compression – Selectable
  - Best for photos, natural images
  - JPEG 2000
- **PNG – Portable Network Graphics**
  - Lossless, Indexed color + RGB
  - Open standard: GIF- & JPEG-like



(Photoshop Elements)

## Image File Formats – Photos

- **Platforms**

- PICT – Picture – Macintosh – Mono to full-color
- BMP – Bitmap – Windows – Mono to full-color
- RAS – Raster – Sun

- **Photos / Print**

- TIFF – Tagged Image File Format
  - Lossless, often uncompressed, but LZW supported
  - Best for print, sharing
- PSD – Adobe Photoshop Digital
  - Layers: Bitmap pixels & Vector text, objects
  - Uncompressed
- EPS - Encapsulated PostScript – Adobe Illustrator
  - Vector and bitmapped
  - Packaged for printer

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Photoshop (*.PSD;*.PDD)
BMP (*.BMP;*.RLE;*.DIB)
CompuServe GIF (*.GIF)
Photoshop EPS (*.EPS)
JPEG (*.JPG;*.JPEG;*.JPE)
JPEG 2000 (*.JPF;*.JPX;*.JP2;*.J2C;*.J2K;*.JPC)
PCX (*.PCX)
Photoshop PDF (*.PDF;*.PDP)
Photoshop Raw (*.RAW)
PICT File (*.PCT;*.PICT)
Pixar (*.PIR)
PNG (*.PNG)
Scitex CT (*.SCT)
Targa (*.TGA;*.VDA;*.ICB;*.VST)
TIFF (*.TIF;*.TIFF)
```

(Photoshop Elements)

## Image Processing – Scanning

- **Options**

- DPI / Resolution, Colors, Page Crop, Descreen (newspapers)
- Line Art – Gray scale or halftone, binary black & white
- Halftone – Newsprint – Dot patterns
- Photo – Grayscale and color - Continuous tone

- **DPI Rules of Thumb**

- OCR – Clean monochrome / grayscale, enough dpi
- Printer – 2 X LPI (Lines Per Inch); 600 dpi printer ~ 150 dpi scan
  - 150-300-600-1200 dpi actual, 4800 optimized
- Web – 72 dpi – 100-200 dpi to edit and scale
- Photos – 300-600-1200, scaled small to full-size
- Not too little dpi (quality), nor too much (size)

# Image Editing

- **Photo Operations**

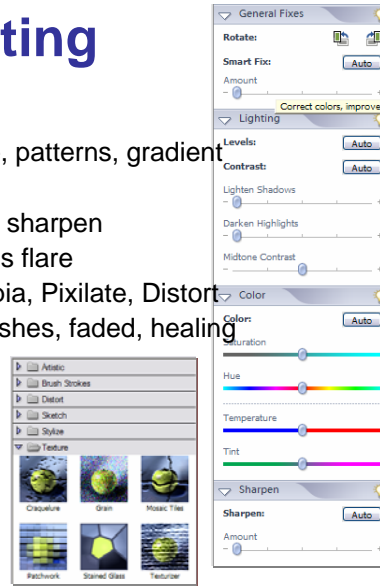
- Paint – Pan, brush, fill, shapes, clone, patterns, gradient
- Format – Crop, straighten, resize
- Enhance – Exposure, contrast, color, sharpen
- Photo – Dodge / burn, lens filters, lens flare
- Filters – Artistic, Stylize, Texture, Sepia, Pixilate, Distort
- Retouch – Red eye, scratches, blemishes, faded, healing
- Annotate – Text, graphics, borders
- Compose – Transparency, blend

- **Layers**

- Raster, vector objects, text – Masks
- Blend, Opacity – Styles, Adjust, Fill

- **Export**

- Slideshow, animation
- E-mail, Web gallery, Print book, Handheld



(Photoshop Elements)

# For More Information



The Manifest Technology site by Douglas Dixon contains over 150 articles and technical references on multimedia technology, especially digital video editing and DVD authoring.



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