CHAPTER

6. Graphics

COM205
MULTIMEDIA APPLICATIONS

MULTIMEDIA & GRAPHICS

- Graphics covers wide range of pictorial representations.
- Uses for computer graphics include:
  - Buttons
  - Charts
  - Diagrams
  - Animated images

MULTIMEDIA GRAPHICS

- Challenges of computer images include:
  - Large file size
  - Slow downloads and processing
  - Possible inferior quality from original
  - File format compatibility
  - Images display differently on various monitors and printers

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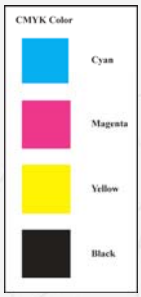
TRADITIONAL GRAPHICS

- Color image reproduction.
  - Use a series of four-color dots of transparent inks.



- CMYK
  - Cyan, magenta, yellow, black.
  - Small dots of color combinations can reproduce many different colors.

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COLOR REPRODUCTION

Subtractive Color (CMYK)

- Color images on printed surface are formed using subtractive process.
  - Light is reflected from the printed surface.
  - Pigments that form image absorb some of the colors.
  - Remaining colors reach the eye to produce image.

Additive Color (RGB)

- Color images on computer monitor use additive process.
  - Varying amounts of Red, Green, and Blue light are added together to create the color.

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2-D COMPUTER GRAPHICS

BITMAPPED IMAGES &
VECTOR DRAWN GRAPHICS

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BITMAPPED GRAPHICS

- Bitmapped/Raster graphics
  - Used for photorealistic and detailed drawings
  - Each element is a pixel
- Pixels
  - Pixels are small squares.
  - Assigned a binary code to define color.
    - More bits = more color possibilities
- 3 types of bitmapped graphics

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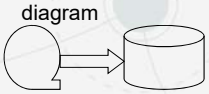
BITMAPPED IMAGES – LINE ART

- Two colors, usually black and white.
  - Advantages
    - Clear, crisp image.
    - Small file size.
  - Uses include:
    - Charts
    - Illustrations
    - Diagrams

Line art flow chart diagram



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BITMAPPED IMAGES - GRAYSCALE

- Generally 8-bit images of 256 shades of gray.
- For images that require more detail than line art.
  - Advantages
    - Excellent representation of black and white photos.
    - Smaller files size than full color.
    - Lower printing costs than color.

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BITMAPPED IMAGES - COLOR

- Consists of a pattern of colored pixels.
- Amount of color depends on bit depth of each pixel.
- Photo-realistic color requires 24-bit color.
  - Two methods to create color on a computer:
    - Identify a table of possible colors for the computer (Color Lookup Table).
    - Specify varying amounts of Red, Green, Blue.

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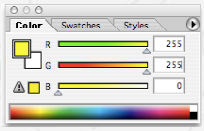
MAKING COMPUTER COLOR

- 8-bit color presents a specific range of colors in a table.
  - PCs and Macs use different tables.
  - Web-safe table provides colors that display the same on all platforms.
- 24-bit color combines 8-bit values of red, green, or blue to create the result.
  - 16.7 million color possibilities.
- 48-bit color has 16-bit values
  - 281 trillion color possibilities.



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BITMAPPED IMAGE QUALITY

- Image quality depends on spatial and color resolution.
  - Spatial resolution = density of pixels per inch.
  - Color resolution = number of colors each pixel can display.
- Spatial resolution measurements.
  - Monitor output is measured in ppi (pixels per inch).
  - Print output is measured as dpi (dots per inch).

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SPATIAL RESOLUTION

- Higher spatial resolution
  - Captures more detail.
    - Pixels are smaller and closely packed.
  - Produces sharper, more accurate images.

- Lower spatial resolution
  - Captures less detail.
    - Pixels are larger.
  - Images appear fuzzy.

- High spatial resolutions yield large file sizes but better image quality.

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DEVICE-DEPENDENCE

- Dimensions of an image depend on the resolution of the output device.
  - Monitors have low spatial resolution:
    - 72 ppi (Mac) or 96 ppi (PC).
  - Printers have higher spatial resolutions:
    - 300 dpi to 2400 dpi.
- Bitmapped images are device-dependent.
  - 300 ppi image prints the original size on 300 dpi printer.
  - Same image is greatly enlarged on a 72 ppi monitor.

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COLOR RESOLUTION

- Bit-depth determines color resolution.
- Making the bit-depth choice:
  - Simple color images do not require many colors. Low bit-depth yields small file size.
  - Complex color images require millions of colors. High bit-depth yields better quality but larger files.
- Low color resolution may cause quantization and color banding.
  - Quantization leads to breaks in shades of continuous tone images.

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RESAMPLING BITMAPPED IMAGE

- Process of increasing or decreasing the number of samples described in a file.
  - Often need to control spatial resolution of bitmapped images.
    - 72 ppi for web display.
    - 300 ppi for laser output.
- Upsampling: adding samples to the file. (can degrade img)
- Downsampling: reducing the samples in the image. (can produce smaller images that maintain good quality. Capture at highest resolution and downsample as needed.

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RESIZE without RESAMPLING

- A bitmapped image can be resized without resampling.
  - Enlarging a printout may produce acceptable results.
    - Caution: excessive enlargement will distort the image with blocky, mottled surface appearance.
  - Reducing the image size without resampling can produce high quality printouts.
    - Pixels are packed more closely together.

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RESIZE without RESAMPLING

- Excessive enlarging without resampling can lead to distorted images.

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COLOR RESOLUTION

- Indexing
  - A specific palette of colors is identified to optimize the appearance of lower color resolution image.
  - Two methods to create the index of colors:
    - Adaptive
    - Perceptual
- Dithering
  - Combining pixels of different colors to produce another color not available in the indexed palette.
  - Improves image quality without increasing bit depth.

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BITMAPPED IMAGE SOURCES

- Paint programs (Paint, Photoshop)
- Digital cameras
- Scanner
- Clip Art
- Screen Grab

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BITMAPPED FILE FORMATS

- Common graphic file formats are:
  - PICT
  - BMP
  - TIFF
  - JPEG
  - GIF
  - PNG-8, PNG-24
- Compression of bitmapped graphics are:
  - Lossy
  - Lossless

What form of compression do each of these formats use?

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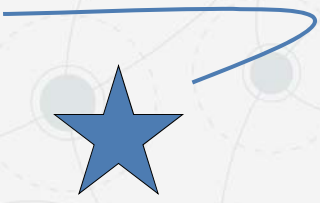
VECTOR-DRAWN GRAPHICS

- Vector: a line with length, curvature, and direction.
- Vector graphics: images created from mathematically defined shapes.
- Drawing programs: software used to create vector graphics.
- Main advantages:
  - Images can be enlarged without distortion.
  - Small file size.



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VECTOR-DRAWN GRAPHICS

- Draw programs use tools that resemble those of a draftsman:
  - Fixed shapes
  - Bezier curves
  - Pen

- Objects are layered on each other and grouped to form complex images.
  - Grouping joins individual shapes.
  - Ungrouping restores image to separate shapes.

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DEVICE INDEPENDENCE

- Vector graphics can be used with different devices without altering the image dimension.
  - Printers and monitors preserve the original dimension of the image.

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VECTOR to BITMAPPED & BACK AGAIN

- Autotracing: software analyzes a bitmapped image for shapes and converts the image to a vector graphic.
- Rasterizing: samples the vector image and saves it in bitmapped form.
  - Vector graphics displayed on a screen can be screen grabbed and saved as a bitmapped graphic.

Bitmapped

Autotraced

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VECTOR GRAPHIC FILE FORMATS

- Files are saved in native format or general purpose formats.
  - Native format: dependent on the application.
  - General purpose: can be used in many applications.
    - Vector-only:
      EPS—Encapsulated Postscript.
      PDF— Portable Document Format.
    - Metafiles:
      SVG—Scalable Vector Format.

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ADVANTAGES

Bitmapped Images

- Represent complex images.
- Full-featured photo editing.
- Wide range of artistic effects.
- Precise editing.

Vector Images

- Smooth scaling and reshaping.
- Ease of editing objects in layers.
- Low file size.
- Device-independent.

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DISADVANTAGES

Bitmapped Images

- Large file sizes.
- Loss of precise shapes when scaled or rotated.
- Device-dependent.

Vector Images

- Inaccurate, incomplete representation of complex contone images.
- No photo-editing capability.
- Limited artistic control.

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3-D COMPUTER GRAPHICS

PRODUCE THE ILLUSION OF DEPTH
ON A FLAT SURFACE.

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3-D GRAPHICS

- Computer becomes a virtual partner in the creative process.
- Four interconnected steps in creating 3-D images:
  - Modeling
  - Surface definition
  - Scene composition
  - Rendering

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STEP 1: MODELING

- Process of specifying the shape of the 3-D object.
- Two major approaches to modeling:
  - Combine cubes, cones, cylinders and other 3-D shapes supplied with the graphics program - modeling with primitives.
  - Use a modeler to create shapes directly.

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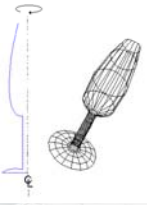
3-D MODELING

- Modelers have ability to:

Extrude: extends the shape perpendicular to the shapes outline



Lathe: a shape is rotated around a defined axis to create the 3-D object.

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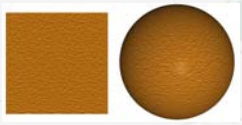
STEP 2: SURFACE DEFINITION

- Surface definition: where textures are applied to the model's surface.
  - Menu choices of surfaces include wood, glass, metal, skin.
  - Can vary the appearance of surfaces with color, opacity, reflectivity.
- Custom surfaces include:
  - Image maps
  - Bumb maps.



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STEP 3: SCENE COMPOSITION

- Objects are arranged, backgrounds introduced, environmental effects added, and lighting established.
- Lighting choices in a scene include:
  - Omni lights
  - Directional lights
  - Spot lights
  - Volumetric light.
- Adjust lighting with brightness, color, and attenuation.

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STEP 4: RENDERING

- Computer creates the scenes specified by the artist.
- Two main approaches:
  - Pre-rendering
    - Used primarily for still graphics, animation, and video with limited interactivity.
  - Real-time rendering
    - Used for highly interactive 3-D applications such as video games.

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RENDERING (cont.)

- Forms of rendering to create test scenes in 3-D graphics:
  - Wire frame rendering
    - A series of lines used to define the shape of an object without defining its surface.
    - Useful to test the basic geometry and placement of an object.

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RENDERING (cont.)

- Surface rendering applies lighting and shaders to the object.
  - Flat shaders, has imperfections but a fast render process.
  - Smooth shaders, better quality surface.
  - Ray tracing, traces each ray of light as it interacts with objects on a scene.
  - Radiosity, recreates the changes that result from interaction of different wavelengths of light.

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FINAL RENDER

- Final rendering translates 3-D information to a 2-D image.
- Rendering engines apply effects to the finished product such as shadows, reflections, bumps, transparencies and lighting considerations.
- Successful rendering requires processing power, time, and artistic talent.

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CREATING WORLDS

- 3-D graphics are powerful tools to create reproductions of the world around us.
- Fantasy worlds come alive with creative artists and software applications such as Maya, Blender, Zbrush, 3-D StudioMax.

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GUIDELINES FOR USING GRAPHICS

- Identify purpose of the graphic.
- Choose best format for each image.
- Match graphic design to purpose.
- Locate graphics.
- Preserve image quality.
- Economize.
- Organize and store graphics files for later use.

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