CHAPTER

2. Digital Data

COM 205
MULTIMEDIA APPLICATIONS

CHAPTER HIGHLIGHTS

- Elements of digital media.
- Digital codes.
- Digital files.
- Digitization process.
- Compression for digital media.
- Advantages of digital media.
- Challenges of digital media.

CODING DIGITAL INFORMATION

- Symbols represent something else.
  - Organized and understood by a conventional standard.
- Data are the givens of experience.
  - Measurements, facts, observations.
- Information is data made useful, interpreted, and applied to produce understanding.

YOU DECIDE: DATA OR INFORMATION?

Age = 30 yrs.

Temperature = 30 degrees

Distance = 30 mi.

Cost = $30

People who are 30 years old, pay $30 to run 30 miles in 30 degree weather for a charity benefit.

ANALOG vs. DIGITAL DATA

- Analog data - varies continuously.
- Digital data - consists of separate, discrete units.

Hour glass to tell time.

Numbers

1, 2, 3, 4

Wind mill motion.

DIGITAL DATA

- Digit = number.
- Binary digit (bit) = 0 or 1.
- Bits are the symbols to encode digital data.
- Digital encoding assigns bits to data items.

Data	Binary Representation
Letter A	0100 0001
Number 5	0011 0101

More bits in the code, means more distinct items to encode.

BUILDING DIGITAL CODES

- Number of distinct bit combinations that can be produced is given by the formula 2n.
  - n = number of bits used in the code.
- Adding 1 to the power doubles the number of distinct data items that can be encoded.

2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8
2 items	4 items	8 items	16 items				

Complete the table to identify the number of distinct items represented by 2^5, 2^6, 2^7, and 2^8.

COMMON CODES

- ASCII (7 bit code) - 128 letters, numbers, & symbols in English language.
- ASCII-8 (8 bit code) - 256 letters, numbers, & symbols in English language.
- Unicode (16 bit code) - Over 65,000 different characters.
- 24-bit color - Displays the full range a human eye can perceive.
- 16-bit sound - Plays the full decibel range the human ear can perceive.

DIGITAL FILES

- A container for binary codes.
- File formats define how instructions and data are encoded in the file.
  - Sample formats that define data differently:
    - Word file format
    - Acrobat file format
    - Media player file format

ALL ABOUT FILES

- File size
  - Measured in units of bytes.
    - Kilo Bytes, Mega Bytes, Giga Bytes.
- File extensions
  - Series of letters to designate the file format.
    - .fla, .exe, .rtf, .jpg
- File compatibility
  - Ability to use the file in a different platform of hardware and software.

FILE TYPES

- Program files
  - Contain executable instructions.
- Data files
  - Can hold text, images, sounds, video, animation.

DATA FILE COMPATIBILITY

- Cross-platform compatible files.
  - Open and use on any computer hardware and software configuration.
- Files that are native or specialized to the application that created the data file.
  - Require source application to open the file.

FILE MAINTENANCE

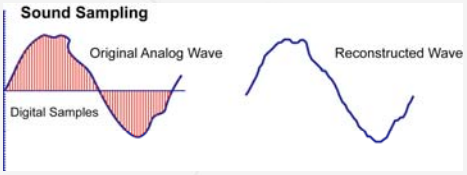
- Data loss and destruction impacts multimedia project completion.
- Effective file maintenance involves:
  - Identification
  - Categorization
  - Preservation

DIGITIZATION

ANALOG TO DIGITAL CONVERSION.

SAMPLING ANALOG DATA

- Sampling analyzes a small portion of the analog source and converts it to digital code.



SAMPLE QUALITY

- Factors that influence sample quality
  - Sample Resolution.
    - Number of bits used to represent digital sample.
    - Quantization is process of rounding off the value of a sample to the nearest available digital code.
  - Sample Rate.
    - Number of samples taken in a given unit of time (sounds) or space (images).
    - Spatial resolution describes sample rate in image files.

YOU DECIDE: SAMPLE RESOLUTION

Which image and sound sample will have better quality?

Image	Sound
8 bits / sample	8 bits / sample
24 bits / sample	16 bits / sample

Which image uses fewer bits to describe the color sample?

YOU DECIDE: SAMPLE RATE

Which image and sound sample will have better quality?

Image	Sound
72 pixels/inch	11 kHz
300 pixels/inch	16 bits / sample

Which image has a higher spacial resolution?

50ppi

300ppi

DIGITAL ENCODING

- Description-based encoding
  - A detailed representation of the discrete elements that comprise the media.
- Command-based encoding
  - A set of instructions the computer follows to produce the digital media.

MEDIA ENCODING COMPARED

Description	Command
Advantages	
Represent natural scenes and sounds.	File sizes are small.
Supports detailed editing.	Scaled without distortion.
Limitations	
Large file sizes.	Not appropriate for detailed photographs and natural sounds.
Lose quality if enlarged.	Requires knowledge of music and vector image creation.

FILE COMPRESSION

- Process of re-encoding digital data to reduce file size.
- Codec: a program to compress a file into a smaller size and decompress it into a usable form.

MAJOR TYPES OF COMPRESSION

- Lossy
  - Number of bits is reduced and some data is lost.
  - Lossy strategies include MP3 and JPEG compression.
- Lossless
  - Efficient encoding reduces file size without loss of original data.
  - Lossless strategies include RLE and GIF compression.

YOU DECIDE… Lossy or Lossless

- Choose a compression strategy best suited for:
  - Photograph of sailboat on ocean.
  - Journal article explaining nanotechnology.
  - 1812 Overture by New York Philharmonic Orchestra.
  - Database of student names and addresses.
  - Video of hot air balloon flying over a cornfield.

ERROR DETECTION & CORRECTION

- Digital bits may be lost during transmission or damaged on storage media.
  - CDs get scratched.
  - Communication lines have interference.
- Strategies to preserve data vary.
  - Parity bits help detect an error during transmission.
  - CDs include redundant data to replace data when an error occurs.

DIGITAL INFORMATION: ADVANTAGES

- Reproduction without generation decay.
- Editing and re-editing is much easier than with analog media.
- Integration of media using cut, copy, paste is more efficient.
- Distribution over Internet - nearly everyone can be reached by anyone else.

DIGITAL INFORMATION: CHALLENGES

- File sizes are large.
- Digital media is processor intensive.
- Absence of media standards renders data files incompatible.
- Some media requires high bandwidth to distribute on networks.
- Concern for longevity and future accessibility of digital data.

WRAP UP

- Analog vs. Digital data.
- Symbols and binary code.
- Data vs. Information.
- Files as containers.
- Digitization process.
- Description- vs. Command-based media.
- Compression strategies.
- Error detection & correction.
- Advantages & Challenges of digital data.