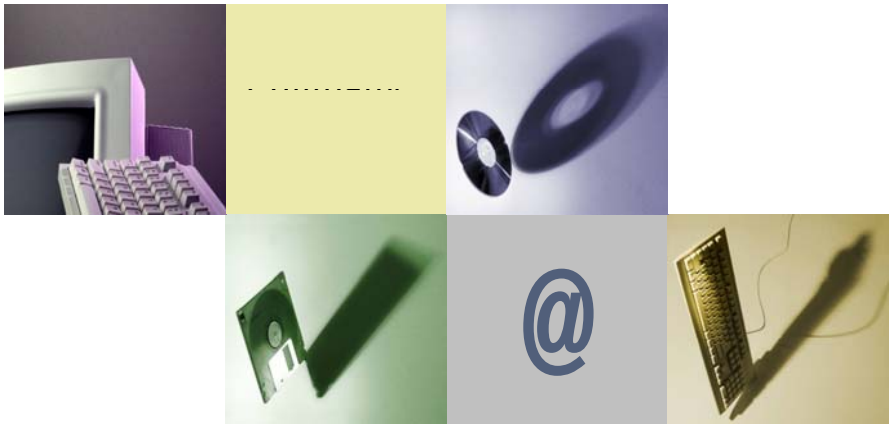
Multimedia



Digital Computer Concept and Practice

Multimedia

- Utilizing a combination of different content forms
- Integration of continuous media (e.g., audio, video) and discrete media (e.g., test, graphics, images)
- Web: text → multimedia

Multimedia Devices

- **Monitor**
- **Scanner/Digital Camera**
- **Sound Card**

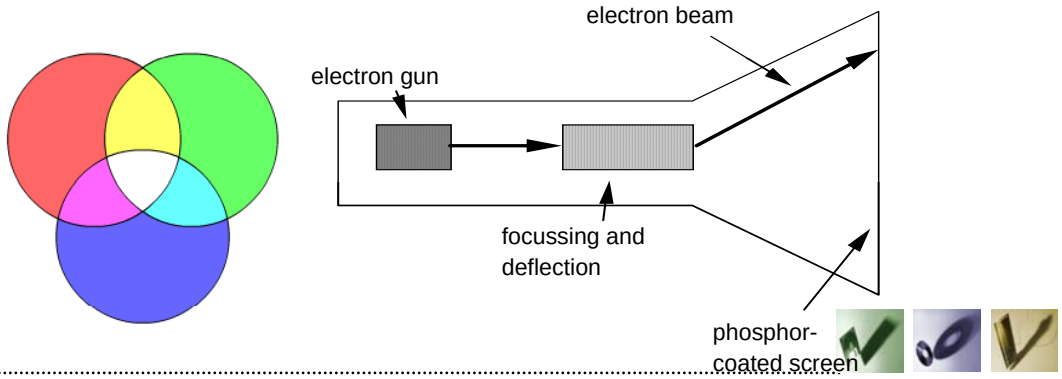
Monitor

- CRT (Cathode-Ray Tube)

- LCD (Liquid Crystal Display)

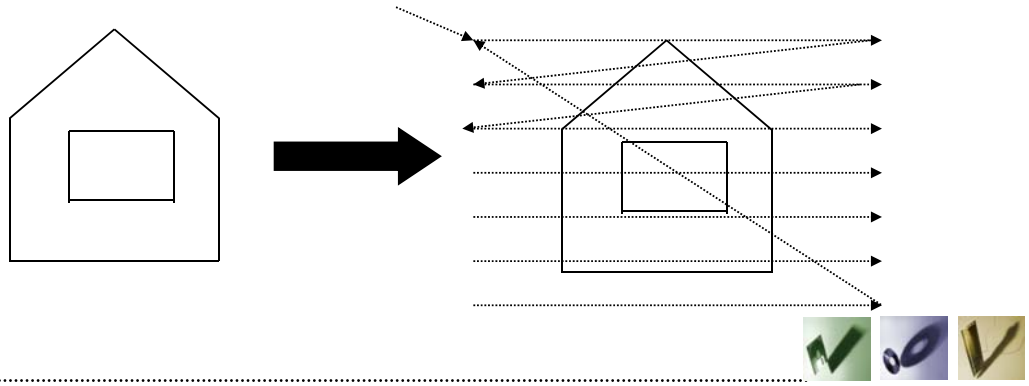
CRT Monitor

- Contains millions of tiny red (R), green (G), and blue (B) phosphor dots on a screen.
- Using electron beams to create a visible image
- When electrons strike the fluorescent screen through a shadow mask, light is emitted.
- Scan types: random scan, raster scan



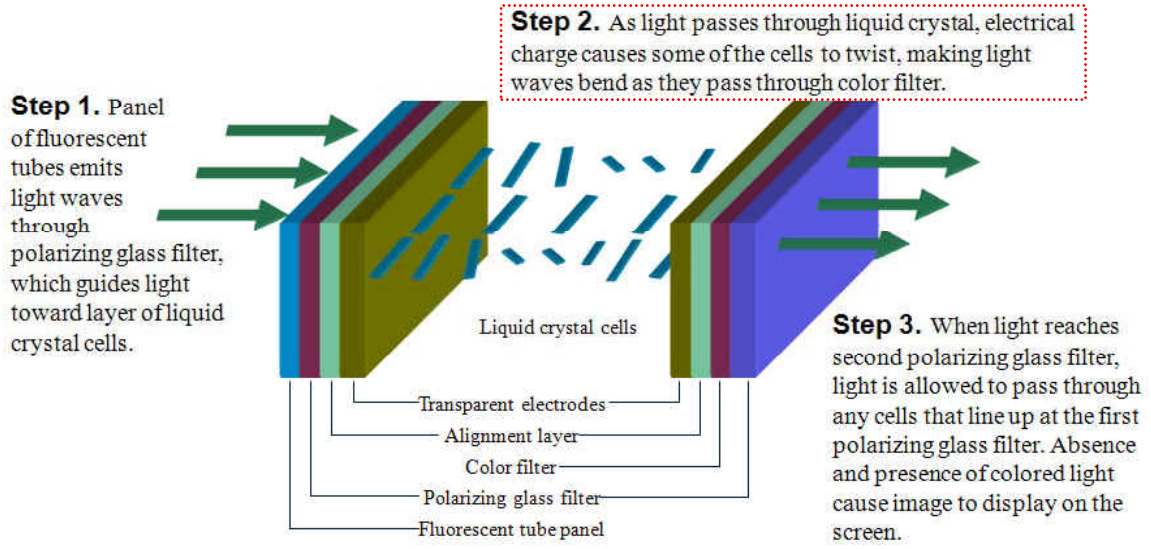
Raster Scan

- Most common, as found in televisions
- Beam scanned left to right, flicked back to rescan from top to bottom, then repeated
  - Repeated at 30Hz per frame, sometimes higher to reduce flickering
- Proceed through all the pixels in raster scan-lines

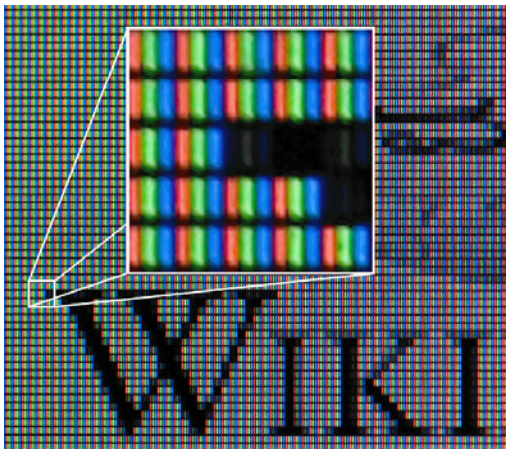


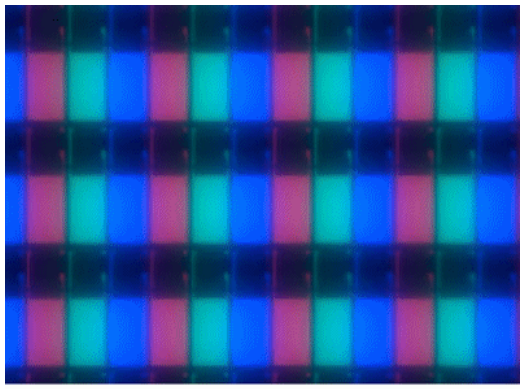
LCD Monitor

- Smaller, lighter, with no radiation problems
- Thin layer of liquid crystal sandwiched between two glass plates

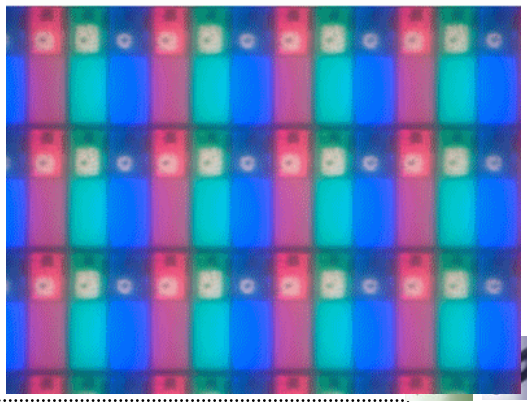


LCD Monitor





off



on

Output Unit: Monitor

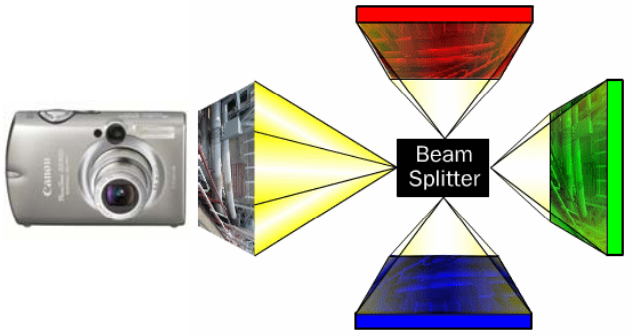
- Resolution
  - Number of horizontal and vertical pixels in a display device
  - Higher resolution makes image sharper, displays more text on screen, makes some elements smaller
    - e.g. 1024 x 768 vs. 1280 x 1024
    - 1920 x 1080 (HDTV)
    - 1920 x 1200 (HD computer monitors)

Output Unit: Monitor

- Video cards
  - Electronic boards that plug into a PC to give it display capabilities
  - Display quality of a computer depends on both the logical circuitry (provided in the video card) and the display monitor
- Video memory
  - A video card have its own video memory
  - The amount of video memory limits the maximum resolution and color depth available.
  - e.g. representation of 1600 millions color (24 bits) by 1280 x 1024 resolution → required at least 4MB

Scanner / Digital Camera

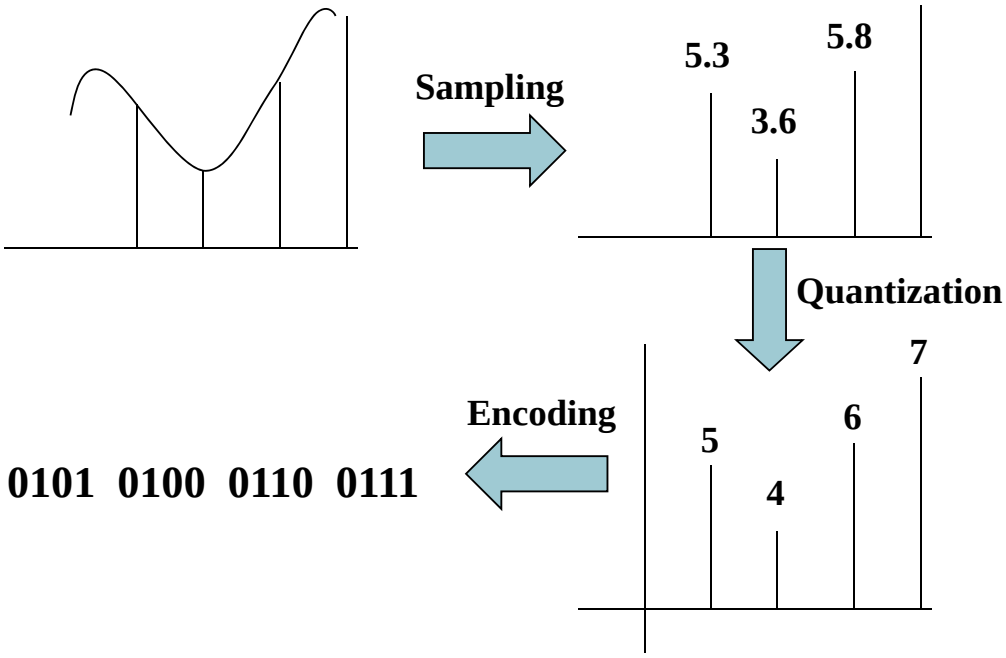
- Image sensors
  - Scanner: CCD (charge-coupled device) or CIS (contact image sensor)
  - Digital camera: CCD or CMOS (complementary metal–oxide–semiconductor)



Sound Card

- Computer devices that allow a computer to handle audio information
- Either in the form of an expansion card or a chipset
- Main features
  - Digital-to-analog converting
  - Analog-to-digital converting
    1) Sampling the amplitude of analog signal with a constant interval
    2) Quantization of the sampling amplitude

Sound Card



- Sound quality?

Data Compression

Compression

- Process of encoding information using fewer than the original representation by using specific encoding schemes.
- Basic idea: reducing repeated patterns
  - 5 cm^2 have the same color (e.g. 174) ➔
  - Saving the location and color information (174) of the area instead of saving 174 of 25 pixels

Compression Algorithms

- Run-length encoding
- Huffman coding

Run-Length Encoding

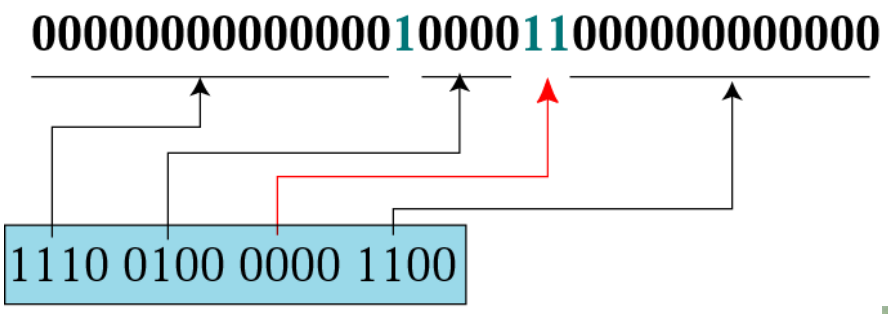
- BBBBBBBBBAAAAAAAAAAAAAAAANMMMMMMMMMM

a. Original Data

B09A16N01M10

b. Compressed Data

- a. Original Data



b. Compressed Data

Huffman Coding

- Known to be the most efficient method of representing numbers, letters, and other symbols using binary codes
- Using probabilities to generate a weighted binary tree, called a Huffman tree.
  - Based on the estimated probability of occurrence for each possible value of source symbols.
- Idea
  - Assign those characters that occur more frequently a shorter code

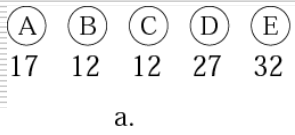
How to Generate Huffman Tree

(1) Probabilities are calculated for each character

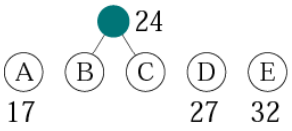
(2) Characters and probabilities are inserted into leaf nodes

(3) The lowest probabilities are added together and put into a dummy node

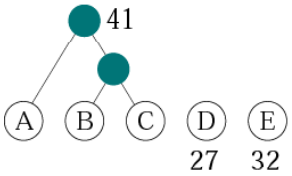
(4) The rest of the nodes (including dummy nodes) are combined in like fashion until one node (the root) remains at the top



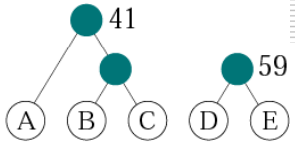
a.



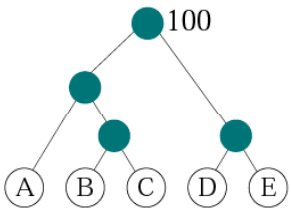
b.



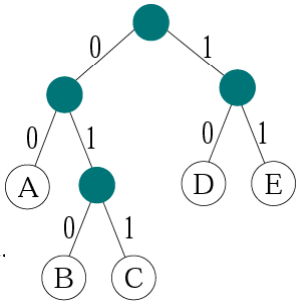
c.



d.



e.



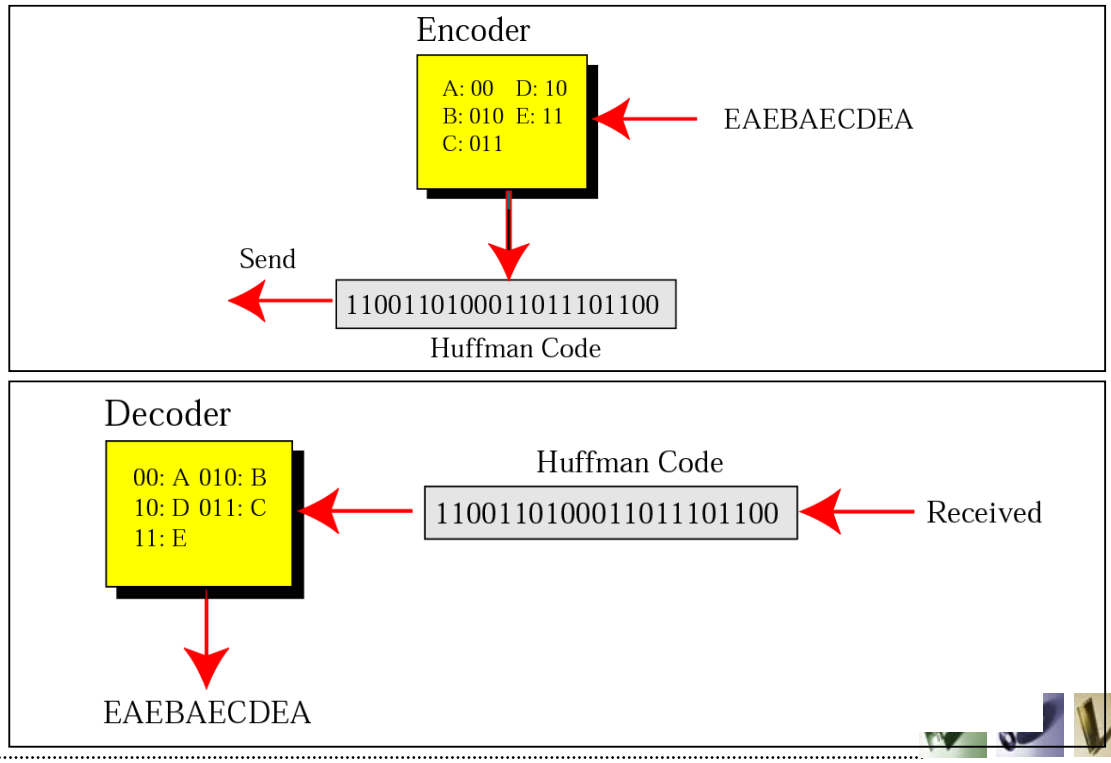
A: 00 D: 10
B: 010 E: 11
C: 011

Code

Huffman Encoding and Decoding

- Reduce size of data by 20%-90% in general
- If no characters occur more frequently than others, no advantages over ASCII
- Encoding
  - Given characters and their frequencies, generate a code table by using Huffman trees. Encode characters using the code table.
- Decoding
  - Given the Huffman tree, figure out what each character is

Huffman Encoding and Decoding



Compression Algorithms

- Lossless data compression
  - Store/Transmit large files using fewer bytes so that the original files can be perfectly retrieved.
  - Text, programs
  - e.g. ZIP, RAR
- Lossy data compression
  - Store/Transmit large files using fewer bytes so that the original files can be approximately retrieved.
  - Image, video, audio
  - e.g. JPEG, MPEG, MP3

Multimedia

- Enormous amount of information
- e.g. one hour video

  (1024 * 1024 pixels/frame) * (3 bytes/pixel) * (30 frame/sec) * (3600 sec)

  → 350 GB/hour

  → can be reduced using lossy data compression, e.g. MPEG

JPEG

- JPEG (Joint Photographic Experts Group)
  - Commonly used for photographic images
  - Defines how an image is compressed into a stream of bytes and decompressed back into an image
  - File extension: .jpg, .jpeg
- Basic idea
  - Save the redundant color of pixels as a block
- Other file formats (uncompressed)
  - .bmp → uncompressed graphic file
  - .tiff (Tagged Image File Format) → an international standard of uncompressed graphic file

MPEG

- MPEG (Moving Picture Experts Group)
  - Video compressed file: .mpg
  - Audio compressed file: .mp2, .mp3
- Basic idea
  - Inter-frame compression (within a frame)
  - Intra-frame compression (between frames)
    - Often a large number of pixels will be the same on a series of frames
    - Only the changes from one frame to the next are encoded