Multimedia

Digital Computer Concept and Practice

Multimedia Devices

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

Multimedia

- Web: Text → Multimedia
- Multimedia
  - A combination of different content forms.
  - Integration of continuous media (e.g., audio, video) and discrete media (e.g., test, graphics, images) through which the digital information can be conveyed to the user in an appropriate way.

Text Audio Still Images

Animation Video Interactivity

Monitor (revisited)

- CRT (Cathode-Ray Tube)
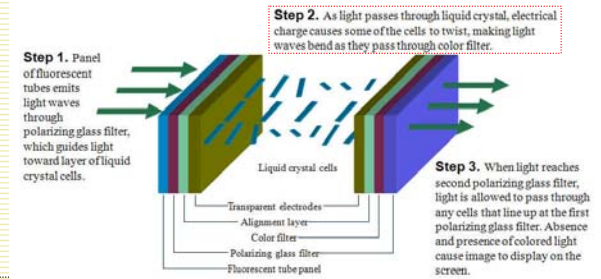
- LCD (Liquid Crystal Display)

CRT Monitor

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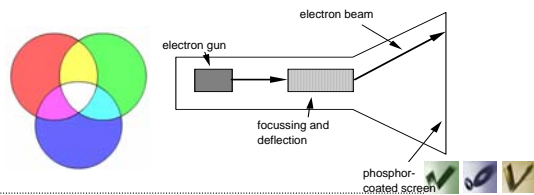
LCD Monitor

- Smaller, lighter, with no radiation problems
- Thin layer of liquid crystal sandwiched between 2 glass plates

Step 1. Panel of fluorescent tubes emits light waves through polarizing glass filter, which guides light toward layer of liquid crystal cells.

Step 2. As light passes through liquid crystal, electrical charge causes some of the cells to twist, making light waves bend as they pass through color filter.

Step 3. When light reaches second polarizing glass filter, light is allowed to pass through any cells that line up at the first polarizing glass filter. Absence and presence of colored light cause image to display on the screen.

- Liquid crystal cells
- Transparent electrodes
- Alignment layer
- Color filter
- Polarizing glass filter
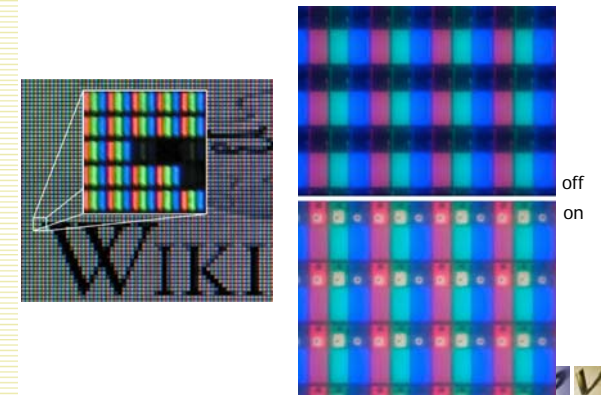- Fluorescent tube panel

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

off

on
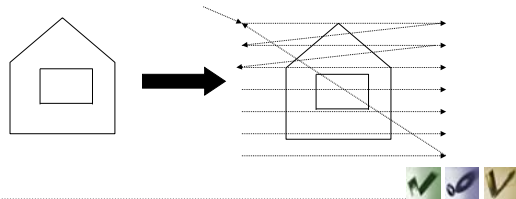
Scanner

- Device that optically scans images or printed text, and converts it to a digital image.
- Using charge-coupled device (CCD) or contact image sensor (CIS) as the image sensor

Sound Card

- Computer device (either in the form of an expansion card or a chipset) that allows a computer to handle audio information.
  - It features a digital-to-analog converter, that converts recorded or generated digital data into an analog format.
- Converting into a digital signal
  - (1) Sampling the amplitude of analog signal with a constant interval
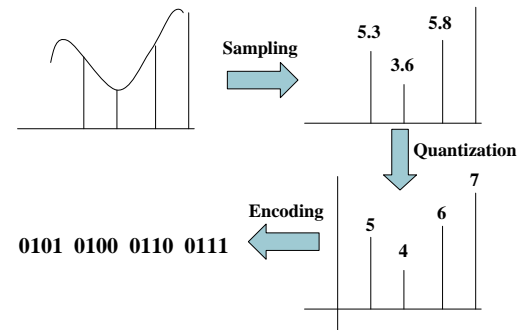 - (2) Quantization of the sampling amplitude

Digital Camera

- Camera that takes video or still photographs or both, digitally by recording images on a light-sensitive sensor.
- Using CCD (charge-coupled device) or CMOS (complementary metal–oxide–semiconductor) as the image sensor

Sound Card

Sampling

5.3   5.8
3.6

Quantization

7
Encoding   6
0101 0100 0110 0111   5
4
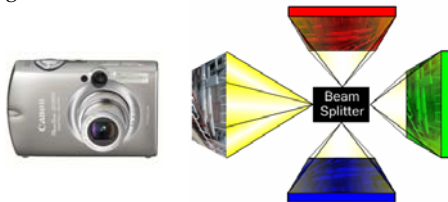
- Sound quality?

Data Compression

Lossless Data Compression
Lossy Data Compression

Data Compression

- Compression algorithms
  - Lossless data compression
    - Store/Transmit large files using fewer bytes so that the original files can be <u>perfectly</u> retrieved.
    - Text, program
    - e.g. ZIP, RAR
  - Lossy data compression
    - Store/Transmit large files using fewer bytes so that the original files can be <u>approximately</u> retrieved.
    - image, video, audio
    - e.g. JPEG, MPEG, MP3

Data Compression

- Compression
  - The 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

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Run-Length Encoding

BBBBBBBBBAAAAAAAAAAAAAAAAANMMMMMMMMMM

a. Original Data

B09A16N01M10

b. Compressed Data

a. Original Data

00000000000000100001100000000000

1110 0100 0000 1100

b. Compressed Data

Huffman Coding

- Huffman coding is an entropy encoding algorithm used for lossless data compression.
  - "the most efficient method of representing numbers, letters, and other symbols using binary codes"
- It uses 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
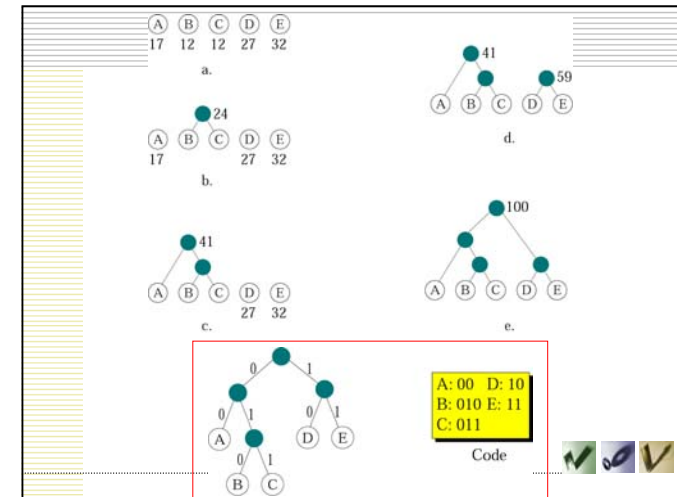
How to Generate Huffman Tree

(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
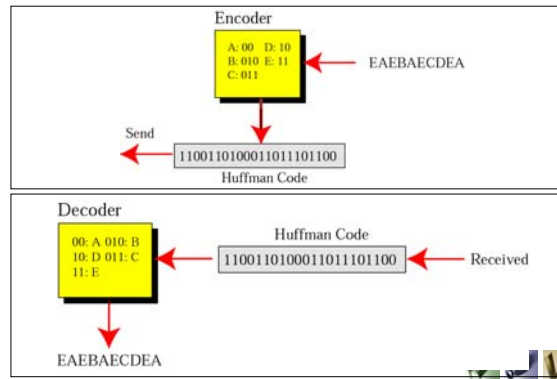
Huffman Encoding and Decoding

- 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

Encoder

```
A: 00   D: 10
B: 010  E: 11
C: 011
```
← EAEBAECDEA

Send ← `1100110100011011101100`
Huffman Code

Decoder

Huffman Code
`1100110100011011101100` ← Received

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

EAEBAECDEA

Lossy Compression

- Multimedia
  - Enormous amount of information
  - e.g. Video
    (1024 * 1024 pixels/frame) * (3 bytes/pixel) *
    (30 frame/sec) * 3600 sec → 350 GB/hour → MPEG
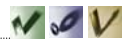

JPEG

- 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

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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)
    - Only the changes from one frame to the next are encoded.
    - Often a large number of pixels will be the same on a series of frames