Digitized Media

Digital encoding of information means the data is stored in discrete units – effectively numbers. Once we have digital data, we can use it to represent any form of digital media
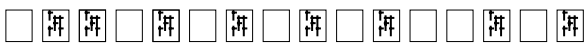

Remember …

- Digital data is discrete: unambiguous and exact
  - □ It's either "on" or "off"
- With one piece of data (e.g. a light switch), you can represent 2 pieces of information
  - □ "On" or "Off" – even when you use a dimmer switch!!!
- We call a single piece of data with 2 states a *bit*.
- If we look at a bunch of bits at the same time, we can represent more pieces of information.

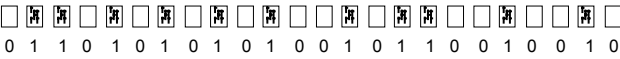| BITS	Number of Pieces of Information	Examples
1	2	0, 1
2	4	00, 01, 10, 11
3	8	000, 001, 010, 011, …

Encoding the Number

- Information is often stored by charge or magnetic field

Schematic diagram of magnetic spots, like on a disk

- Its presence or absence can be detected, leading to a natural association with 1 and 0 to charged/neutral states
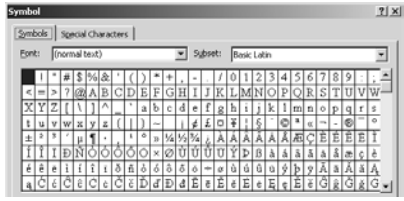
0 1 1 0 1 0 1 0 1 0 1 0 0 1 0 1 1 0 0 1 0 0 1 0

| Byte 0 | Byte 1 | Byte 2 |

## Some Information is Discrete: Character Encodings

- Review:
  - □ Keyboard characters are encoded into a byte or two
  - □ ASCII is one of many encoding of the characters
    - What does ASCII stand for?
  - □ A byte (8 bits) permits 256 things to be represented

But Not All Information is Discrete…

- The physical world is analog –sound comes from pushing air with a certain energy at a certain rate, etc.

- By measuring a phenomenon one derives a value (number) of the phenomenon at that moment

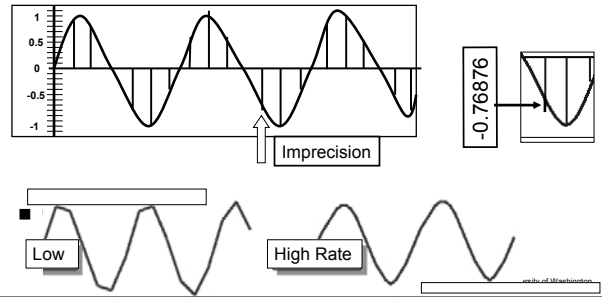- Sampling – taking many measurements at uniform intervals –gives a series of numbers, the digital form
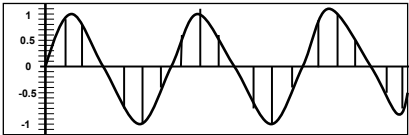
Digital audio:

44,100 sample/s

2 bytes/sample

2 channels, L &R

176,400 B/s

635 MB/hour

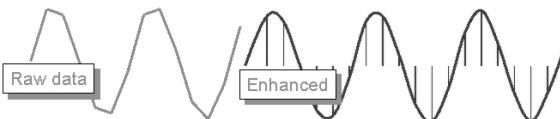0, .9, .8, 0, -.7, -1, -.3, .4, 1, .4, 0, -.7, –1, -.3 …. © Cop

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Digital Data

- Digital samples capture the basic structure of analog data, but it can be inaccurate due to limited precision

-0.76876

Imprecision

-
Low   High Rate

Two Advantages of Digital Data

- A computer can "compute on" digital data, enhancing it to remove noise, artifacts of imprecision, etc.

Raw data   Enhanced

- Digital data can be transmitted and replicated exactly
  - The numbers are the complete representation of data
  - Assuring each number is duplicated or transmitted accurately, means the data is exact

.0 .8 .7 .0 -.8 -.9 -.2 .8 .9 .2 -.7 -1 -.4 .6 1 .4 -.5 -1 -.5 .4 ….
.0 .8 .7 .0 -.8 -.9 -.2 .8 .9 .2 -.7 -1 -.4 .6 1 .4 -.5 -1 -.5 .4 ….
.0 .8 .7 .0 -.8 -.9 -.2 .8 .9 .2 -.7 -1 -.4 .6 1 .4 -.5 -1 -.5 .4 . shington


Picture Elements (Pixels)

- The phosphor on the screen naturally displays the on/off property of binary
  - Suitable for one color (B&W) video
  - The bits in memory are streamed out on the screen is "raster" order, like a standard TV

- For a color display, three (basic) colors of light must be displayed: red, green and blue (RGB)
  - Requires three different numbers, e.g. one byte each.
  - Range of colors in determined by the intensity of each component
  - When all three values are at their maximum, the color is white, and when they are at their minimum the color is black

Color Control

- Select the color palette from an application and play
- Notice when values are equal – you get gray results
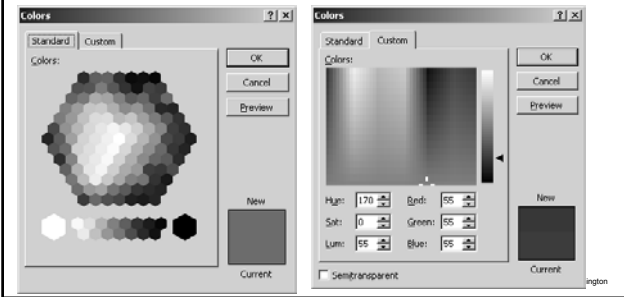
Bits as a Medium

- What does this string of bits represent?

0 1 1 0 1 0 1 0 1 0 1 0 0 1 0 1 1 0 0 1 0 0 1 0

Bits as a Medium

- The way that bits represent information is determined by how we interpret the bits

0 1 1 0 1 0 1 0 1 0 1 0 0 1 0 1 1 0 0 1 0 0 1 0

- As separate byte these are: 106, 165, 146
- As ASCII these bytes are: ʋ, ¥,
- As a 24 bit integer these bytes are: 6,989,202
- As a color value these bytes are: ☐
- Bytes can be interpreted in an unlimited number of ways

Summary

- Digital representation can be faithfully replicated an transmitted
- It's common to "compute" on a digital representation
- The binary digits (bits) 0 and 1 are a natural way to interpret the presence or absence of a phenomenon
- Bits are bits—what they mean depends on how we interpret their meaning… sometimes they are numbers, sometimes letters, sometimes sound, sometimes color, …