

Strategic
Computing and Communications
Technology

BA 290D, EECS 201, IS 224
Spring 99

Technical properties of
information

by
David G. Messerschmitt

Key concept

- The key commodity manipulated by information technology is information
- To be manipulated in a computing/networking environment, information must be represented by data

What is information?

2

Information

- From a user (human) perspective...
....recognizable patterns that influence you in some way
(perspective, understanding, behavior...)
- In the computing infrastructure, information has a somewhat different connotation as structure and interpretation added to data

3

Data

- A bit is “0” or “1” — the atom of the information economy
- Data is a collection of bits, like
 - “0101110111010110”
 - “0000011”
 - “11101110101101011010111101101010”
- Note: the terms data and information are not always used consistently!

4

Representation

- Take the place of the original
- Equivalent to, in the sense that the original can be reconstructed from its representation
- Often the original can only be approximately reconstructed, although it may be indistinguishable to the user
 - e.g. audio or video

5

ASCII

Alphabet	Hex	Binary
<T>	/x37	00110111
	/x38	00111000
<N>	/x39	00111001
<O>	/x3A	00111010
<C>	/x3B	00111011
<D>	/x3C	00111100
<E>	/x3D	00111101
<F>	/x3E	00111110
<P>	/x3F	00111111
<A>	/x40	01000000
	/x41	01000001
<C>	/x42	01000010
<D>	/x43	01000011
<E>	/x44	01000100

Note that this representation is not unique...

....this one happens to be a standard
(ANSI X3.110-1983)

Interpretation Structure

6

A picture



This picture conveys information

This information is represented in this computer, but how?

7

Representation of picture: image



An approximation!

Expanding a small portion of the picture, we see that it is represented by square pixels....

....300 tall by 200 wide....

....with a range of 256 intensities per pixel

$300 \cdot 200 \cdot 8 \text{ bits} = 480,000 \text{ bits}$ (but it can be compressed)

8

Color picture

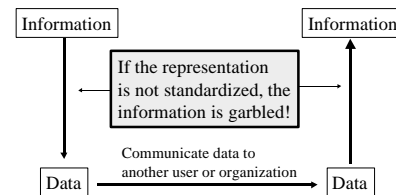


A color picture can be represented by three monochrome images...

At the expense of three times as many bits

9

Representation needs to be standardized



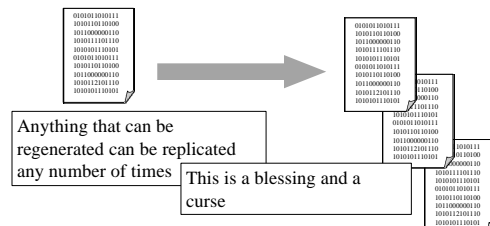
10

Regeneration

- Make a precise copy of the data (copy bit by bit)
- If you know the representation, this is equivalent to making a precise copy of the information
- Each such precise copy is called a generation, process is called regeneration


11

Replication of information



12

Analog information cannot be regenerated




Analog information can be copied, but not regenerated

We will never know exactly what the original of this Rembrandt looked like

13

Discrete information can be regenerated



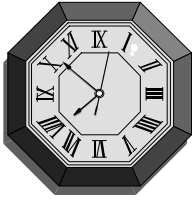
Regeneration can preserve data (but not its original physical form)

Regeneration is possible for information represented digitally (which is tolerant of physical deterioration)

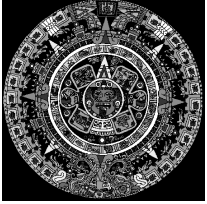
0 + noise → 0
1 + noise → 1

14

Example

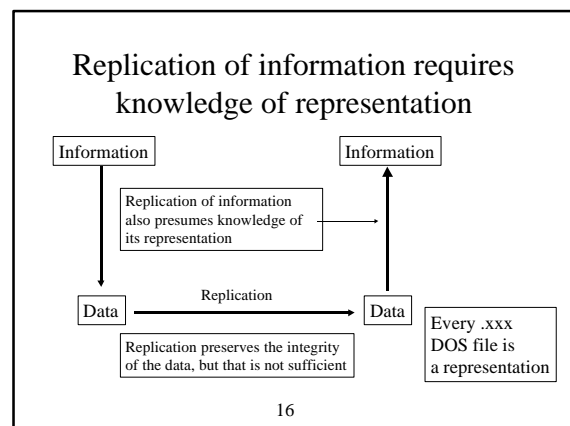


Analog information



Digital information

15



Implications

- Digitally represented information can be preserved over time or distance in its precise original form by occasional regeneration
 - digital library
 - digital telephony
- Replication of data is easy and cheap

17

Implications (con't)

- Replication of information requires knowledge of the structure and interpretation
 - Standardization or some other means
- Extreme supply economies of scale
- You can give away or sell and still retain
- Unauthorized replication or piracy relatively easy

18