Storage 1

Reading

Petzold, Ch. 1 & 2; Pp.84-85; Ch. 20

Handouts

ASCII Code
Morse Code
Ancient Information Storage
Computer Memory
English Letter Frequency
Text message Abbrev 5th gr
Encoding and Decoding

Resources:

Text message abbreviations https://www.slicktext.com/blog/2019/02/text-abbreviations-guide/

Quipu https://peru.info/en-us/talent/news/6/24/quipu--discover-the-mysteries-of-the-inca-method-of-recording-information

Pueblo Revolt https://indianpueblo.org/a-brief-history-of-the-pueblo-revolt/#:~:text=The%20Pueblo%20Revolt%20of%201680,colonizing%20power%20in%20North%20America

Petroglyphs
https://www.bradshawfoundation.com/ancient_symbols_in_rock_art/ancient_symbols_in_rock_art.php

Seagate Hard Drives: https://www.youtube.com/watch?v=NtPc0jI21i0

More on Hard Drives: https://www.youtube.com/watch?v=wI0upu9eVcw

Solid State Drives (SSD) : https://www.youtube.com/watch?v=E7Up7VuFd8A

Electromagnets: magnetism produced by an electric coil:
https://www.youtube.com/watch?v=cxELqN7wjS0

Magnetic induction: electric current induced by changing magnetic field
https://www.youtube.com/watch?v=pQp6bmJPU_0

Materials:

(per participant or pair)
D cell battery + holder
coil
screwdriver or bolt
magnetic compass
neodymium magnet
multimeter
alligator clip leads
hobby motor with tabs lifted

Materials, Continued:

(per class)
samples of audio & video storage technologies: tape, CD, DVD, phonograph record
hand generator + LED
6v. lantern battery
computer hard drive opened up

1. What is storage? Compare storage of energy, materials, and information; compare storage with communication/transmission.

Displacement in …	**… of Materials**	**… of Energy**	**… of Information**
… time	storage	storage	storage
… space	transportation	transmission	communication

Class activity: Fill in additional examples of technologies for each category:

	… of Materials	**… of Energy**	**… of Information**
Storage	warehouse	Rechargeable battery	book
Transportation, Transmission, communication	truck	Oil pipeline	telephone

Some information technologies might qualify as both communication and storage.

Class discussion:

- How can you use a letter you wrote for either storage or communication?
- How can you use newspapers for either storage or communication or both?
- How are supermarket bar codes used for both storage and communication?

2. Biological information storage: hormones, memory, DNA; how birds remember migration routes and sites to return to; dog memory study; counting on

   Class discussion: Think of other examples of biological information storage.

3. History of social information storage Every human society has been an "information society". Whether through gestures, speech or body language, people (and some other animals) have always survived by exchanging information.

   However, information storage is relatively new. It began with writing, use of numbers, floor plans and other technologies for recording information such as the Quipu knot tying system of the Inca, Sumerian numbers and Egyptian Hieroglyphics and Native American petroglyphs.

4. Modern pre-computer storage technologies: blackboards, books, notebooks, photos, phonograph records, cassette tapes

Questions for Class discussion:

- What are modern methods of storing information?
- What kind of information (if any) does an abstract painting store?
- What information is contained in a poem written in a foreign language that you don't understand?

5. Storage processes: Read (record) vs Write (playback)
6. Analog vs. digital storage: compare phonograph record & CD or MP3; film vs digital photography CD. Old vs. new photocopiers.

   Processes in storage: record or write; playback or read.

   Individual project: Select a pre-computer technology for storing data, identify the codes used to store it, and investigate the history of this technology.

7. Computer memory types

   a) ROM stands for Read-Only Memory. Once it is written it cannot be changed. ROM chips are hidden inside a computer and perform routine tasks like starting up and doing some calculations.

      Examples of ROM: Book, chart paper, CD, DVD

   b) RAM stands for Random Access Memory, which can be accessed quickly at random locations within it. On a computer, this is simply called "Memory". I(f you look up the specifications for your computer, you will find something like Another term for RAM is Read-Write Memory, because it can be overwritten, unlike ROM. In the specifications for a computer, RAM is usually simply called "Memory" and the size is usually listed as some number of MB or GB. These stand for Megabytes and Gigabytes, respectively. Mega means 1,000,000 = one million, giga means 1,000,000,000 = one billion, and a Byte is 8 bits.

      Examples of Read/write memory: Blackboard, smartboard, flash drive, hard drive, R/W CD, video tape

   c) A hard drive stores more data than RAM but takes longer to access. On Apple computers, the hard drive is called "Storage". The size is usually listed in GB or TB. T stands for Tera, which means 1,000,000,000,000 = one trillion.

      Group activity: Identify and list examples of read-write memory and read-only memory in your classroom and home.

8. Magnetic storage:

   a) writing magnetic data: battery, coil, screwdriver, compass.

   b) reading magnetic data: coil, magnet, screwdriver, ammeter

   c) computer hard drive unwraped

   d) video: how a hard drive works

   BREAK BETWEEN SESSIONS

9. Electromagnets (Ampere) & Magnetic Induction (Farday)
   Videos

10. Energy transformations using electromagnetism
    motors & generators
    doorbells, speakers and mirrophones

11. Text encoding

    a) Fixed-length codes:

    ASCII is an abbreviation of American Standard Code for Information Interchange. It uses 7 bits per character, represents all the common characters used in text, punctuation, and arithmetic, and also contains 32 control characters, such as Start of text (STX) and End of Text (ETX). ASCII is an example of a fixed-length code.

    Group activity: Write a sentence of 20 – 25 words. How many bits would it take to store or transmit your sentence?

    Next, we will look at some simple methods for reducing the number of bits needed to represent text. These techniques are in a category called data compression.

    b) Morse Code:

    When someone is receiving Morse Code, how do they recognize the spaces between letters or between words? The answer can be found on p. 6 of Codes by Petzold.

    Group activity: Estimate the number of bits it would take to store or send your sentence in Morse Code rather than ASCII. Then identify some strategies that Morse code uses to reduce the number of bits needed to express the same sentence.

    c) Reducing the character set:

    Group activity: Compare the character sets available in ASCII and Morse Code. What are the advantages and disadvantages of each code?

    d) Variable-length codes:

    Group activity: Compare the number of bits used to represent each letter in ASCII and Morse Code.

    - Does each letter require the same number of bits in Morse Code?
    - Which letters require the least number of bits and which ones require the most?
    - What characteristics of English text did the designers of Morse Code use to decide this pattern?
    - Examine the letter frequency chart and bar graph. How does this information help to answer the question about the number of bits used for each letter?

Morse code is a variable-length code because different letters use different numbers of bits. It uses these bits more efficiently by assigning shorter codes to more frequently used letters.

e) Dictionary codes

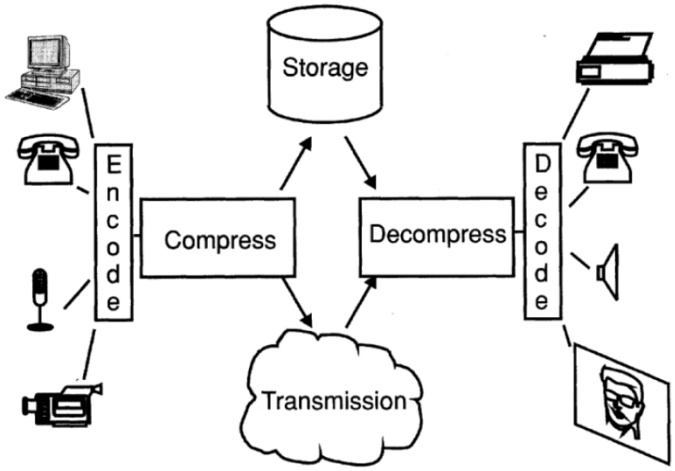
Individual letters in text do not appear randomly, but in certain well-known patterns. For example, the word "the" is a very common combination of three letters. To represent "the', is it necessary to store all three letters, or would it be more efficient to use one code for the entire word? A shorter code that represents a longer code, is called a dictionary code. For example, text message abbreviations represent longer messages, such as G2G (got to go) and LOL (laugh out loud). Another example is the 3-digit CVC or CVV code on a credit card. These stand for Card Verification Code or Card Verification Value, and are often used by your computer to look up a stored credit card number and expiration date.

Group activity: Look again at the sentence you wrote and see if any words are repeated. If so, discuss how the code for the sentence could be compressed further using a dictionary code.

12. Data compression: To reduce the needed amount of memory, data is often compressed to save space. This happens not only in computers, but also in everyday life. Some examples are mnemonics, text message abbreviations, and Cliff Notes.

    Group activity: Text message abbreviations, such as LOL or G2G, are commonly used to compress the data contained in a text message. Make a list of your favorite text message abbreviations and exchange it with other members of your group to see if they can decode them.
    Individual activity: Create a key for your favorite text message abbreviations.

13. Encoding and decoding: Nearly all computer data is today stored or sent in a binary digital format. Data is first encoded in binary and then usually compressed in various ways before being stored or sent, and then decompressed and decoded before being presented to a human user. Here is a diagram that summarizes this process:



Group Project: Identify types of data that might be stored on a computer, select one type, and explore the methods used to encode, compress, decompress and decode this form of data.

10. Planning for Final Project