

Lesson: Electrical Engineering: Computer Engineering

Grade Level: 8-9) – Time Required: 40 minutes – Lesson Dependency: None – Subject Areas:

- Computer Science

Summary

Computer Engineering is the combination of both Computer Science and Electrical Engineering. As it is a part of our daily lives nearly everyday. We will discuss the four basic functions of a computer and how computers have changed as years have gone by. This also includes hardware and software. Elaborating on certain pieces of hardware and software that students may have not known about such as the CPU and data. Binary is what computers use to represent information. It only has two digits, 1 and 0. In this lesson the students will learn about what is binary and its overall importance in computer engineering. There will be a worksheet provided to test the students on their knowledge on Binary and regarding whether or not they have paid attention.

Engineering Connection

We interact with computers and all their components nearly everyday. The Computer Engineering branch is the combination of both Computer Science and Electrical Engineering. They focus on the software and hardware sides of computing. Although they not only focus on how a computer system works, but also how it incorporates into the real world. As we can send emails through smartphones, take money out of ATMS, and interact with one another through a webcam.

Learning Objectives

Upon completing the lesson, the students should be able to:

- Describe why computers are important
- Explain how computers work
- Describe the four basic computer functions
- Explain the difference between computer hardware and computer software
- Understand the history of computers
- Know what binary is and how it relates to computers

Educational Standards

- CTE-IT.68.PROG.02.03 - Understand the binary representation of data and programs in computers.
- CTE-IT.68.PROG.08.02 - Explain the binary representation of data and programs in computers.
- SC.912.CS-CS.4.3 - Differentiate between multiple levels of hardware and software (such as CPU hardware, operating system, translation, and interpretation) that support program execution.
- CTE-IT.68.PROG.02.02 - Describe how hardware and software make up computer architecture.
- SC.35.CS-CS.4.3 - Compare and contrast hardware and software.
- CTE-GEN.68.GENRL.19.01 - Define computer related terms (computer, data input, output, hardware, software, language, processing, memory, program, terminal, peripheral devices, keyboard characters, virtual reality, three-dimensional devices).
- CTE-IT.68.GENRL.02.01 - Describe what defines a computer and ways a computer can be used.

Materials List

- Binary Data Sheet
- Computer/Laptop
- Pencil

Worksheets and Attachments

- Computer Engineering Presentation - (Slides 1-18)
- The First Computer Video
- Binary Data Sheet

Pre-Req Knowledge

This lesson revolves around computers and how they function so the students should have a basic understanding of what a computer is and how it works. As well as the adding skills to solve a binary addition equation.

Lesson Background and Concepts for Teachers

The text and lessons follow the attached Google Slides Presentation. It starts off on slide 1 to 18. Each will breakdown the main objective of each slide and the key points/ideas behind them that could lead into a discussion. The presentation may be changed to adhere to certain examples or teaching methods to suit the needs of the class.

Procedure

- **Slide 1- Computer Engineering**
 - Icebreaker
 - Introduce yourself and try to get the students to do the same thing.
 - Ask if any of them know what Computer Engineering is.
- **Slide 2- Explain what Computer Engineering is**
 - Computer Engineering is the branch that combines both computer science and electrical engineering
 - This includes aspects from software to hardware.
 - Computer Engineering is included in most of our daily lives as we have computers in our pockets, cars, tvs, etc.
 - Ask the students how long they're on their phones daily
- **Slide 3- What a Computer is**
 - A computer is an electronic device that is able to store and process data into information.
 - What actually makes a computer a computer is when the electronic device is able to input, store, process, and output data.
 - A computer is designed to manipulate data
 - Explain the importance of a computer in our lives.
 - Computers are everywhere and most people use them. They can be seen in our cars, living rooms, fridges, stores, and work. Computers are so important that we have to use them for work in order to complete our task. This includes the text that is just being read.

- We use computers to communicate and to complete tasks. The ability to communicate allows us to keep in touch with friends and family, but also find things we need.
- **Slide 4- Input**
 - This is what the user of the computer tells the computer to do
 - To simplify input is the transfer of information onto a computer system.
 - This can be done through typing on a keyboard, using a mouse to move the pointer, taking a photo with your phone's camera, etc
 - When you use your finger on an electronic device with touchscreen it senses your finger and takes that information as input
- **Slide 5- Storage**
 - This is where the data from the input devices go to
 - Data is stored in memory
 - The storage is usually in hard drives or other external storage devices
 - Computers store the data so that it may be processed
- **Slide 6- Process**
 - Processing is when the computer takes raw, unorganized data and turns it into information
 - The data is transformed by using algorithms
 - When data is turned into information it gets sent back to storage and continues being processed until it is output
 - Computer processes input and produces output
 - An analogy to this would be similar to taking dirty water and turning it into clean water. Without processing the dirty water it will just stay the same.
- **Slide 7- Output**
 - When the data is processed it turns into an output
 - The data is processed so that the information can be understood by people
 - Output is what allows a computer to display information depending on what the computer was designed to do
 - An output can be from a monitor that displays text and pictures
 - Printers produce a hard copy
 - Speakers produce sound that can be heard throughout the room
- **Slide 8- The First Computer**
 - We will now show a video about one of the very first computers
- **Slide 9- Modern Computers**
 - Compared to now the technology used in computers has skyrocketed as computers are now an integral part of our lives
 - Nowadays computers have been so applicably compacted that innovative utilizations of these amazing machines have been brought to the engineering community's light almost weekly
 - None of those people could have possibly imagined the vast uses of the easily portable computer and how this would have been the future.
- **Slide 10- Computer Hardware Engineering**
 - Computer Hardware mainly focuses on the installing of external and internal physical components of the computer and possible eventual fixing
 - Hardware is directed by the software to go about a task and follow the command
 - Ask the students to name at least 5 pieces of hardware
- **Slide 11- Central Processing Units**

- The most important part of a computer system
 - It is known as the brain of the computer sending signals to control the other computer components
- The CPU is responsible for storing and processing information
- It inputs data is processed by the CPU
- The CPU outputs data using devices such as a monitor or speaker or just saves it in storage
- **Slide 12- Memory Units**
 - There are two types of memory RAM and ROM
 - RAM (Random Access Memory) this memory can be accessed randomly
 - This is the primary memory of a computer as it is mostly common in computers and other devices such as smartphones, printers, and tablets.
 - Stores data in MBs
 - Temporary Storage
 - Volatile
 - Used during normal operations
 - Processing time is faster but uses too much power
 - ROM (Read Only Memory)
 - ROM is used for storing permanent data, however it can only be read. Along with the difficulty it is to modify it. It is able to hold its memory even when turned off
 - ROM is used in video game consoles as the cartridge that allows a system to run the game
 - ROM starts and boots up the PC
 - Stores data in GBs
 - Permanent storage
 - Non-volatile
 - It is used during the startup process
 - Processing time is fast but uses very little power
- **Slide 13- Computer Software Engineering**
 - Computer Software Engineering mainly focuses on the installing of programs and operating softwares and the possible repair of those due to aging or malware
 - It is mainly information processed by a computer system
 - Ask the students to name at least 5 pieces of software
- **Slide 14- Applications**
 - An application is a program or app that allows the user to complete certain tasks done by the user
 - Applications allow for specific functions
 - We use computer applications constantly as it can be used to play a game on an app or to access this lesson.
 - Web Browser - Software applications used for retrieving and launching a URL on the World Wide Web
 - WWW- a collection of web pages and other resources which are connected across the internet
- **Slide 15- Data**
 - Data is information that that needs to be processed or stored in a computer
 - Computer Data is stored and processed as a string of ones and zeros.
 - Data is processed to become more useful and to serve a purpose
 - Data that is processed must be required when available, accurate, and complete.
 - The steps for processing data are input, process, and output

- **Slide 16- What is Binary**

- Binary is a form of software that is able to control the hardware of a computer
- Binary is a numerical system that is represented with 1 and 0 to store data and perform calculations using binary digits or bits.
- Computers use binary as the primary language to represent information using electricity.
- Most software information that is processed and stored uses binary
- The speed of a computer depends on the number of bits a computer can process at once.
- It is called binary is because it only uses two digits
- The reason why computers use binary
 - It is very simple as it is just two digits that can represent any number
 - The 1 and 0 make it quick to learn if the signal is on or off
- Bits and Bytes are all that a computer uses to store and transmit information.
- It doesn't just represent numbers, but also text, sounds, and images

- **Slide 17- Counting in Binary**

- Computers use binary to represent computer data.
- In a circuit the signal is either ON or OFF/ 1 or 0
- Each 1 and 0 is a bit
- The bits have an exponential increase of 1,2,4,8,16,32,64,128 and so on
- When the bit is 1 that means it could be added
- When the bit is 0 that means the value is off so just ignore them
- By adding all of the bits with an On value it reveals the decimal equivalent
- Since a single bit can't represent much they are typically grouped together in groups of eight
 - A group of 8 bits is called a byte which represents numbers from 0 to 255
- Binary just needs two digits to represent any number

- **Slide 18- Binary Worksheet**

- Tell the students they are going to take a quick review to see how much they have learned
- Provide a link to allow the students complete the worksheet
- Add binary numbers together and then convert it into decimal
- Use the Binary Data sheet to answer the following questions
- This should take them 5-10 minutes to complete

- **Slide 19- Break Slide**

- The students will now take a break from everything that was taught
 - The lesson ends here if you want this could be expanded on with a discussion

Lesson Closure

Lesson Closure starts when the Binary Data Sheet ends. Slide 19 can be a transition into a closing where students are asked what is at least 1 thing that they learned or liked about the lesson. Now that the students understand a bit more about Computers and Binary, they will be better prepared if they want to pursue a career in Electrical Engineering.

Associated Activities

Binary Data Sheet - Students will be given a worksheet in which they will be assigned binary equations where they must add binary numbers together. Students must calculate for the sum and then convert the binary into decimals.

Name 5 - When the students first learn about hardware and software ask them to list 5 examples off the top of their heads. This is a quick activity that shouldn't take a lot of time. The purpose of this activity is to interact with the students as well as to explain things they may have not known before.

Vocabulary

- **Application** - *A program or app that allows the user to complete certain tasks done by the user*
- **Binary** – *Binary is a numerical system that is represented with 1 and 0 to store data and perform calculations.*
- **Bits** – *A binary digit that is the basic unit of information used in computers.*
- **Computer** – *An electronic device used for storing and processing data, usually in binary form, at high speeds.*
- **CPU** – *Central Processing Unit: the part of the computer that allows for operations to be executed.*
- **Data** – *Information that is processed or stored in a computer.*
- **Information** – *Data that has been processed and organized so that it can be used*
- **Hardware** – *The physical part of the computer system*
- **Processing** - *When the computer takes raw, unorganized data and turns it into information*
- **Software** – *The programs used to operate the computer*

Homework

After learning about binary, the students must fill out the binary numbers using cards as bits. To complete this activity the bits must be converted into decimal and binary numbers.

Lesson Extension

One way to extend the lesson is with a longer explanation on the history of computers. Provide examples on the different generations and how each generation was able to impact the way we use computers today.

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