

Lesson: Electrical Engineering: Computer Science

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

- Physics
- Algebra
- Science and Technology

Summary

Computer Science has become a popular branch of engineering in the last few years as computers have become more integrated into our society. To the point where they are able to perform certain tasks. To solve these tasks a computer program is written which are instructions set in place to solve a problem. This leads to algorithms which are an analysis of the rules set in place to solve calculations and operations step by step. Although to simplify an algorithm we would use a flowchart that explains the program method in a graphical process. In this lesson the students will learn about how to create a flowchart and what the various symbols represent. There will be a worksheet provided that will test their knowledge on flowcharts and regarding whether or not they have paid attention.

Engineering Connection

Computer Science has become a popular branch of engineering in the last few years as computers have become more integrated into our society. To make certain jobs easier computer scientists and engineers create and execute algorithms that include sequencing, selection, and iteration. Sequencing is the execution of statements one at a time in the algorithm. Selection is the use of IF, THEN, or ELSE statements to allow the computer to make a logical decision based on the information provided to it. Finally, iteration is the use of repetition or a loop in an algorithm until it reaches a certain condition. As it provides an outline on how to write code in a detailed sequence of operations for a specific issue.

Learning Objectives

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

- Answer what is Computer Science and why it is important
- Understand what an algorithm is and how it is used in our everyday life.
- Tell the difference between an algorithm and program while also explaining how they relate to one another.
- Know what a Flowchart is and how it relates to an algorithm
- Explain the flowchart symbols
- Grasp the complexity that goes into algorithm flowcharts

Educational Standards

- CTE-IT.68.PROG.04.08 - Create a model flowchart for a computer program.
- LAFS.68.RST.3.7 - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

- MAFS.K12.MP.4.1 - Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.
- SC.K2.CS-CS.2.5 - Create a simple algorithm, individually and collaboratively, without using computers to complete the task (e.g., making a sandwich, getting ready for school).
- SC.912.CS-CS.2.7 - Explain how sequence, selection, iteration, and recursion are building blocks of algorithms.
- SC.912.CS-CP.2.6 - Describe a variety of commonly used programming languages.

Materials List

- Flowchart Data Sheet
- Pencil
- Laptop
- 1 Sheet of Paper

Worksheets and Attachments

- Computer Science Presentation (Slides 1-17)
- Rubik Cube solved by robot (Video) – Stop the video at 0:48 mark.
- Flowchart Data Sheet (doc) - Make sure to download on your computer

Pre-Req Knowledge

This lesson revolves around the basics of flowcharts so when creating a diagram, it may be similar to the design process. Students should have background knowledge of what is the design process specifically the analysis, design, and iterative steps in order to fully understand how to use a flowchart. When creating the flowchart, the students should have prior experience with certain projects that will have led them to think methodical and sequentially.

Lesson Background and Concepts for Teachers

The text and lessons follow the attached Google Slides Presentation. It begins on slide 1 to 17 . 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 Science
 - Introduction to what is Computer Science
 - Ask a question to see what the students know about this topic
- **Slide 2** - Explain what Computer Science is
 - Well, Computer Science is the study of the ideas, ways of thinking, languages, and the software needed to solve problems by using computers.
 - Unlike electrical engineers, computer scientists focus mainly on software issues and systems that can include design, theories, and development.
 - Most people in this profession will have to learn various programming languages, maintain databases, and use operating systems.
- **Slide 3** - Popularity of Computer Science

- In recent years Computer Science has become one of the most popular branches of engineering.
- This is due to the newfound appeal of computers as they have slowly become more integrated into our society and daily lives.
- There are various reasons as to why Computer Science is considered important.
 - The main reason being that we use computing in almost everything that we do.
 - As it allows us to tackle complex and challenging problems. Along with the increase in computers that led to numerous computing jobs and opportunities.
- **Slide 4 - Coding**
 - Ask if they know what coding or programming is.
 - Essentially they are the same thing as it is the process of creating instructions for your computer so that it may be able to complete certain tasks.
 - In other words it is how humans are able to communicate with computers.
 - These instructions are written by a computer programmer in a programming language.
- **Slide 5 - Uses of Coding**
 - When you think about it because of programs we are able to use most of the devices that we use today.
 - From phones and apps to websites and whole supercomputers, coding is the basic instruction of every piece of technology we use.
 - Even billboards and things as overlooked as pop-up ads use coding.
- **Slide 6 - What is the difference**
 - Computer Science is the study of the ideas, ways of thinking, languages, and software needed to solve problems with computers.
 - Programming is the process of creating instructions for your computer so that it may be able to complete the task.
 - Basically, Computer Programming is the process of designing and creating programs to solve a specific task while Computer Science is the overall study of that process.
 - While Computer Science is solving a problem using computers, coding and programming is the implementation of the solutions.
- **Slide 7- Algorithms**
 - Even though knowing how to program is vital to the study of computer science it is still only one part of a bigger puzzle.
 - So what is a programming algorithm? It is a set of rules that need to be followed by calculations in order to solve the issue.
 - Computer scientists create and analyze algorithms to solve problems and evaluate the softwares performance.
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 - You can compare an algorithm to a food recipe as they list their ingredients and the steps that need to be taken.
 - The algorithm has to be converted into a programming language so that it is capable of operating. That program is a sequential set of directions that needs to comply with the rules of the language in order to complete the task.
- **Slide 8 - Rubik Cube**
 - Algorithms are the step by step instructions needed in order to solve a specific problem.
 - One example of an algorithm is with a Rubik's Cube. Does anyone know how to solve one?
 - We're now going to play a video of the fastest time a Rubik's Cube was ever solved
- **Slide 9 - Algorithms and Rubik's Cubes**
 - So to solve a rubik's cube there are certain algorithms a person could use as each rotation is a move. By putting the movies together it becomes an algorithm with the purpose of solving the cube!
 - With six sides representing nine blocks of a single color—orange, yellow, green, red, white, and blue—a Rubik's is said to hold 43 quintillion potential configurations.
 - As not even the original creator, Erno Rubik, knew how to solve it!

- **Slide 10 - Algorithms and Flowcharts**
 - There are two tools used in explaining the process of a program: the algorithm and a flowchart.
 - The main difference being that a flowchart is the graphical version of an algorithm.
 - Flowcharts are simple to understand as it follows a sequential flow.
- **Slide 11 - Introduction to a Flowchart**
 - A flowchart is a figure that represents an algorithm or a process.
 - It is a step-by-step method of how to solve a problem.
 - One of the reasons why people use flowcharts is because it simplifies complex problems into simple steps that can be programmed into a computer later.
 - Since it shows data flow they are used to explain the process behind a program as it shows the way the code is organized.
- **Slide 12 - Flowchart symbols and Terminator**
 - So in a flowchart there are these symbols each that represent a different function.
 - The first shape is called a Terminator, but not like the robot from the movie.
 - This represents the start and end function in a flowchart. As you can see it has an oval shape.
 - Start is always required in a flowchart, but some flowcharts may not have an end.
- **Slide 13 - Input/Output Operation**
 - An Input/Output Operation with the shape being a parallelogram.
 - It indicates an input or output operation while also representing any type of data in a flowchart.
- **Slide 14 - Processes**
 - A process is a rectangle that involves the action part of the flowchart.
 - Some of these examples include Add 1, Turn the light on, or Rotate the knob.
- **Slide 15 - Decisions**
 - Decisions are shaped like rhombuses and are indicated as a decision point between different paths in the chart.
 - As the outcome is either a yes, no, and could include an or.
- **Slide 16 - Arrows**
 - Arrows show the flow of the chart as they are drawn from the output of one block to the input of another.
 - There can only be one arrow that represents an output. On the other hand various arrows could represent inputs.
- **Slide 17 - Flowchart 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
 - Draw the flowchart symbol that matches with the command
 - Use the Flowchart Data sheet to answer the following questions
 - This should take them 5-10 minutes to complete
- **Slide 18- 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 Flowchart Worksheet ends. Slide 18 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 algorithms they will be prepared if they want to pursue a career in Computer Science.

Vocabulary/Definitions

- **Algorithm** - A process or set of instructions to be followed in calculations or other problem-solving operations.
- **Flowchart** - A diagram that represents an algorithm or a process
- **Iteration** - Uses repetition or a complete loop until it reaches a certain condition
- **Programming** - The process of creating instructions for your computer so that it may be able to complete the task.
- **Selection** - The use of IF, THEN, or ELSE statements to inform a computer how to make choices depending on the information provided.
- **Sequencing** - The execution of statements one at a time that follows the order of one after the other.

Homework

Students will be asked to label some of the following flowchart symbols that are used in the diagram. Afterwards they would need to fill out a table drawing the symbol, name, and function.

Lesson Extension

One way to extend the lesson is with an activity where they have to create a flowchart. Provide them with a scenario about doing an action then tell them to create a flowchart based on that. For instance, opening a door includes many steps such as the steps taken, the knob turning, or getting out of your seat. That depends on how the student creates it.

References

- **CPALMS Standards (Source of educational standards)**
 - <https://www.cpalms.org/Public/search/Standard>
- **TeachEngineering Program Analysis Using App Inventor (Based on the lesson structure)**
 - https://www.teachengineering.org/lessons/view/uno_appinventor_lesson01
- **WHAT IS A FLOWCHART? (Information)**
 - <https://asq.org/quality-resources/flowchart>
- **Encyclopedia Britannica (Information)**
 - <https://www.britannica.com/>
- **Fastest robot to solve a Rubik's Cube**
 - Copyright of Guinness World Records on Youtube

Contributors

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Supporting Program

SYIP 2020 Summer Internship Program partnered with Hialeah Gardens Senior High School.

Acknowledgments

I would like to acknowledge the author(s) of Lesson: Computer Science Algorithms. I based the structure of my lesson on the article. I would also like to acknowledge Hialeah Gardens Senior High School for allowing me to write this lesson and conduct the research on it.

