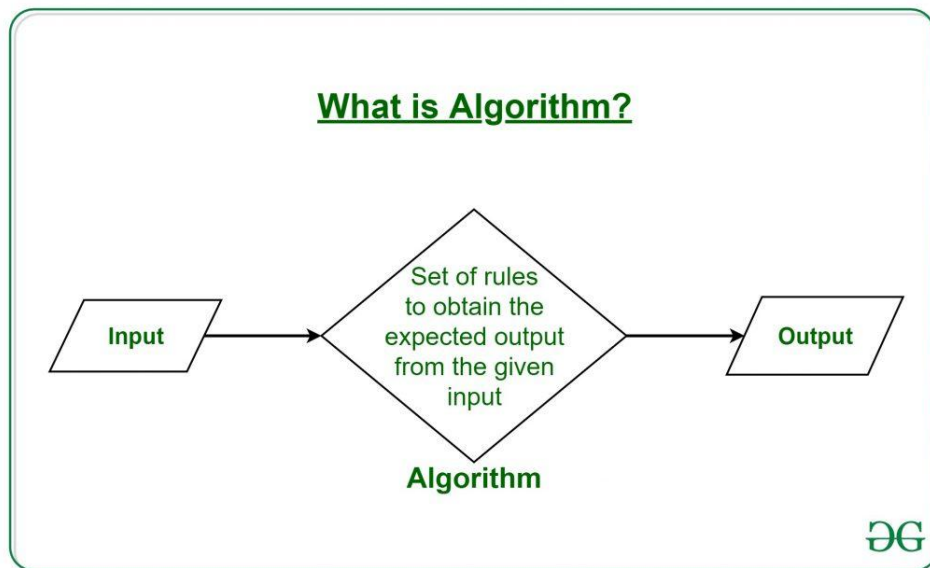


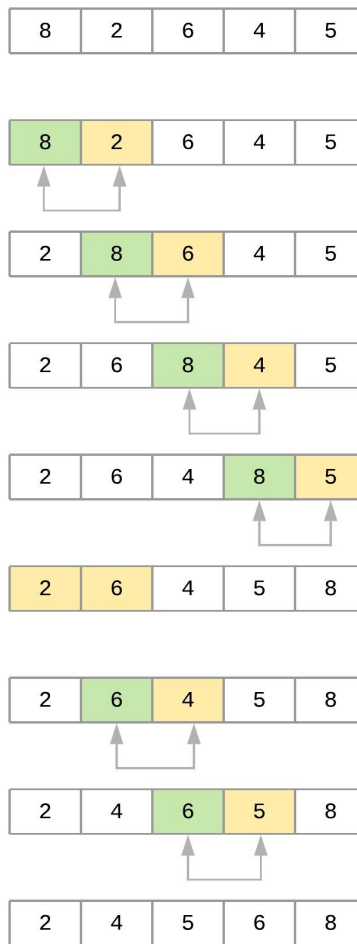
Algorithms Introduction

Algorithms are very powerful tools in our world in the 21st century. What exactly is an algorithm? According to the famous [Introduction to Algorithms book](#) known to be a foundation for algorithms research and knowledge, an algorithm is any computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output. In other words, an algorithm is a sequence of computational steps that transform the input into the output.



Reference: <https://www.geeksforgeeks.org/introduction-to-algorithms/>

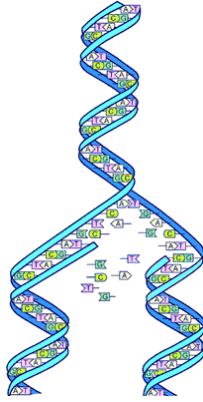
Algorithms run the world. Without efficient algorithms, Google, Internet, Facebook, Whatsapp, and any other technological device would not exist. Today, algorithms are very fast, accurate, and everywhere. Many algorithms are simple while many others are very complicated. For example, consider a simple problem of trying to sort four numbers 23,25,30, and 19 from the smallest value to the highest value. We know the answer is 19,23,25, and 30, but the computer needs specific instructions in order to give us the correct output quickly. A simple algorithm to solve this problem is to start at the beginning with the number 23 and remember it. Then, move on the next numbers and check if 23 is the smallest. If it is, then we know 23 is the smallest and we can move on to the next number. After some steps, the computer would also give us the correct answer of 19,23,25, and 30.



Reference: <https://realpython.com/sorting-algorithms-python/>

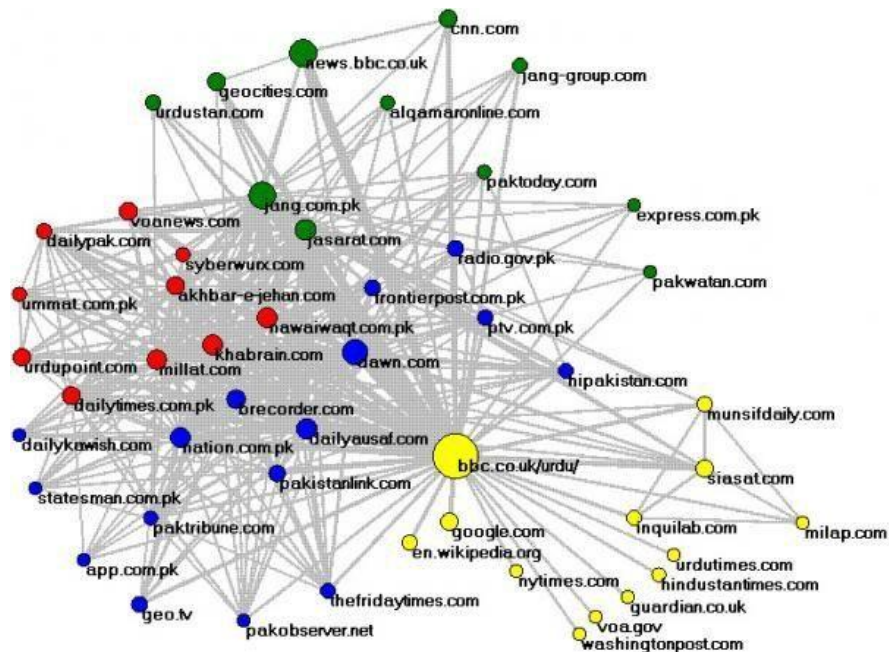
Sorting a list of 4 numbers from smallest to largest does not seem very helpful for the world or even hard. I can probably sort 4 numbers really quickly. Why then do we study algorithms? The answer is because algorithms allow human beings to solve hard problems really quickly. Imagine if instead of sorting 4 numbers, we had to sort 1000 numbers from smallest to largest. A computer, like a calculator, can do fast calculations and will give us the correct answer much more quickly than a human ever can.

In addition, algorithms can solve very large and complicated problems. For example, the Human Genome Project has been very successful with identifying all the 100,000 genes in the human DNA, determining the sequences of the 3 billion chemical base pairs that make up the human DNA, memorizing the information, and analyzing the information to help researchers while saving money, time, and critical resources.



Reference: https://en.wikipedia.org/wiki/Human_Genome_Project

The Internet is full of complicated algorithms that help you find any information within milliseconds, give you personalized recommendations, give you navigation directions, and allow you to connect with billions of people all over the world. In addition, algorithms in electronic commerce enable goods and services to be bought and sold over the Internet. Businesses utilize social media and websites to attract customers and make billions of US Dollars. Politicians use online advertisements to target voters in certain areas using complicated algorithms.



Reference: <https://www.quora.com/What-are-the-most-mind-blowing-algorithms-ever-used>

There are many uses of algorithms from simple sorting to running Google's search engine. No matter what, algorithms are fundamentally sequences of instructions and procedures that take

an input and make calculations/computations/predictions in order to give out an output. Therefore, it is important to study and understand algorithms.

With knowledge of algorithms, we have power. However, algorithms alone cannot make the world a better place. We also need physical hardware to be able to do what the algorithm dictates. For instance, imagine we have the most powerful and efficient algorithm to store data to be able to send it to other countries. However, this is impossible without physical cables that transmit important data. Therefore, efficient algorithms need optimal hardware for ideal computations.

Algorithms are implemented by programmers every day in many different programming languages that computers understand. This can be seen in the context of Arduino programming. Suppose we develop a faster algorithm to make an LED blink. Knowing this is not enough for anything. We need to implement this by writing computer code in the language that a computer or Arduino can understand. Oftentimes, this is done using the Arduino Integrated Development Environment(IDE) with a programming language called C/C++. Once we have the algorithm written in a language that a computer or Aduino can understand, we still cannot do everything. We need the actual physical Arduino in order for any action to occur. This occurs when we upload our program to the Arduino, meaning our program is actually executed and we can see the output. The power of computer science is not only due to software and algorithms, but also their interaction with physical hardware.