**Tutorial 02**

**Algorithms**

1. In mathematics and computer science, what is a typical definition of algorithm?

**Solution:**

In mathematics and computer science, an algorithm is a sequence of clear and precise step-by-step instructions for solving a problem.

**Additional Notes:**

* Algorithms are implemented by translating the step-by-step instructions into a computer program that can be executed by a computer.
* This translation process is called computer programming or simply programming.

1. During the lecture, a few examples of algorithms in action that we can observe in our daily lives were discussed e.g.:

* + [audio and video compression algorithms](https://video.ibm.com/blog/streaming-video-tips/what-is-video-encoding-codecs-compression-techniques/) (Instagram Live Video)
  + [routing algorithms](https://geoawesomeness.com/the-famous-algorithm-that-made-navigation-in-google-maps-a-reality/) (Google Maps)
  + [rendering algorithms](https://en.wikipedia.org/wiki/Ray_tracing_(graphics)#/media/File:Ray_trace_diagram.svg) (Pixar)

Discuss other examples of algorithms in action that you can observe in your daily lives.

**Solution:**

Suggested algorithms for discussion:

* **Cryptographic algorithm**, or a cipher, is the means of altering data from a readable form (also known as plaintext) to a protected form (also known as ciphertext), and back to the readable form. Changing plaintext to ciphertext is known as encryption, whereas changing ciphertext to plaintext is known as decryption. Examples of applications: HTTPS for secure communication over a computer network, Cryptocurrencies e.g. Bitcoin, where cryptographic algorithms are used to enable integrity, block-chaining and hashcash.
* **Facial Recognition algorithm** that analyses the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features. Examples of applications: Security feature (for unlocking device) in modern smartphones, Facebook’s Photo Review feature that finds photos of you across its site, even if you are not tagged in those photos.
* **Path Planning algorithm** for autonomous vacuum cleaning robot that will perform task like sweeping and vacuuming in a single pass. This is one example of many Artificial Intelligence (AI) algorithms that are “capable of learning from data, enhance themselves by learning new heuristics (strategies, or “rules of thumb”, that have worked well in the past), or can themselves write other algorithms.” – <https://en.wikipedia.org/wiki/Artificial_intelligence> .

1. The Towers of Hanoi is a mathematical game that is often used in computer science to illustrate the use of algorithm for problem solving, particularly the concept and power of recursion (which we will discuss further in Topic 05).

The game uses three pegs and a set of discs with holes through their centers. The discs are stacked on the leftmost peg, in order of size with the largest disc at the bottom.

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Data Structures & Algorithms



Diagram

Description automatically generated

The objective of the game is to move all the discs from the first peg to the third peg, using the middle peg as a temporary holder – with the minimum number of moves. In addition, the following rules must be observed while moving the discs:

* + Only one disk may be moved at a time
  + A disk cannot be placed on top of a smaller disc
  + All discs must be stored on a peg except while being moved

*(Content adapted from: Starting out with Python. Tony Gaddis, Addison Wesley, 2nd*

*Edition, 2012.)*

Devise an algorithm to solve the Tower of Hanoi problem.

<https://www.youtube.com/watch?v=q6RicK1FCUs&ab_channel=AbdulBari>

***-- End of Tutorial --***

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