In [computer science](https://en.wikipedia.org/wiki/Computer_science), an **online algorithm**[[1]](https://en.wikipedia.org/wiki/Online_algorithm#cite_note-karp92-1) is one that can process its input piece-by-piece in a serial fashion, i.e., in the order that the input is fed to the [algorithm](https://en.wikipedia.org/wiki/Algorithm), without having the entire input available from the start.

In contrast, an **offline algorithm** is given the whole problem data from the beginning and is required to output an answer which solves the problem at hand. In [operations research](https://en.wikipedia.org/wiki/Operations_research), the area in which online algorithms are developed is called [online optimization](https://en.wikipedia.org/wiki/Online_optimization).

As an example, consider the [sorting algorithms](https://en.wikipedia.org/wiki/Sorting_algorithms) [selection sort](https://en.wikipedia.org/wiki/Selection_sort) and [insertion sort](https://en.wikipedia.org/wiki/Insertion_sort): selection sort repeatedly selects the minimum element from the unsorted remainder and places it at the front, which requires access to the entire input; it is thus an offline algorithm. On the other hand, insertion sort considers one input element per iteration and produces a partial solution without considering future elements. Thus insertion sort is an online algorithm.

Note that the final result of an insertion sort is optimum, i.e., a correctly sorted list. For many problems, online algorithms cannot match the performance of offline algorithms. If the ratio between the performance of an online algorithm and an optimal offline algorithm is bounded, the online algorithm is called [competitive](https://en.wikipedia.org/wiki/Competitive_analysis_(online_algorithm)).[[1]](https://en.wikipedia.org/wiki/Online_algorithm#cite_note-karp92-1)

Not every *offline algorithm* has an efficient *online* counterpart.

https://statisticaapplicata800375216.wordpress.com/2020/03/25/algoritmo-di-knuth-per-il-calcolo-della-running-mean/

To present large amounts of data, some indicators are often used that summarize their characteristics, one of these synthetic indicators is the average. Usually, the average relative to a given character is calculated by adding all the available data, relative to that character, divided by the number of data:

The classic calculation of the average with the aid of software can lead to different types of errors, first of all the Catastrophic Cancellation, or the cancellation of significant figures. Furthermore, for large amounts of data there may be anomalies and disadvantages also linked to high calculation and memory times. To overcome this type of problem, the American computer scientist Donald Knuth proposed, through the following algebraic passages, a different algorithmic formulation for calculating the average:

=

The algorithm presented (Knuth algorithm, or online algorithm) is incremental, i.e., the average at step n is obtained from the average at step n-1 and updated with the new observations. With this type of solution, it is therefore possible to build a stable algorithm without overflow problems.

This type of algorithm can also be applied for the calculation of other synthetic indices such as variance.