**Donald Knuth’s definition of an algorithm**

In his seminal work The Art of Computer Programming   
(1962-2022-?), Donald Knuth proposed a five-point definition of algorithm, which has been widely accepted and used.

**Definition.** An **algorithm** is a finite set of rules specifying sequences of computational steps for solving a given problem, with the following five properties.

• **Finiteness**. An algorithm must always terminate after a finite number of steps.

• **Definiteness**. Each step of an algorithm must be precisely defined, that is, the actions to be carried out must be rigorously and unambiguously specified.

• **Input**. An algorithm has zero or more inputs, given before the algorithm begins or during the algorithm’s execution.

• **Output**. An algorithm has one or more outputs, which relate to the inputs.

• **Effectiveness**. Every operation of an algorithm must be sufficiently rudimentary, such that in principle, the operation can be done by a human using paper and pencil, in finite time.

From the algorithmic lens, a problem is often specified as follows: design an algorithm according to Knuth’s definition, such that for any given input data, it produces the desired output data. The algorithm is specified as follows, where the Steps part must satisfy the five properties in Knuth’s definition.

• Input: specifying the given input data.

• Output: specifying the desired output data.

• Steps: specifying one or more sequences of computational steps.

An algorithm is not the same as a program. The quicksort algorithm was discovered before the invention of the Go

programming language. Many algorithms were designed and used long before the modern computer era.