Data structure

In [computer science](https://en.wikipedia.org/wiki/Computer_science), a **data structure** is a data organization and storage format that enables [efficient](https://en.wikipedia.org/wiki/Algorithmic_efficiency) access and modification.[[1]](https://en.wikipedia.org/wiki/Data_structure#cite_note-1) Data structures can implement one or more particular [abstract data types](https://en.wikipedia.org/wiki/Abstract_data_type) (ADT), which specify the operations that can be performed on a data structure and the [computational complexity](https://en.wikipedia.org/wiki/Computational_complexity_theory) of those operations. In comparison, a data structure is a concrete implementation of the space provided by an ADT.[*[citation needed](https://en.wikipedia.org/wiki/Wikipedia:Citation_needed" \o "Wikipedia:Citation needed)*]

Different kinds of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks. For example, relational databases commonly use [B-tree](https://en.wikipedia.org/wiki/B-tree) indexes for data retrieval,[[5]](https://en.wikipedia.org/wiki/Data_structure" \l "cite_note-5) while [compiler](https://en.wikipedia.org/wiki/Compiler) implementations usually use [hash tables](https://en.wikipedia.org/wiki/Hash_table) to look up identifiers

[[2]](https://en.wikipedia.org/wiki/Data_structure#cite_note-2)[[3]](https://en.wikipedia.org/wiki/Data_structure#cite_note-3) More precisely, a data structure is a collection of data values, the relationships among them, and the functions or operations that can be applied to the data.[[4]](https://en.wikipedia.org/wiki/Data_structure#cite_note-4)

Modern languages also generally support [modular programming](https://en.wikipedia.org/wiki/Modular_programming), the separation between the [interface](https://en.wikipedia.org/wiki/Interface_(computing)) of a library module and its implementation. Some provide [opaque data types](https://en.wikipedia.org/wiki/Opaque_data_type)that allow clients to hide implementation details. [Object-oriented programming languages](https://en.wikipedia.org/wiki/Object-oriented_programming_language), such as [C++](https://en.wikipedia.org/wiki/C%2B%2B), [Java](https://en.wikipedia.org/wiki/Java_(programming_language)), and [Smalltalk](https://en.wikipedia.org/wiki/Smalltalk), typically use [classes](https://en.wikipedia.org/wiki/Classes_(computer_science)) for this purpose.

Many known data structures have [concurrent](https://en.wikipedia.org/wiki/Concurrent_data_structure) versions which allow multiple computing threads to access a single concrete instance of a data structure simultaneously

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1.jeffrey d.ullman

2.john e. hopcroft

3.richard f.gilberg

4.david mount

5.s.chand