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## Abstract structure

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*This article is about a type of abstraction in science, mathematics, and philosophy. For the structure of an abstract (summary), see [Abstract \(summary\)](#) § [Structure](#).*

In [mathematics](#) and related fields, an **abstract structure** is a way of describing a set of mathematical objects and the relationships between them, focusing on the essential rules and properties rather than any specific meaning or example.<sup>[1][2]</sup>

For example, in a game such as [chess](#), the rules of how the pieces move and interact define the structure of the game, regardless of whether the pieces are made of wood or plastic. Similarly, an abstract structure defines a framework of objects, operations, and relationships. These structures are studied in their own right, revealing fundamental mathematical principles. While a real-world object or computer program might *represent*, *instantiate*, or *implement* an abstract structure, the structure itself exists as an abstract concept, independent of any particular representation.

This abstraction allows to see common patterns across seemingly different areas of mathematics and to apply the same reasoning and tools to analyze them. Abstract structures are studied not only in [logic](#) and [mathematics](#) but in the fields that apply them, as [computer science](#) and [computer graphics](#), and in the studies that reflect on them, such as [philosophy](#) (especially the [philosophy of mathematics](#)).

An abstract structure has a richer structure than a [concept](#) or an [idea](#). An abstract structure must include precise rules of behaviour which can be used to determine whether a candidate implementation actually matches the abstract structure in question, and it must be free from [contradictions](#). Thus we may debate how well a particular government fits the concept of [democracy](#), but there is no room for debate over whether a given sequence of moves is or is not a valid game of chess (for example [Kasparovian](#) approaches).

## Examples [\[ edit \]](#)

- A [sorting algorithm](#) is an abstract structure, but a [recipe](#) is not, because it depends on the properties and quantities of its ingredients.
- A simple [melody](#) is an abstract structure, but an [orchestration](#) is not, because it depends on the properties of particular instruments.
- [Euclidean geometry](#) is an abstract structure, but the theory of [continental drift](#) is not, because it depends on the geology of the [Earth](#).
- A [formal language](#) is an abstract structure, but a [natural language](#) is not, because its rules of grammar and syntax are open to debate and interpretation.

## Notes [\[ edit \]](#)

1. <sup>^</sup> ["Bourbaki and the Foundations of Modern Mathematics"](#)<sup>↗</sup>. CNRS News. Retrieved 2025-01-26.
2. <sup>^</sup> Mac Lane, Saunders (2010). *Categories for the working mathematician*. Graduate texts in mathematics (2nd. ed., Softcover version of original hardcover edition 1998 ed.). New York, NY: Springer. [ISBN 978-1-4419-3123-8](#).

See also [\[ edit \]](#)

- Abstraction in computer science
- Abstraction in general
- Abstraction in mathematics
- Abstract object
- Deductive apparatus
- Formal sciences
- Mathematical structure

Categories: [Abstraction](#) | [Mathematical terminology](#) | [Structure](#)

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