

[Isabelle](#) is a generic proof assistant. It allows mathematical formulas to be expressed in a formal language and provides tools for proving those formulas in a logical calculus. The main application is the formalization of mathematical proofs and in particular *formal verification*, which includes proving the correctness of computer hardware or software and proving properties of computer languages and protocols.

Compared with similar tools, Isabelle's distinguishing feature is its flexibility. Most proof assistants are built around a single formal calculus, typically higher-order logic. Isabelle has the capacity to accept a variety of formal calculi. The distributed version supports higher-order logic but also axiomatic set theory and several other formalisms.

Isabelle provides excellent notational support: new notations can be introduced, using normal mathematical symbols. Proofs can be written in a structured notation based upon traditional proof style, or more straightforwardly as sequences of commands. Definitions and proofs may include TeX source, from which Isabelle can automatically generate typeset documents.

The main limitation of all such proof systems is that proving theorems requires much effort from an expert user. Isabelle incorporates some tools to improve the user's productivity by automating some parts of the proof process. In particular, Isabelle's *classical reasoner* can perform long chains of reasoning steps to prove formulas. The *simplifier* can reason with and about equations. Linear *arithmetic* facts are proved automatically.

Isabelle comes with a large theory library of formally verified mathematics, including elementary number theory (for example, Gauss's law of quadratic reciprocity), analysis (basic properties of limits, derivatives and integrals), algebra (up to Sylow's theorem) and Zermelo-Fraenkel set theory (the relative consistency of the Axiom of Choice). Also provided are numerous examples arising from research into formal verification. A particularly notable proof development is [Avigad's formalization](#) of the prime number theorem.

With *Isar*, Isabelle offers a concise proof formulation language which enables a user to write proof scripts naturally understandable for both humans *and* computers.

Isabelle is closely integrated with the [ProofGeneral](#) user interface, which eases the task of writing and maintaining proof scripts.

Ample documentation is available about Isabelle, including a [Tutorial](#) published by Springer-Verlag and numerous research publications.