The contents of this document are to be included in the main thesis.

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From the site[1] of the creators:

> 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.

Isabelle/HOL is the most widespread instance of Isabelle. HOL stands for HOL. Isabelle/HOL provides a HOL proving environment ready to use, which include: (co)datatypes, inductive definitions, recursive functions, locales, custom syntax definition, etc. Proofs can be written in both human[2] and machine-readable language based in Isar. The tool also includes the *sledgehammer*, a port to call external first-order provers to find proofs automatically. The user interface is based in jEdit[3], which provides a text editor, syntax parser, shortcuts, etc (see fig. 1).

Theories in Isabelle/HOL are based in a few axioms. Isabelle/HOL Library's theories—that comes with the installer—and user's theories are based on these axioms. This design decision avoids inconsistencies and paradoxes.

Besides the provided theories, its active community provides a comprehensive AFP. Each entry in this archive can be cited and usually contains an *abstract*, a document, and a theory file. For example, FBA theory is available in [**?**]. To use it, it is enough to download and put on the same directory of your own theory files.

Bellow we show an example and explain the overall syntax of the human and machine-readable language.

[1] Accessed 27/jan/2016: https://isabelle.in.tum.de/overview.html

[2] By human we mean that anyone with mathematics and logic basic knowledge—it means that deep programming knowledge is not essential.

[3] Accessed 27/jan/2016: http://www.jedit.org/

[0.8]basic-symmetry-isabelle-window

Figure 1: Isabelle/HOL window, showing the basic symmetry theorem

theorem *basic-symmetry*:
assumes $x = y$ — Assumptions
shows $y = x$ — Hypothesis
proof −
have $x = x$ **..** — Proof step
from *assms* — Using assumptions
show $y = x$ **..** — Show thesis
qed

Finally, Isabelle/HOL provides LaTeX syntax sugar and allow easy document preparation: this entire section was written in a theory file mixing Isabelle's and LaTeX's syntax). The above theorem can be written using Isabelle's quotation and anti-quotations. For example, we can write it using usual LaTeX theorem environment: Assuming $x = y$, thus:

$$y = x$$

have x = x **..** — Proof step
from assms — Using assumptions
show y = x **..** — Show thesis

Otherwise specified, in the next sections we will omit proofs because they are all verified using Isabelle/HOL.