Getting Started with Isabelle/jEdit in 2018

Christian Sternagel

University of Innsbruck, Austria
christian.sternagel@uibk.ac.at

Abstract

This is a beginner-oriented introduction to Isabelle/jEdit, the main user interface for the proof assistant Isabelle.

1 Introduction

Before we start, let me clarify my goals. This document is intended as a short introduction to Isabelle/jEdit (as shipped with Isabelle2018) from a new user’s perspective. As an aside: this is an updated version of an earlier document (for Isabelle2012), in which I also highlighted differences to the (now obsolete) Proof General interface.

In the remainder I will sometimes highlight common pitfalls for new users (mostly issues that have been collected from the Isabelle mailing lists). I do however not give any technical or implementation details (for those, I refer to [1, 2, 5, 3, 4] and the Isabelle documentation). Moreover, my intended audience are newcomers to Isabelle/jEdit (in other words: I have nothing to say that people could not easily find out on their own, but hope to save some people some time).

Points that may need special attention are marked like this.

⚠️ In the following, I use the following conventions: When indicating a menu like A→B→C I mean: “Click on submenu C in submenu B of menu A.” When indicating keyboard shortcuts like C-s I mean: “Keep key C pressed while pressing key s.” Here, C refers to the control key (usually labeled with Ctrl on PC keyboards; on Mac OS this is actually command). The remainder is structured as follows:

• First, in Section 2, I argue why Isabelle/jEdit is a great user interface for Isabelle.
• Then, in Section 3, I explain how to obtain and start Isabelle/jEdit and give an example walkthrough.
• The next section (Section 4) is concerned with some typical use cases.
• Finally, I conclude in Section 5.

2 Why Isabelle/jEdit is Awesome

The most important point (in my opinion) is that Isabelle/jEdit (or rather the technology\(^1\) that makes it possible to use the editor jEdit as an interface to the proof assistant Isabelle) provides an interaction model that is broadly known and used nowadays (e.g., in word processors and

\(^{\text{1}}\)Isabelle/jEdit is a client to the PIDE framework [5]; there may be other clients (e.g., web-based or as part of an existing IDE, like Eclipse).
Getting Started with Isabelle/jEdit

C. Sternagel

integrated development environments for programming languages). Let us call it the *continuous model*. The user sees and freely edits a document and all the heavy machinery of Isabelle asynchronously runs in the background and supplies *source text* with semantic information that is again presented in ways people are used to nowadays (highlighting, hyperlinks, tooltips, wavy underlines, etc.).

The traditional interaction model, in contrast (which is still employed by most other proof assistants), is more like a command-line interface, we sequentially enter commands (one at a time) and wait for the corresponding output. Since this would be exceedingly tedious whenever we wanted to change something we entered very early (essentially, we have to enter everything again), this kind of interaction is usually combined with source text. Such that instead of typing everything again, we just tell the system which part of the source text has to be reloaded. However, in order for this to work, we need some kind of *locked region* (the part of the source text that has already been processed) which we are not allowed to edit. Or alternatively, reload everything after each change.

At this point you may wonder: “What’s the big deal about the continuous model?” Since it may seem that the only difference to the traditional model (let’s call it the *sequential model*) is that we do not have to manage a locked region manually. Well, the main point is that the sequential model is inherently sequential, whereas the continuous model offers plenty of space for parallelization. Thus, Isabelle/jEdit does not only provide a more modern (and for many potential users more familiar) user interface but additionally facilitates (again, the real reason is rather the underlying technology) to seamlessly make use of multi-core architectures.

3 Get Rolling

Before we can use Isabelle/jEdit, we have to download it. Since it is contained in the official Isabelle release, we download that from:

- [http://isabelle.in.tum.de](http://isabelle.in.tum.de)
or[http://www.cl.cam.ac.uk/research/hvg/Isabelle/](http://www.cl.cam.ac.uk/research/hvg/Isabelle/)
or[http://mirror.cse.unsw.edu.au/pub/isabelle/](http://mirror.cse.unsw.edu.au/pub/isabelle/)

The correct version for your operating system and architecture should be provided by the big green button and can be installed to an arbitrary directory `ISABELLE_HOME`.

⚠️ Do not try to combine arbitrary versions of PolyML, Isabelle, Scala, Java, and jEdit if you want to avoid problems. *Everything* you need is packaged in the Isabelle bundle.

To start Isabelle/jEdit from a command line (e.g., under Linux) use (something similar to)

```
ISABELLE_HOME/bin/isabelle jedit
```

In Figure 1 you see how Isabelle/jEdit presents itself after being started the first time (I just reduced the initial window size in favor of readability). In the center we have the *main buffer*, this is where our source text is shown and editing takes place. On the right we have (among others) buttons *Output* and *Theories* which activate corresponding panels when pressed. When selecting *Output* the panel shows the *output buffer*, this is where messages from the current command are to be found, where the current command is determined by the cursor position in the main buffer (that is, by default the output buffer shows the message(s) corresponding to the command on which the cursor is positioned).

⚠️ The *Theories* panel can always be consulted to check whether Isabelle/jEdit agrees with you on which files are loaded (and how much of them), where problems are indicated in red.
To start using Isabelle/jEdit let us formalize a simple fact about lists. Before we can do so, we need to start a theory (which is Isabelle parlance for a source file that bundles definitions and facts under a common name). We start by typing "theory Test imports Main begin" into the main buffer, which tells the system to start a theory with name Test on top of the theory named Main, the default starting point for Isabelle theories (that is, providing some kind of “standard library” of definitions and facts). At this point you may notice an error message in the output buffer (which is additionally stressed by showing a red sign in the left margin (the gutter) as well as wavy underlining the word “Test” in the input.

```
Warning: Bad theory name "Test" for file "Scratch.thy"
```

This happens because the default file name for theories is Scratch.thy and can easily be resolved by saving (either File→Save or C-s) the current file under the name Test.thy.

A theory with name Name has to reside in a file with name Name.thy. The Isabelle convention is to capitalize theory names and separate words by underscores, e.g., Complete_Partial_Order rather than completePartialOrder, complete_partial_order, etc.

Now, let us come back to the announced fact about lists: when we combine the head and the tail of a non-empty list, we obtain the same list again. To make it a bit more interesting (and informative), we define our own functions for computing the head and the tail of a list as follows:
fun head :: "'a list => 'a" where "head (x # xs) = x"
fun tail :: "'a list => 'a list" where "tail (x # xs) = xs"

There are already a few things to note here. When defining head, a warning occurs (which is additionally stressed by showing a yellow sign in the gutter as well as wavy underlining the word “fun” in the input)

Missing patterns in function definition:
head [] = undefined

which tells us that our function is not defined on input []. This is not an error but just a warning, since we could intend our function to be undefined in this case (as we indeed do). A similar warning is issued for tail. Further note that the status of an identifier is indicated by its color: free variables are rendered blue, bound variables green, defined constants black, etc. Moreover, many entities allow us to jump to their definition by holding C pressed while left-clicking on them with the mouse. For head and tail this means that we end up in the line containing the corresponding fun keyword (even if that line is part of a different file). We can test this behavior by C-left-clicking # in the definition of head which brings us to the theory List of Isabelle’s standard library. More concretely, to the line where the list datatype is defined (since # refers to one of the constructors of the list datatype). The fastest way of going back is C-" (control together with backtick, not to be confused with a single quote) or View→Go to Recent Buffer.

Now we prove our little lemma, giving it the name head_tail_id (note that at this point head and tail are printed black, since they are defined constants now):

lemma head_tail_id: "~(xs = []) ==> head xs # tail xs = xs"
   by (cases xs) simp_all

We finish our small theory by adding end at the end of the file.

4 How To .

In this section I collect typical use cases of things that you might want (or have) to do inside Isabelle/jEdit. It is organized by typical user questions/statements.

4.1 How can I use fancy mathematical symbols?

This is really easy and convenient thanks to the code completion facility of the SideKick plugin. By default, code completion is active (you can change the corresponding settings at Plugins→Plugin Options...→SideKick) and works as follows: you just enter what you mean in plain ASCII and if available the system offers you a popup with alternative choices. If you want to close the popup, just keep on typing (if you are at the end of a word just enter a space) or press ESC. If you want to choose an alternative, navigate through the popup using the arrow keys (or the mouse) and press TAB when you are satisfied. Some symbols will be completed automatically. For example, after typing ==> (two equal signs followed by a greater than) you will end up with \( \Rightarrow \). Many symbols also have names that are close to the usual \LaTeX names, e.g., type \( \forall \) (followed by TAB) to obtain \( \forall \), \( \exists \) to obtain \( \exists \), etc. Often, you do not even have to enter the full name, a prefix is enough, e.g., after typing \( \forall \) you will obtain a choice between the symbol \( \forall \) and several other symbols.
An alternative way to enter “Isabelle symbols” is like \texttt{\forall} (and this is how special symbols are actually stored in your theory files).

5 Conclusions

I summarized some of the points that have already been discussed on the Isabelle mailing lists (or elsewhere). Nevertheless, I hope that this short and beginner-oriented introduction may help potential new users out there to get up and running faster than they would have without this document.

Acknowledgments. I want to thank the Isabelle community (especially the developers) for always being very helpful (and friendly) on the Isabelle mailing lists and Makarius Wenzel for developing such an awesome tool as Isabelle/jEdit (keep going!).

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