Why3 Installation Instructions

15-414 Bug Catching: Automated program verification

February 13, 2021

We provide here some instructions for installing Why3 along with Alt-Ergo, Z3, and CVC4 (the three automated provers we will use for this class) on Ubuntu Linux and MacOS. It should not be too hard to adapt these instructions for other Linux distributions. If you happen to use Windows however, we recommend that you use the Ubuntu virtual machine that we provide on the class website (`http://tinyurl.com/48wbqtqb`).

Instructions for MacOS

Note: if any instructions fail because your operating system is unable to support the recommended versions, we suggest you follow the virtual machine setup instructions instead.

You will need the Homebrew package manager. Then:

1. Install `opam`, the OCaml package manager and libraries for Why3:

   ```
   brew install hg darcs opam gtk+ gmp gtksourceview3 libgnomecanvas autoconf
   ```

2. Initialize opam:

   ```
   opam init; eval $(opam config env)
   ```

   Answer *yes* if queried.

   Please make sure your opam version is > 2.0 and that your ocaml version is $>= 4.0.8$ with `opam switch` – some future commands will not work on earlier versions.

   (a) If your OCaml version is too low, you may try running the following commands:

   ```
   opam switch create 4.08.0; eval $(opam config env)
   ```

3. Install Why3 & Alt-Ergo:

   ```
   opam install zarith lablgtk3 lablgtk3-sourceview3 why3 why3-ide alt-ergo.2.3.1
   ```

4. Install Z3:

   ```
   brew tap stonebuddha/formulae; brew install z3@4.8.6
   ```

5. Install CVC4[1]:

   ```
   brew tap cvc4/cvc4; brew install cvc4/cvc4/cvc4
   ```

6. Finally, set up Why3 by running `why3 config --detect-provers`. The three provers, Alt-Ergo (version 2.3.1), Z3 (version 4.8.6), and CVC4 (version 1.7), should be detected on your system.

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[1]If installing CVC4 fails on `make install`, try the workaround listed here.

Instructions for Ubuntu Linux

Note: if any instructions fail because your operating system is unable to support the recommended versions, we suggest you follow the virtual machine setup instructions instead.

1. Install `opam`, the OCaml package manager:

   ```
   sudo add-apt-repository ppa:avsm/ppa
   sudo apt update
   sudo apt-get install build-essential m4 make opam
   ```

2. Initialize opam:

   ```
   opam init; eval $(opam config env)
   ```

   Answer *yes* if queried. Please make sure your opam version is > 2.0 and that your ocaml version is $>= 4.0.8$ with `opam switch` – some future commands will not work on earlier versions.

   (a) If your OCaml version is too low, you may try running the following commands:

   ```
   opam switch create 4.08.0; eval $(opam config env)
   ```

3. Install required packages:

   ```
   sudo apt-get install libgmp-dev libgtksourceview2.0-dev
   ```

4. Install Why3 & Alt-Ergo:

   ```
   opam install why3 why3-ide alt-ergo.2.3.1
   ```

5. Install Z3 (note the url is broken onto two lines):

   ```
   wget https://github.com/Z3Prover/z3/releases/download/z3-4.8.6/
                         z3-4.8.6-x64-ubuntu-16.04.zip
   unzip z3-4.8.6-x64-ubuntu-16.04.zip
   sudo cp z3-4.8.6-x64-ubuntu-16.04/bin/z3 /usr/local/bin
   sudo chmod +x /usr/local/bin/z3
   ```

6. Install CVC4 (note the url is broken onto two lines):

   ```
   wget https://github.com/CVC4/CVC4/releases/download/1.7/
                          cvc4-1.7-x86_64-linux-opt
   sudo cp cvc4-1.7-x86_64-linux-opt /usr/local/bin/cvc4
   sudo chmod +x /usr/local/bin/cvc4
   ```

7. Finally, set up Why3 by running `why3 config --detect-provers`. The three provers, Alt-Ergo (version 2.3.1), Z3 (version 4.8.6), and CVC4 (version 1.7), should be detected on your system (at least).

Setting up the virtual machine

1. Download the VM at `http://tinyurl.com/48wbqtqb`.

2. Install the latest version of Oracle VirtualBox.

3. Launch VirtualBox, go to "*Files/Import Appliance*" and select the file above.

4. Start the virtual machine, and then you're done: everything you need is already pre-installed.

A note on versions

You should make sure that the version of Why3 that you install is 1.3.3. You can check this by running `why3 --version`. If you see a version number less than 1.3.3, then you should upgrade as follows:

1. `opam remove why3`

2. Make sure that the `.why3.conf` file in your home directory is removed.

3. `opam upgrade; opam update`

4. `opam install why3 why3-ide`

5. `why3 config --detect-provers`

Installing a text editor for WhyML

There are WhyML plugins for VSCode, Atom, and Emacs. If you have no experience with Emacs, we recommend that you use the VSCode or Atom plugins. If you do not have a strong preference, you are encouraged to use VSCode/Atom for development, and the included Why3 IDE for verification.

- To install the VSCode plugin, start VSCode (`https://code.visualstudio.com`) and go to the `Extension Marketplace`. Search for `WhyML`.

- To install the Atom plugin, start Atom (`https://atom.io/`) and go to `Preferences/Install`. Search for `language-whyml`.

- To install the Emacs plugin, download `why3.el` at

    `http://www.cs.cmu.edu/~15414/misc/why3.el`

  (updated from `https://gist.github.com/sagotch/46a92bcc41abfecf4d79`) and put in in your `~/.emacs.d/lisp/` folder. Then, add the following lines to your `.emacs` file:

  ```
  (add-to-list 'load-path "~/.emacs.d/lisp/")
  (load "why3.el")
  ```