# Installing Software and Writing Modules (I)

# Introduction

# Model, CoC and URLs

- Carpentries model: hands-on portion, aka *live coding*
  - Carpentries Code of Conduct
- `https://github.com/SmithsonianWorkshops/`
  - view *slides* or the *markdown* version

# In the intro portion of the workshop you will learn:

- About downloading code
- About compiling code
- How to build a package from source code
  - configure
  - build
  - install
- What are `yum`, `rpm`, `get-apt`, & `sudo`
- How to write modules

# Downloading Code

# Source vs Executable

- In most cases you are better off downloading the source and building the code (aka the executable) yourself.
- Downloading an executable is easier but likely will not to work.

# Downloading Executables

Some developers provide pre-built executables of their software.

There are instances when available executables will run flawlessly on Hydra, but make sure that:

1. you can trust the origin,
2. you get a version compatible with Hydra,
   - *i.e.*, CentOS 7.x for Intel/AMD CPUs (`x86_64`)

# Remember

- Hydra configuration is specific:
  - pre-built code may need *stuff* (dependencies) not on Hydra.

# Notes on Downloading Executables

# Risks

- Since users on Hydra do not have elevated privileges (root access) you are very unlikely to damage the cluster, but malicious software can still damage your files.

- In rare cases it may install a *Trojan horse* that could exploit a known vulnerability.
  - Be vigilant and responsible.
  - In case of doubt, never hesitate to contact us.

# Compiling code

# Steps

Creating executable from source code is typically done as follows:

1. compile the source file(s) to produce object file(s),
2. link the object file(s) and libraries into an executable.

# In Practice

- Often aided by a `makefile`,
- *Configuring* is creating such `makefile` or equivalent.

*This will be illustrated in the hands-on section.*

# Building from Source

# 1. Configure

- Most packages come with a configuration script, a list of prerequisites (dependencies/libraries) and instructions,
- Some packages allow you to build the code without some features in case you cannot satisfy some of the prerequisites,
- You most likely need to load the right module(s) to use the appropriate tools (compilers).
- The configuration step will test if the code can be built:
  - check dependencies, versions, etc.
  - if this fails, the code cannot be built as is.

# 1.b Makefile only

- Other (simpler) packages come with a `makefile` that needs to be edited,
  - check the instructions.

# Building from Source (cont'd)

# 2. Build

- make sure you have loaded the right modules,
- run `make` to compile and link (aka build) the code.

# 2.b Test

- some packages come with the optional step of testing the built before installing it, using something like `make test`.

# 3. Install

- copy the executable(s) to the right place(s),
  - usually defined by the configuration,
- best practice is to separate build from install locations.

# Basics about `make` and `makefile`

# The command `make`

- `make` is a utility to maintain groups of programs.
- Uses instructions in a `makefile` to build targets from sources by following rules.
- written to help build & maintain code, can be used for a lot more (full Carpentries module).

# Examples:

- build the first target listed in the `makefile`:

```
make
```

- build the target "`this`" listed in the "`makefile`" file:

```
make this
```

- build "`that`" using "`makefile.special`" and set "`VAR`" to "`val`":

```
make -f makefile.special VAR=val that
```

# Basics about `make` and `makefile` (cont'd)

# The `Makefile` or `makefile` files

- a file that defines targets and codifies rules and dependencies to build targets;
  - dependency: has a source needed to build something changed?
- it can be very simple, but can also be quite complex.

# Also

- `make` has implicit rules:
  - can build targets w/out a `makefile` or w/out rules.

*This will be illustrated in the hands-on part*

# Setting up Your Environment to Run Your Code

# Likely Needed

You likely will need to adjust your *environment* to run some code:

1. the location of the code: `path` or `PATH`,
2. the location of the libraries: `LD_LIBRARY_PATH`,
3. you may also need to set some environment variables, etc.

# Easier Way: modules

This is where using a module makes things easy:

- compact, and
- works with any shell.

# The `yum`, `rpm`, `get-apt` and `sudo` Soup

# Definitions

- `yum`: is a package-management utility for CentOS
- `rpm`: pre-built software package
  - *both* are for sys-admin,
  - help handle dependencies,
  - *yet* . . .
- `get-apt`: Debian's version of `yum`, *does not work* on CentOS.

# Also

- `sudo`: allows to run a command as ‘root’: **you can’t!**

# BTW

- Instructions that mention `yum`, `rpm`, `apt-get` or `sudo`
  - **will not work** on Hydra,
  - **yet** in most cases there is another way.

# How about Hydra

# Using `yum`

- While you **cannot** install packages with `yum`,
- you can check if we've installed a prerequisite package

# In practice

- if the instructions say

```
sudo yum -y install <package>
```

- you can run

```
yum info <package>
```

# Using `yum info`

# Example

```
yum info libXt-devel
... stuff and may be slow the first time ...
Installed Packages
Name        : libXt-devel
Arch        : x86_64
Version     : 1.1.5
...
Description : X.Org X11 libXt development package
...
```

You want the `Arch: x86_64` to be listed as “Installed” not *just* “Available”.

# How to avoid sudo

# sudo make install

- if the instructions says

```
sudo make install
```

- instead, set the installation directory to be under your control,
- in most cases at the configuration step

```
./configure -prefix=/home/<username>/big-package/3.5
```

- and use

```
make install
```

Replace `<username>` by your username.

# Final Notes

# Remember

- there is a way to use `yum` as a non privileged user
  - not recommended, unless you're an **expert**!
- you can always ask about a missing prerequisite,
- most of those can be built from source since Linux is an open source OS.

Let's pause here for 5-10 minutes

# Switch to `github` for the Hands-on

# Go to

https://github.com/SmithsonianWorkshops/advanced-hydra-workshops/

# Convention

- I use % as prompt
  - your prompt might be different, like $
  - you type what is **after** the prompt
  - no prompt: result from previous command.
- I where you see `<genomics|sao>`, you need to use either `genomics` or `sao`,
- I where you see `<username>`, you need to substitute your username.