EasyBuild tutorial
DEEP project

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What is EasyBuild?

- **EasyBuild is a software build and installation framework**
- Strong focus on scientific software, performance, and HPC systems
- Open source (GPLv2), implemented in Python (2.7, 3.5+)
- Brief history:
  - Created in-house at HPC-UGent in 2008
  - First released publicly in Apr'11
  - EasyBuild 1.0 released in Nov'11 (during SC11)
  - Worldwide community has grown around it since then!

https://easybuild.io

https://docs.easybuild.io

https://github.com/easybuilders

https://easybuild.slack.com
(https://easybuild.io/join-slack)

Twitter: @easy_build

EasyBuild in a nutshell

- **Tool to provide a *consistent and well performing* scientific software stack**
- Uniform interface for installing scientific software on HPC systems
- Saves time by *automating* tedious, boring and repetitive tasks
- Can empower scientific researchers to self-manage their software stack
- **A platform for collaboration among HPC sites worldwide**
- Has become an “expert system” for installing scientific software

Key features of EasyBuild (1/2)

- Supports fully **autonomously** installing (scientific) software, including dependencies, generating environment module files, ...
- **No admin privileges are required** (only write permission to install path)
- Highly configurable, easy to extend, support for hooks, easy customisation
- Detailed logging, fully transparent via support for “dry runs” and trace mode
- Support for using custom module naming schemes (incl. hierarchical)

Key features of EasyBuild (2/2)

- Integrates with various other tools (Lmod, Singularity, FPM, Slurm, GC3Pie, ...)
- **Actively developed and supported by worldwide community**
- **Frequent stable releases** since 2011 (every 6 - 8 weeks)
- **Comprehensive testing**: unit tests, testing contributions, regression testing
- **Various support channels** (mailing list, Slack, conf calls) + yearly user meetings

Focus points in EasyBuild

Performance

- Strong preference for building software from source
- Software is optimized for the processor architecture of build host (by default)

Reproducibility

- Compiler, libraries, and required dependencies are mostly controlled by EasyBuild
- Fixed software versions for compiler, libraries, (build) dependencies, ...

Community effort

- Development is highly driven by EasyBuild community
- Lots of active contributors, integration with GitHub to facilitate contributions

What EasyBuild is *not*

- EasyBuild is **not YABT (Yet Another Build Tool)**
  - It does not try to replace CMake, make, pip, etc.
  - It wraps around those tools and automates installation procedures
- EasyBuild does **not replace traditional Linux package managers** (yum, dnf, apt, ...)
  - You should still install some software via OS package manager: OpenSSL, Slurm, etc.
- EasyBuild is **not a magic solution** to all your (software installation) problems
  - You will still run into compiler errors (unless somebody worked around it already)

EasyBuild terminology

- It is important to briefly explain some terminology often used in EasyBuild
- Some concepts are specific to EasyBuild: easyblocks, easyconfigs, ...
- Overloaded terms are clarified: modules, extensions, toolchains, ...

EasyBuild terminology: framework

- The EasyBuild framework is the **core of EasyBuild**
- **Collection of Python modules**, organised in packages
- Implements **common functionality** for building and installing software
- Support for applying patches, running commands, generating module files, ...
- Examples: `easybuild.toolchains`, `easybuild.tools`, ...
- Provides `eb` command, but can also be leveraged as a Python library
- GitHub repository: https://github.com/easybuilders/easybuild-framework

EasyBuild terminology: easyblock

- A **Python module** that implements a specific software installation procedure
  - Can be viewed as a “plugin” to the EasyBuild framework
- **Generic easyblocks** for “standard” stuff: cmake + make + make install, Python packages, etc.
- **Software-specific easyblocks** for complex software (OpenFOAM, TensorFlow, WRF, ...)
- Installation procedure can be controlled via easyconfig parameters
  - Additional configure options, commands to run before/after build or install command, ...
  - Generic easyblock + handful of defined easyconfig parameters is sufficient to install a lot of software
- GitHub repository: https://github.com/easybuilders/easybuild-easyblocks
- Easyblocks do not need to be part of the EasyBuild installation (see `--include-easyblocks`)

EasyBuild terminology: easyconfig file

- Text file that specifies what EasyBuild should install (in Python syntax)
- **Collection of values for easyconfig parameters** (key-value definitions)
- Filename typically ends in '`.eb`'
- Specific filename is expected in some contexts (when resolving dependencies)
  - Should match with values for `name`, `version`, `toolchain`, `versionsuffix`
  - `<name>-<version>-<toolchain><versionsuffix>.eb`
- GitHub repository: https://github.com/easybuilders/easybuild-easyconfigs

EasyBuild terminology: extensions

- **Additional software that can be installed *on top* of other software**
- Common examples: Python packages, Perl modules, R libraries, ...
- Extensions is the general term we use for this type of software packages
- Can be installed in different ways:
  - As a stand-alone software packages (separate module)
  - In a bundle together with other extensions
  - As an actual extension, to provide a "batteries included" installation

EasyBuild terminology: dependencies

- Software that is **required to build/install or run other software**
- **Build dependencies**: only required when building/installing software (not to use it)
  - Examples: CMake, pip, pkg-config, ...
- **Run-time dependencies**: (also) required to use the installed software
  - Examples: Python, Perl, R, ...
- **Link-time dependencies**: libraries that are required by software to link to
  - Examples: glibc, OpenBLAS, FFTW, ...
- Currently in EasyBuild: no distinction between link-time and run-time dependencies

EasyBuild terminology: toolchains

- **Compiler toolchain: set of compilers + libraries for MPI, BLAS/LAPACK, FFT, ...**
- Toolchain component: a part of a toolchain (compiler component, etc.)
- **Full toolchain**: C/C++/Fortran compilers + libraries for MPI, BLAS/LAPACK, FFT
- **Subtoolchain** (partial toolchain): compiler-only, only compiler + MPI, etc.
- **System toolchain**: use compilers (+ libraries) provided by the operating system
- **Common toolchains**: widely used toolchain in EasyBuild community:
  - `foss`: GCC + OpenMPI + (FlexiBLAS +) OpenBLAS + FFTW
  - `intel`: Intel compilers + Intel MPI + Intel MKL

EasyBuild terminology: modules

- Very overloaded term: kernel modules, Python modules, Perl modules ...
- In EasyBuild context: "*module*" usually refers to an **environment module file**
  - **Shell-agnostic specification of how to "activate" a software installation**
  - Expressed in Tcl or Lua syntax (scripting languages)
  - Consumed by a modules tool (**Lmod**, Environment Modules, ...)
- Other types of modules will be qualified explicitly (Python modules, etc.)
- EasyBuild automatically generates a module file for each installation

Bringing all EasyBuild terminology together

The EasyBuild **framework** leverages **easyblocks** to automatically build and install (scientific) software, potentially including additional **extensions**, using a particular compiler **toolchain**, as specified in **easyconfig files** which each define a set of **easyconfig parameters**.

EasyBuild ensures that the specified **(build) dependencies** are in place, and automatically generates a set of (environment) **modules** that facilitate access to the installed software.

An **easystack** file can be used to specify a collection of software to install with EasyBuild.

Installing EasyBuild: requirements

- **Linux** as operating system (CentOS, RHEL, Ubuntu, Debian, SLES, ...)
  - EasyBuild also works on macOS, but support is very basic

- **Python** 2.7 or 3.5+
  - Only Python standard library is required for core functionality of EasyBuild
  - Using Python 3 is highly recommended!

- An **environment modules tool** (`module` command)
  - Default is Lua-based Lmod implementation, highly recommended!
  - Tcl-based implementations are also supported

Installing EasyBuild: different options

- Installing EasyBuild using a standard Python installation tool
  - `pip install easybuild`
  - … or a variant thereof (`pip3 install --user`, using `virtualenv`, etc.)
  - May require additional commands, for example to update environment
- **Installing EasyBuild as a module, with EasyBuild *(recommended!)***
  - 3-step “bootstrap” procedure, via temporary EasyBuild installation using `pip`
- Development setup
  - Clone GitHub repositories:

    `easybuilders/easybuild-{framework,easyblocks,easyconfigs}`
  - Update `$PATH` and `$PYTHONPATH` environment variables

Installing EasyBuild as a module (recommended)

3-step bootstrap procedure

- **Step 1: Use `pip` to obtain a temporary installation of EasyBuild**

```
export TMPDIR=/tmp/$USER/easybuild

pip3 install --prefix $TMPDIR easybuild

# update environment to use this temporary EasyBuild installation

export PATH=$TMPDIR/bin:$PATH

export PYTHONPATH=$TMPDIR/lib/python3.6/site-packages:$PYTHONPATH

# instruct EasyBuild to use python3 command

export EB_PYTHON=python3
```

Installing EasyBuild as a module (recommended)

3-step bootstrap procedure

- **Step 2: Use EasyBuild to install EasyBuild (as a module) in home directory**

```
eb --install-latest-eb-release --prefix $HOME/easybuild
# and then clean up the temporary EasyBuild installation
rm -r $TMPDIR
```

- **Step 3: Load EasyBuild module to use final installation**

```
module use $HOME/easybuild/modules/all
module load EasyBuild
```

Verifying the EasyBuild installation

- Check EasyBuild version:

```
eb --version
```

- Show help output (incl. long list of supported configuration settings)

```
eb --help
```

- Show the current (default) EasyBuild configuration:

```
eb --show-config
```

- Show system information:

```
eb --show-system-info
```

Updating EasyBuild

- Updating EasyBuild (in-place) that was installed with pip:

```
pip install --upgrade easybuild
```

(+ additional options like `--user`, or using `pip3`, depending on your setup)

- Use current EasyBuild to install latest EasyBuild release as a module:

```
eb --install-latest-eb-release
```

  - This is *not* an in-place update, but a new EasyBuild installation!
  - You need to load (or swap to) the corresponding module afterwards:

```
module load EasyBuild/4.4.0
```

Configuring EasyBuild

- EasyBuild should work fine out-of-the-box if you are using Lmod as modules tool
- … but it will (ab)use `$HOME/.local/easybuild` to install software into, etc.
- It is ***strongly*** recommended to configure EasyBuild properly!
- Main questions you should ask yourself:
    - Where should EasyBuild install software (incl. module files)?
    - Where should auto-downloaded sources be stored?
    - Which filesystem is best suited for software build directories (I/O-intensive)?

Primary configuration settings

- Most important configuration settings: (strongly recommended to specify the ones in **bold**!)
  - Modules tool + syntax (`modules-tool` + `module-syntax`)
  - **Software + modules installation path** (`installpath`)*
  - **Location of software sources "cache"** (`sourcepath`)*
  - **Parent directory for software build directories** (`buildpath`)*
  - Location of easyconfig files archive (`repositorypath`)*
  - Search path for easyconfig files (`robot-paths` + `robot`)
  - Module naming scheme (`module-naming-scheme`)
- Several locations* (+ others) can be controlled at once via `prefix` configuration setting
- *Full* list of EasyBuild configuration settings (~250) is available via `eb --help`

$EASYBUILD_* environment variables

- Very convenient way to configure EasyBuild
- **There is an `$EASYBUILD_*` environment variable for each configuration setting**
    - Use all capital letters
    - Replace every dash (-) character with an underscore (_)
    - Prefix with `EASYBUILD_`
    - Example: `module-syntax` → `$EASYBUILD_MODULE_SYNTAX`
- Common approach: using a shell script or module file to (dynamically) configure EasyBuild

Command line options for `eb` command

- **Configuration settings specified as command line option always "win"**
- Use double-dash + name of configuration setting, like `--module-syntax`
- Some options have a corresponding shorthand (`eb --robot` == `eb -r`)
- In some cases, only command line option really makes sense (like `eb --version`)
- Typically used to control configuration settings for current EasyBuild session;
  for example: `eb --installpath /tmp/$USER`

Inspecting the current configuration

- It can be difficult to remember how EasyBuild was configured
- Output produced by **`eb --show-config`** is useful to remind you
- Shows configuration settings that are different from default
- Always shows a couple of key configuration settings
- Also shows on which level each configuration setting was specified
- Full current configuration: `eb --show-full-config`

Inspecting the current configuration: example

```
$ cat $HOME/.config/easybuild/config.cfg
[config]
prefix=/apps

$ export EASYBUILD_BUILDPATH=/tmp/$USER/build

$ eb --installpath=/tmp/$USER --show-config
# Current EasyBuild configuration
# (C: command line argument, D: default value,
#  E: environment variable, F: configuration file)
buildpath      (E) = /tmp/example/build
containerpath  (F) = /apps/containers
installpath    (C) = /tmp/example
packagepath    (F) = /apps/packages
prefix         (F) = /apps
repositorypath (F) = /apps/ebfiles_repo
robot-paths    (D) = /home/example/.local/easybuild/easyconfigs
sourcepath     (F) = /apps/sources
```

Basic usage of EasyBuild

- **Use `eb` command to run EasyBuild**
- Software to install is usually specified via name(s) of easyconfig file(s), or easystack file
- `--robot` (`-r`) option is required to also install missing dependencies (and toolchain)
- Typical workflow:
    - Find or create easyconfig files to install desired software
    - Inspect easyconfigs, check missing dependencies + planned installation procedure
    - Double check current EasyBuild configuration
    - Instruct EasyBuild to install software (while you enjoy a coffee... or two)

Specifying easyconfigs to use

- There a different ways to specify to the `eb` command which easyconfigs to use
    - Specific relative/absolute paths to (directory with) easyconfig files
    - Names of easyconfig files (triggers EasyBuild to search for them)
    - Easystack file to specify a whole stack of software to install (via `eb --easystack`)
- Easyconfig filenames only matter when missing dependencies need to be installed
    - “Robot” mechanism searches based on dependency specs + easyconfig filename
- `eb --search` can be used to quickly search through available easyconfig files

Inspecting easyconfigs via `eb --show-ec`

- To see the contents of an easyconfig file, you can use `eb --show-ec`
- No need to know where it is located, EasyBuild will do that for you!

```
$ eb --show-ec TensorFlow-2.4.1-foss-2020b.eb
easyblock = 'PythonBundle'

name = 'TensorFlow'
version = '2.4.1'

homepage = 'https://www.tensorflow.org/'
description = "An open-source software library for Machine Intelligence"

toolchain = {'name': 'foss', 'version': '2020b'}
toolchainopts = {'pic': True}
…
```

Checking dependencies via `eb --dry-run`

To check which dependencies are required, you can use `eb --dry-run` (or `eb -D`):

- Provides overview of all dependencies (both installed and missing)
- Including compiler toolchain and build dependencies

```
$ eb SAMtools-1.11-GCC-10.2.0.eb -D
 ...
 * [ ] $CFGS/x/XZ/XZ-5.2.5-GCCcore-10.2.0.eb (module: XZ/5.2.5-GCCcore-10.2.0)
 * [ ] $CFGS/c/cURL/cURL-7.72.0-GCCcore-10.2.0.eb (module: cURL/7.72.0-GCCcore-10.2.0)
 * [x] $CFGS/g/GCC/GCC-10.2.0.eb (module: GCC/10.2.0)
 * [x] $CFGS/n/ncurses/ncurses-6.2-GCCcore-10.2.0.eb (module: ncurses/6.2-GCCcore-10.2.0)
 * [ ] $CFGS/s/SAMtools/SAMtools-1.11-GCC-10.2.0.eb (module: SAMtools/1.11-GCC-10.2.0)
```

Checking *missing* dependencies via `eb --missing`

To check which dependencies are stil *missing*, use `eb --missing` (or `eb -M`):

- Takes into account available modules, only shows what is still missing

```
$ eb h5py-3.1.0-foss-2020b.eb -M

2 out of 61 required modules missing:

* pkg-config/0.29.2-GCCcore-10.2.0 (pkg-config-0.29.2-GCCcore-10.2.0.eb)

* h5py/3.1.0-foss-2020b (h5py-3.1.0-foss-2020b.eb)
```

Inspecting software install procedures

- EasyBuild can quickly unveil how exactly it *would* install an easyconfig file
- Via `eb --extended-dry-run` (or `eb -x`)
- Produces detailed output in a matter of seconds
- Software is not actually installed, all shell commands and file operations are skipped!
- Some guesses and assumptions are made, so it may not be 100% accurate...
- Any errors produced by the easyblock are reported as being ignored
- Very useful to evaluate changes to an easyconfig file or easyblock!

Inspecting software install procedures: example

```
$ eb Boost-1.74.0-GCC-10.2.0.eb -x
...

preparing... [DRY RUN]

[prepare_step method]
Defining build environment, based on toolchain (options) and specified dependencies...

Loading toolchain module...

module load GCC/10.2.0

Loading modules for dependencies...

module load bzip2/1.0.8-GCCcore-10.2.0
module load zlib/1.2.11-GCCcore-10.2.0
module load XZ/5.2.5-GCCcore-10.2.0
```

Inspecting software install procedures: example

```
$ eb Boost-1.74.0-GCC-10.2.0.eb -x
...
Defining build environment...
  ...
  export CXX='mpicxx'
  export CXXFLAGS='-O2 -ftree-vectorize -march=native -fno-math-errno -fPIC'
  ...

configuring... [DRY RUN]

[configure_step method]
  running command "./bootstrap.sh --with-toolset=gcc
  --prefix=/tmp/example/Boost/1.74.0/GCC-10.2.0/obj --without-libraries=python,mpi"
  (in /tmp/example/build/Boost/1.74.0/GCC-10.2.0/Boost-1.74.0)
```

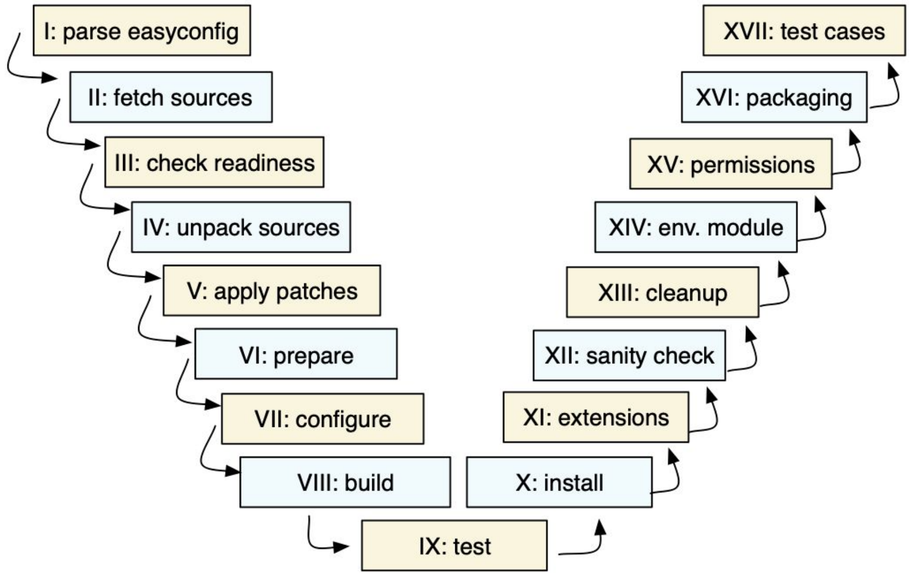
Inspecting software install procedures: example

```
$ eb Boost-1.74.0-GCC-10.2.0.eb -x
...

[sanity_check_step method]
Sanity check paths - file ['files']
  * lib/libboost_system.so
  * lib/libboost_thread-mt-x64.so
Sanity check paths - (non-empty) directory ['dirs']
  * include/boost
Sanity check commands
  (none)

...
```

Installing software with EasyBuild

- To install software with EasyBuild, just run the `eb` command:
  - `eb SAMtools-1.11-GCC-10.2.0.eb`
- If any dependencies are still missing, you will need to also use `--robot`:
  - `eb BCFtools-1.11-GCC-10.2.0.eb --robot`
- To see more details while the installation is running, enable trace mode:
  - `eb BCFtools-1.11-GCC-10.2.0.eb --robot --trace`
- To reinstall software, use `eb --rebuild` (or `eb --force`)

Step-wise installation procedure



- EasyBuild framework defines step-wise installation procedure, leaves some unimplemented
- Easyblock completes the implementation, override or extends installation steps where needed

Troubleshooting failing installations

- Sometimes stuff still goes wrong…
- Being able to troubleshoot a failing installation is a useful/necessary skill
- Problems that occur include (but are not limited to):
  - Missing source files
  - Missing dependencies (perhaps overlooked required dependencies)
  - Failing shell commands (non-zero exit status)
  - Running out of memory or storage space
  - Compiler errors (or crashes)
- EasyBuild keeps a thorough log for each installation which is very helpful

Troubleshooting: error messages

- When EasyBuild detects that something went wrong, it produces an error
- Very often due to a shell command that produced a non-zero exit code...
- Sometimes the problem is clear directly from the error message:

```
== building...
== FAILED: Installation ended unsuccessfully (build directory:
/tmp/example/example/1.0/GCC-10.2.0):
build failed (first 300 chars): cmd "make" exited with exit code 2 and output:
/usr/bin/g++ -O2 -ftree-vectorize -march=native -std=c++14 -c -o core.o core.cpp
g++: error: unrecognized command line option '-std=c++14' (took 1 sec)
```

- In some cases, the error message itself does not reveal the problem...

Troubleshooting: log files

- EasyBuild keeps track of the installation in a detailed log file
- During the installation, it is stored in a temporary directory:

```
$ eb example.eb
== Temporary log file in case of crash /tmp/eb-r503td0j/easybuild-17flov9v.log
...
```

- Includes executed shell commands and output, build environment, etc.
- More detailed log file when debug mode is enabled (`debug` configuration setting)
- There is a log file per EasyBuild session, and one per performed installation
- **When an installation completes successfully,**
  the log file is copied to a subdirectory of the software installation directory

Troubleshooting: navigating log files

- **EasyBuild log files are well structured, and fairly easy to search through**
- Example log message, showing prefix ("== "), timestamp, source location, log level:

```
== 2021-06-25 13:11:19,968 run.py:222 INFO running cmd:  make -j 9
```

- Different steps of installation procedure are clearly marked:

```
== 2021-06-25 13:11:48,817 example INFO Starting sanity check step
```

- To find actual problem for a failing shell command, look for patterns like:
    - ERROR
    - Error 1
    - error:
    - failure
    - not found
    - No such file or directory
    - Segmentation fault

Troubleshooting: inspecting the build directory

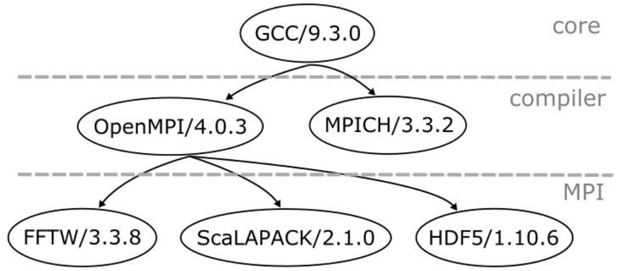
- EasyBuild leaves the build directory in place when the installation failed

```
== FAILED: Installation ended unsuccessfully (build directory:
/tmp/build/example/1.0/GCC-10.2.0): build failed ...
```

- Can be useful to inspect the contents of the build directory for debugging
- For example:
  - Check `config.log` when `configure` command failed
  - Check `CMakeFiles/CMakeError.log` when `cmake` command failed (good luck...)

Flat vs hierarchical module naming schemes

- Handful of supported module naming schemes (MNS), `EasyBuildMNS` is the default
- Flat module naming scheme (like `EasyBuildMNS`)
  - Clear mapping of easyconfig filename to name of generated module file
  - All modules immediately available for loading
- Hierarchical scheme typically has 3 levels
  - **core** level for things like compilers
  - **compiler** level
  - **MPI** level
  - Use "gateway modules" to access different levels



Adding support for additional software

- Every installation performed by EasyBuild requires an easyconfig file
- Easyconfig files can be:
  - Included with EasyBuild itself (or obtained elsewhere)
  - Derived from an existing easyconfig (manually or automatic)
  - Created from scratch
- Most easyconfigs leverage a generic easyblock
- Sometimes using a custom software-specific easyblock makes sense...

Easyblocks vs easyconfigs

- When can you get away with using an easyconfig leveraging a generic easyblock?
- When is a software-specific easyblock really required?
- Easyblocks are “implement once and forget”
- Easyconfig files leveraging a generic easyblock can become too involved (subjective)
- Reasons to consider implementing a custom easyblock:
    - 'critical' values for easyconfig parameters required to make installation succeed
    - interactive commands that need to be run
    - custom (configure) options related to toolchain or included dependencies
    - having to create or adjust specific (configuration) files
    - 'hackish' usage of a generic easyblock
    - complex or very non-standard installation procedure

Writing easyconfig files

- Collection of easyconfig parameter definitions (Python syntax), collectively specify what to install
- Some easyconfig parameters are mandatory, and **must** always be defined: `name`, `version`, `homepage`, `description`, `toolchain`
- Commonly used easyconfig parameters (but strictly speaking not required):
  - `easyblock` (by default derived from software name)
  - `source_urls`, `sources`, `patches`, `checksums`
  - `dependencies`, `builddependencies`
  - `preconfigopts`, `configopts`, `prebuildopts`, `buildopts`, `preinstallopts`, `installopts`
  - `sanity_check_paths`, `sanity_check_commands`

Generating tweaked easyconfig files

- Trivial changes to existing easyconfig files can be done automatically
- Bumping software version: `eb example-1.0.eb --try-software-version 1.1`
- Changing toolchain (version): `eb example.eb --try-toolchain GCC,9.4.0`
- Changing specific easyconfig parameters (limited): `eb --try-amend ...`
- Note the “try” aspect: additional changes may be required to make installation work

Copying easyconfig files

- Small but useful feature: copy specified easyconfig file via `eb --copy-ec`
- Avoids the need to locate the file first via `eb --search`
- Typically used to create a new easyconfig using existing one as starting point
- Example:

```
$ eb --copy-ec SAMtools-1.11-GCC-10.2.0.eb SAMtools.eb
...
SAMtools-1.10-GCC-10.2.0.eb copied to SAMtools.eb
```

EasyBuild at Jülich Supercomputing Centre

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- Currently 3 primary systems:
  - JUWELS - 73 Petaflops, #7 in Top500
  - JURECA-DC - 3.54 (CPU) + 14.98 (GPU) + 5 (KNL) Petaflops
  - JUSUF - AMD, V100 GPU. Interactive workflows and community services

EasyBuild at JSC

- Used for production software stack at JSC since 2014

https://easybuilders.github.io/easybuild-tutorial/2021-isc21/jsc

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- Geared towards average user experience
  - Hide lots of indirect software
  - Lots of toolchains => Module hierarchy
  - Renaming some modules, Lmod tweaks

EasyBuild at JSC

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- Geared towards average user experience
  - Hide lots of indirect software
  - Lots of toolchains => Module hierarchy
  - Renaming some modules, Lmod tweaks
- Custom MNS, toolchains, easyconfigs, easyblocks
  - Maintenance and contribution issue
  - Working hard to minimise this

Upgrading and retiring software

- Provide latest software to new projects by default
  - ***Stages*** concept
  - Updates once per year
  - Encourages users to adopt latest software & dependencies (performance, bug fixes,...)

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  - ***Stages*** concept
  - Updates once per year
  - Encourages users to adopt latest software & dependencies (performance, bug fixes,...)
- Give indirect access to "retired" software

Leveraging hooks for users & maintainers

- Very powerful alternative to customisations
  - Much more automated and flexible
  - Easier to maintain (particularly for easyconfigs)

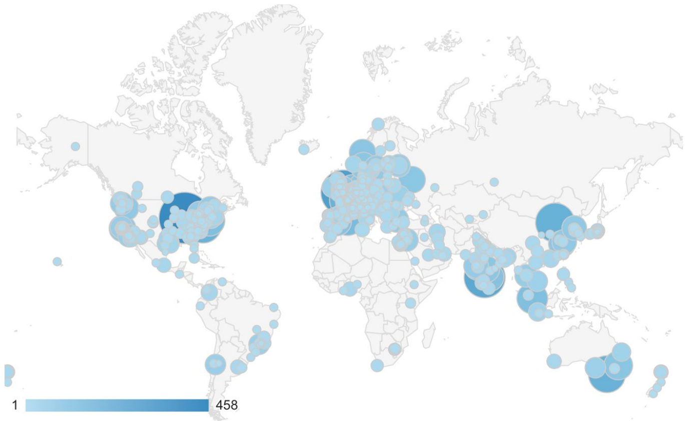
Leveraging hooks for users & maintainers

- Very powerful alternative to customisations
  - Much more automated and flexible
  - Easier to maintain (particularly for easyconfigs)
- Hooks to enable user space installations
  - Guide people on how to do this “properly”
  - Installation hierarchy: system $\longrightarrow$ group $\longrightarrow$ user

EasyBuild on DEEP

- `module load EasyBuild` loads EasyBuild
- `module load Developers` is loading the module with the configuration used for EasyBuild (only swmanage can write into global software dircotry)
- `module load UserInstallations` is loading the configuration to install easyconfigs ir user space

The EasyBuild community



- Documentation read all over the world
- HPC sites, consortia, and companies
- Slack: >450 members, ~100 active members per week, 226K messages
- Regular online conf calls...and we even meet in person sometimes!

https://easybuilders.github.io/easybuild-tutorial/2021-isc21/community

Contributing to EasyBuild

There are several ways to contribute to EasyBuild, including:

- providing feedback
- reporting bugs
- joining the discussions (mailing list, Slack, conf calls)
- sharing suggestions/ideas for enhancements & additional features
- contributing easyconfigs, enhancing easyblocks,

  adding support for new software, implementing additional features, ...
- extending & enhancing documentation

GitHub integration features

- EasyBuild has strong integration with GitHub, which facilitates contributions
- Some additional Python packages required for this: GitPython, keyring
- Also required some additional configuration, incl. providing a GitHub token
- **Enables creating, updating, reviewing pull requests using `eb` command!**
- Makes testing contributions very easy (~2,000 easyconfig pull requests per year!)
- Extensively documented:
  https://docs.easybuild.io/en/latest/Integration_with_GitHub.html

Opening a pull request in 1, ~~2~~, ~~3~~

```
$ mv sklearn.eb scikit-learn-0.19.1-intel-2017b-Python-3.6.3.eb
$ mv scikit-learn*.eb easybuild/easyconfigs/s/scikit-learn
$ git checkout develop && git pull upstream develop
$ git checkout -b scikit_learn_0191_intel_2017b
$ git add easybuild/easyconfigs/s/scikit-learn
$ git commit -m "{data}[intel/2017b] scikit-learn v0.19.1"
$ git push origin scikit_learn_0191_intel_2017b
```

+ log into GitHub to actually open the pull request (clickety, clickety...)

one single `eb` command

no git commands

no GitHub interaction

metadata is automatically derived from easyconfig

saves a lot of time!

`eb --new-pr sklearn.eb`

https://easybuilders.github.io/easybuild-tutorial/2021-isc21/contributing

Topics we didn't cover...

- Implementing easyblocks
- Using RPATH linking
- Using EasyBuild as a library
- Implementing hooks to customize EasyBuild
- Submitting installations as jobs on a cluster
- Integration with the Cray Programming Environment
- Building Docker/Singularity container images with EasyBuild (experimental)

https://docs.easybuild.io - https://easybuild.io/tutorial

Questions?

- Website: https://easybuild.io
- Documentation: https://docs.easybuild.io
- Tutorials: https://easybuild.io/tutorial
- Yearly EasyBuild User Meeting: https://easybuild.io/eum
- Getting help:
  - Mailing list: https://lists.ugent.be/wws/subscribe/easybuild
  - Slack: https://easybuild.slack.com - https://easybuild.io/join-slack
  - Bi-weekly conference calls: https://github.com/easybuilders/easybuild/wiki/Conference-calls