Fortran package manager

Toward a rich ecosystem of Fortran packages

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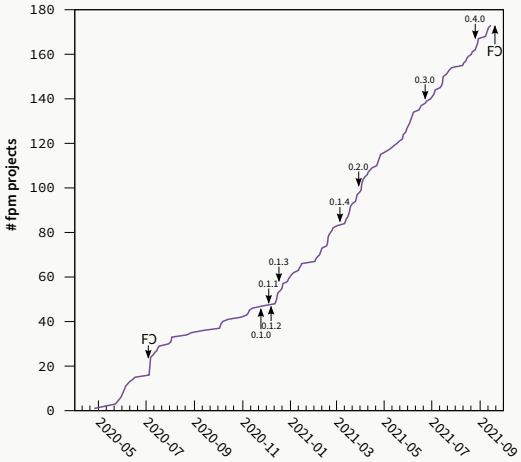
Outline

Motivation

- building and distributing Fortran software is difficult
  - manual makefiles are seldom cross platform compatible
  - autoconf is not working on native Windows
  - learning curve for CMake is incredibly steep
  - meson does not install module files automatically
- writing of build files and adjustment for Fortran is time-intensive
- difficult and tedious to reuse Fortran source code
- system-wide installation dangerous for multiple Fortran compilers (no ABI compatibility)
- impossible to depend on a project without redistributing it

- create a Fortran-specific build system and package manager to fix this
- make it easy to create reusable Fortran libraries
- Fortran package manager (fpm)

Adoption of fpm



Data collected from GitHub and GitLab on 15th Sep, 2021

- today 173 open source projects are using fpm
- ca. 160 unique developers have contributed to those projects
- 53 contributors at the fpm project
- code contributions from 19 developers to fpm
- hosted on GitHub (MIT licensed): https://github.com/fortran-lang/fpm

Language choice for implementing a package manager

- fast without much overhead
- self-contained and simple to setup
- easily accessible for users/contributors

- use compiled language
- small runtime library or static binaries
- mostly Fortran developers

- Fortran is the most well-known language in our community
- compilers can easily produce static binaries for distribution
- we can identify short-comings in Fortran while implementing fpm
- direct feedback for useful features in stdlib

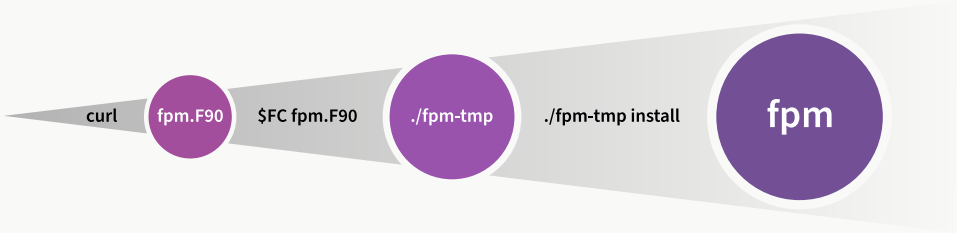
Building blocks for Fortran implementation

1. command-line interface builder
2. TOML parser library
3. Fortran source scanning
4. multiprocessing and scheduling

- M_CLI2 package
- toml-f package
- implemented in fpm
- OpenMP directives

Bootstrapping fpm

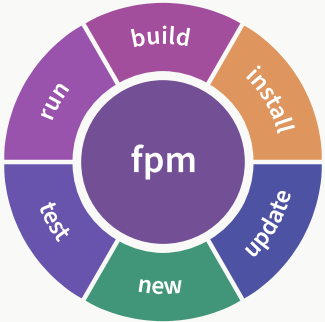
- fpm is built with itself
- single-file version used for creating initial fpm bootstrap binary
- minimal dependencies, requires only a Fortran compiler to build
- bootstrap binary is used to build fpm: Fortran, C compiler and git are required



Command-line features

- handles (sub)module interdependencies
- automatically finds executables and tests

- runs executables and examples
- wildcard globbing for selection



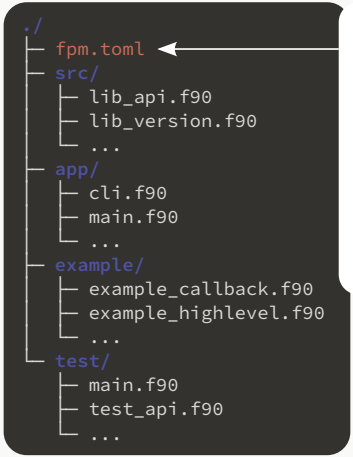
- automatically installs project
- user prefix used by default

- finds and runs test executables
- allows running tests in debugger

- updates all dependencies
- basic caching and locking

- creates new projects with fpm layout
- backfilling to update existing projects

Layout of an fpm project




```toml
# Package manifest
name = "lib"

[library]
source-dir = "src"

[[executable]]
name = "runner"

[build]
link = "nlopt"
```

- package manifest in TOML
- limited complexity of build file
- mainly meta data of project (license, author, keywords, …)
- default layout requires only name (src, app, example, and test)
- source-dir for customizing layout
- executable names from program unit
- system libraries can be linked

First-class dependencies

- dependencies are currently specified by referencing another project (*e. g.* via git URL)

```
name = "lib"

[dependencies]
toml-f.git = "https://github.com/toml-f/toml-f"
stdlib = {git="https://github.com/fortran-lang/stdlib", branch="stdlib-fpm"}

[dev-dependencies]
test-drive.git = "https://github.com/fortran-lang/test-drive"

[[executable]]
name = "runner"
[executable.dependencies]
M_CLI2.git = "https://github.com/urbanjost/M_CLI2"
```

- different scopes available beside full dependencies
- can depend on projects only for testing or limit dependencies to single executable

Extending fpm with plugins

- package manifest provides space for third-party projects
- fpm is available as fpm package and can be used as dependency
- plugins are used automatically from the command-line
- useful for staging new features before integration in fpm

Searching for fpm packages: fpm-search

- available from *fpm search* command
- downloads the fpm registry
- search package names, descriptions

Documentation of intrinsics: fpm-man

- available from *fpm man* command
- access to documentation of intrinsics
- cross-platform, no man required

Near-future roadmap

- compiler profile support
- custom preprocessor step (especially for fypp projects, *i. e.* stdlib)
- support for a package registry in fpm
- optional dependencies
- build script support for complex packages

Get fpm now

```
❯ conda create -n fpm fpm
❯ conda activate fpm
```


```
❯ pacman -S mingw-w64-x86_64-fpm
```

```
❯ spack install fpm +openmp
❯ spack load fpm +openmp
```

```
❯ brew tap awvwgk/fpm
❯ brew install fpm
```

```
❯ git clone https://github.com/fortran-lang/fpm
❯ cd fpm && ./install.sh
```