What’s new in the Fortran standard library?

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What is ~~new in~~ stdlib?

- Part of fortran-lang: https://github.com/fortran-lang/stdlib
- Make Fortran easier to use and more powerful
- Scope: both general purpose (C++/Python) & numerical (Matlab/SciPy)

Utilities	strings, logging, filesystem interaction
Algorithms	searching, sorting
Mathematics	linear algebra, special functions, statistics

- Prototype future intrinsics & provide reference implementation

stdlib has roughly doubled in size in the past year

Modules one year ago vs today		
ascii	bitsets	error
io	kinds	linalg
logger	math	optval
quadrature	sorting	specialfunctions
stats	stats_distribution_PRNG	stringlist_type
strings	string_type	system

18 modules, 7 derived types, 119 procedures

Demo: stdlib_logger

ex_logger.f90

```
use stdlib_logger, only: global_logger
implicit none
call global_logger%add_log_file('log.txt')
call global_logger%log_debug('I am invisible')
call global_logger%log_information('Something informative')
call global_logger%log_error('Oopsie daisy')
end
```

log.txt

```
2021-09-13 23:31:30.346: INFO: Something informative
2021-09-13 23:31:30.346: ERROR: Oopsie daisy
```

Demo: stdlib_bitsets

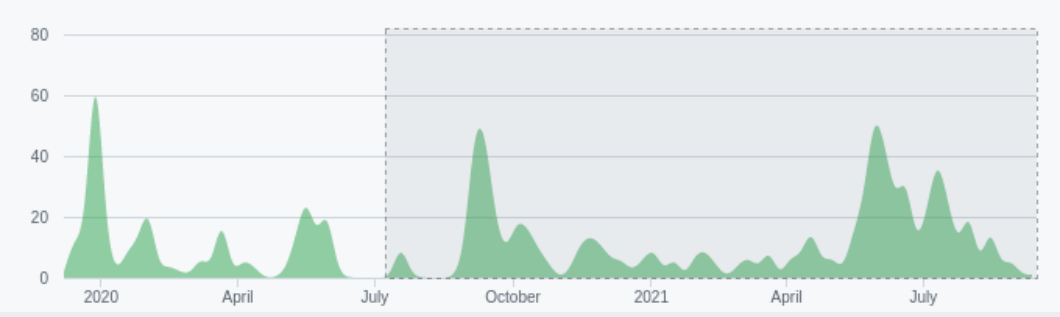
ex_bitsets.f90

```
use stdlib_bitsets
implicit none

integer :: i; type(bitset_64) :: b1, b2

call b1%from_string('001100') ! S6B001110
b2 = [(.true., i=1,6)]        ! S6B111111

call xor(b1, b2)              ! S6B110001, S6B111111

call b1%set(2, 4)             ! S6B111111 -- N.B. 0-based index
print *, b1 == b2             ! T
end
```

New contributors have been key to stdlib’s growth

- From 16 committors to 34, including our 2 GSoC students
- Over 100 new Issues: bugs, workflow improvements, feature proposals
- From 52 to 97 contributors (commits, discussion, reviews)

Commits to stdlib since FortranCon 2020



stdlib is now easier to install

- Dependencies
  - Fortran compiler (supporting at least F2008)
  - CMake (or just make)
  - fypp preprocessor (python script)
- Install each separately or use conda package manager
- Exports both CMake package files & pkg-config files
- New support for fpm-based workflow

It is now trivial for fpm packages to depend on stdlib

fpm.toml

```
...
[dependencies]
stdlib.git = "https://github.com/fortran-lang/stdlib"
stdlib.branch = "stdlib-fpm"
...
```

It just works!

Cross-platform support monitored with GitHub’s CI workflow

Platforms tested on every pull request			
GNU	9,10,11	Ubuntu 20.04	x86_64
GNU	9,10,11	macOS 10.15	x86_64
GNU (MSYS)	10	Windows Server 2019	x86_64
GNU (MinGW)	10	Windows Server 2019	x86_64, i686
Intel classic	2021.1	Ubuntu 20.04	x86_64
Intel classic	2021.1	macOS 10.15	x86_64

- If your compiler supports F2008/F2018, stdlib should compile
- Some require minor workarounds (NAG, some older GNU versions)

Room for improvement

- Fill out numerical capabilities
  - “Simple” functions are often not so simple (e.g., *cbrt*)
  - Difficult to find reviewers with domain knowledge (see: Probability Distributions)
  - What to put in stdlib versus create fpm package?
- Improve consistency of documentation
  - Lots of variability in style & level of detail
  - To be addressed with standardized tempates

Outlook: Next 12 months

- Probability distributions: Uniform, normal, exponential, gamma, and beta (Fisher)
- Generic linked list (Karwa)
- Generic map type (Ehlert)
- Hash functions (Clodius, Ehlert)
- Improved OS and file system facilities (Diehl, Markus)
- Selection algorithms
- Portability across platforms
- All new intrinsics planned for Fortran 202X
- Improved stdlib test suite (Ehlert)

Summary

- stdlib aims to be a de facto standard library of general-purpose and numerical facilities for Fortran
- Roughly doubled in size in the past year, both in terms of modules and contributors
- New modules include bitsets, logging, math utilities, sorting, special functions, RNG, and string handling
- Infrastructure and packaging improvments have made stdlib easier to install and use