Next Generation Computing with D

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Revision	Authors	Remarks
v0.1 Jul 28, 2018	Koo Li	Initial Version for HelloLLVM Offline Meeting in Hangzhou on Jul 28, 2018

Agenda

I. Why D

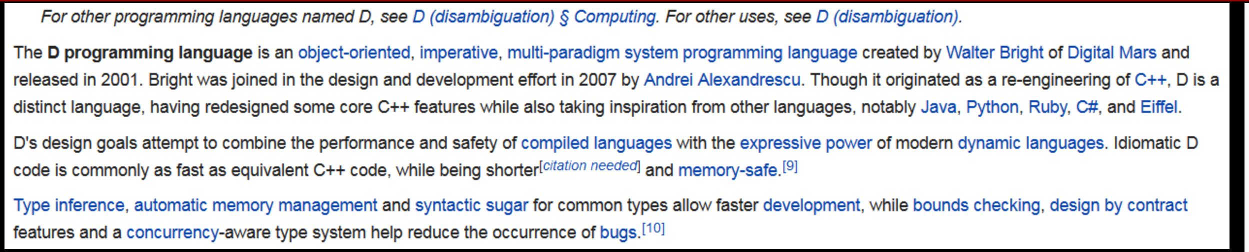
- Overview
- Compilation
- A potential candidate of system language
- A good fit for ARM
- Pros & Cons
- weka.io
- vibe.d
- HPC
- LDC
- D & Python
- D in China

II. Wrap-Up

I. Why

1) Overview

- https://en.wikipedia.org/wiki/D_(programming_language)

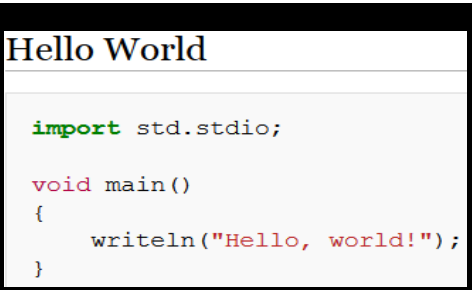


For other programming languages named D, see D (disambiguation) § Computing. For other uses, see D (disambiguation).

The **D programming language** is an object-oriented, imperative, multi-paradigm system programming language created by Walter Bright of Digital Mars and released in 2001. Bright was joined in the design and development effort in 2007 by Andrei Alexandrescu. Though it originated as a re-engineering of C++, D is a distinct language, having redesigned some core C++ features while also taking inspiration from other languages, notably Java, Python, Ruby, C#, and Eiffel.

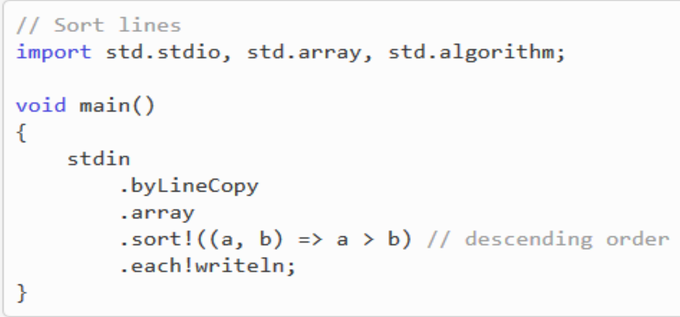
D's design goals attempt to combine the performance and safety of compiled languages with the expressive power of modern dynamic languages. Idiomatic D code is commonly as fast as equivalent C++ code, while being shorter[citation needed] and memory-safe.[9]

Type inference, automatic memory management and syntactic sugar for common types allow faster development, while bounds checking, design by contract features and a concurrency-aware type system help reduce the occurrence of bugs.[10]

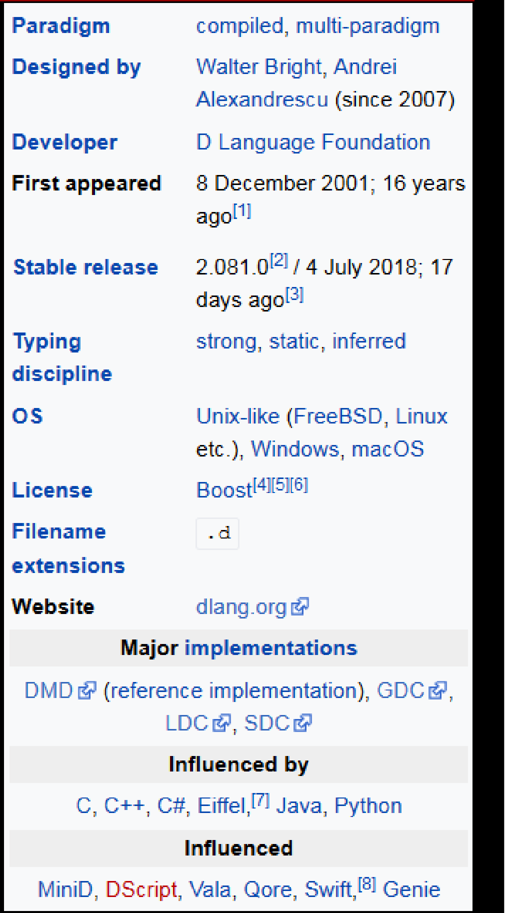


Hello World

```
import std.stdio;

void main()
{
    writeln("Hello, world!");
}
```



```
// Sort lines
import std.stdio, std.array, std.algorithm;

void main()
{
    stdin
        .byLineCopy
        .array
        .sort!((a, b) => a > b) // descending order
        .each!writeln;
}
```



Paradigm	compiled, multi-paradigm
Designed by	Walter Bright, Andrei Alexandrescu (since 2007)
Developer	D Language Foundation
First appeared	8 December 2001; 16 years ago[1]
Stable release	2.081.0[2] / 4 July 2018; 17 days ago[3]
Typing discipline	strong, static, inferred
OS	Unix-like (FreeBSD, Linux etc.), Windows, macOS
License	Boost[4][5][6]
Filename extensions	.d
Website	dlang.org

Major implementations

DMD (reference implementation), GDC, LDC, SDC

Influenced by

C, C++, C#, Eiffel,[7] Java, Python

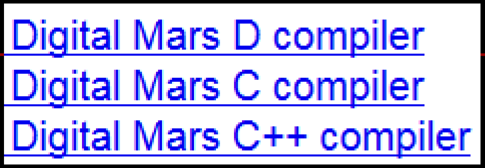
Influenced

MiniD, DScript, Vala, Qore, Swift,[8] Genie

- https://dlang.org/index.html

Designed by Experts

- https://en.wikipedia.org/wiki/Walter_Bright
  http://digitalmars.com/



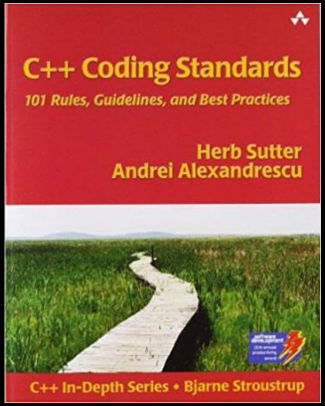
Digital Mars D compiler
Digital Mars C compiler
Digital Mars C++ compiler

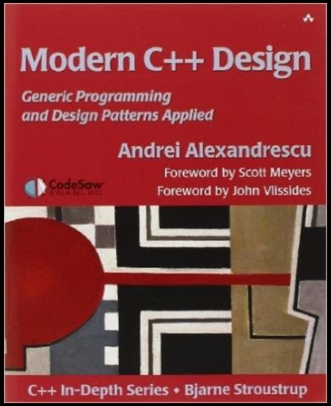
D

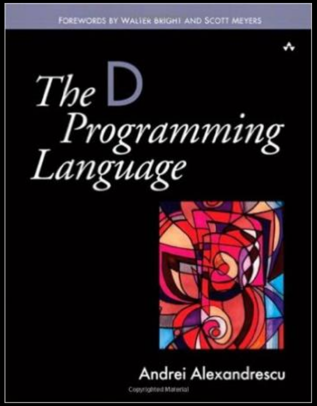
Programming Language

Specification

- https://en.wikipedia.org/wiki/Andrei_Alexandrescu
  http://erdani.org/

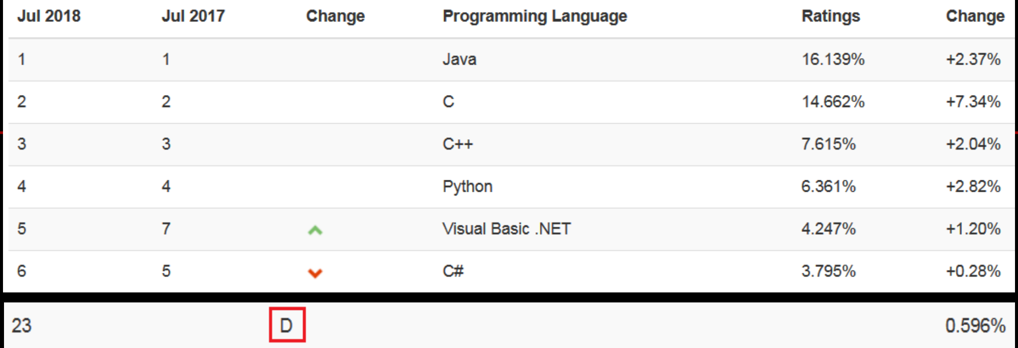

C++ Coding Standards
101 Rules, Guidelines, and Best Practices
Herb Sutter
Andrei Alexandrescu
C++ In-Depth Series • Bjarne Stroustrup


Modern C++ Design
Generic Programming and Design Patterns Applied
Andrei Alexandrescu
Foreword by Scott Meyers
Foreword by John Vlissides
CodeSaw
C++ In-Depth Series • Bjarne Stroustrup


FOREWORDS BY WALTER BRIGHT AND SCOTT MEYERS
The D Programming Language
Andrei Alexandrescu

Ranking

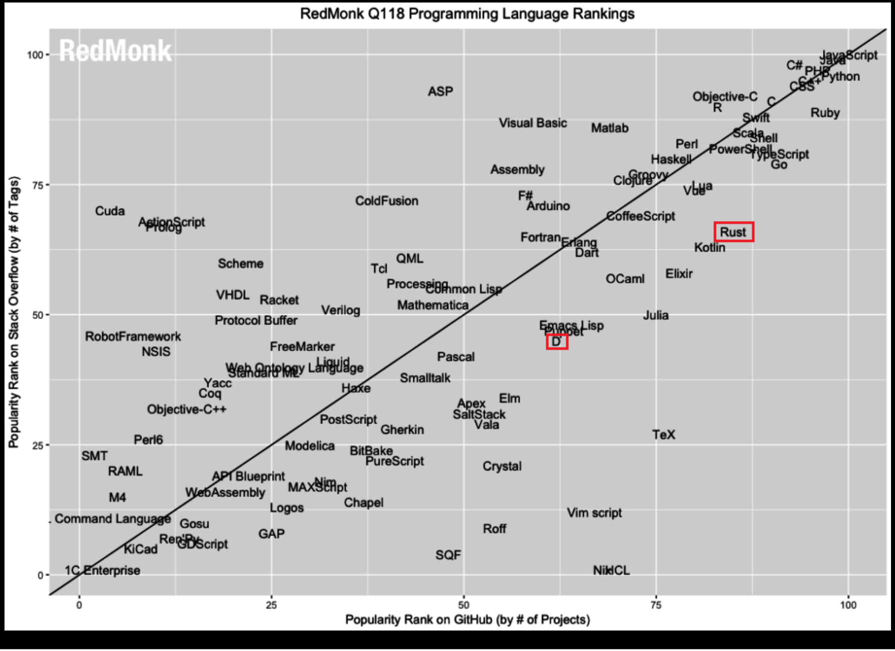
- https://www.tiobe.com/tiobe-index/



Jul 2018	Jul 2017	Change	Programming Language	Ratings	Change
1	1		Java	16.139%	+2.37%
2	2		C	14.662%	+7.34%
3	3		C++	7.615%	+2.04%
4	4		Python	6.361%	+2.82%
5	7	▲	Visual Basic .NET	4.247%	+1.20%
6	5	▼	C#	3.795%	+0.28%

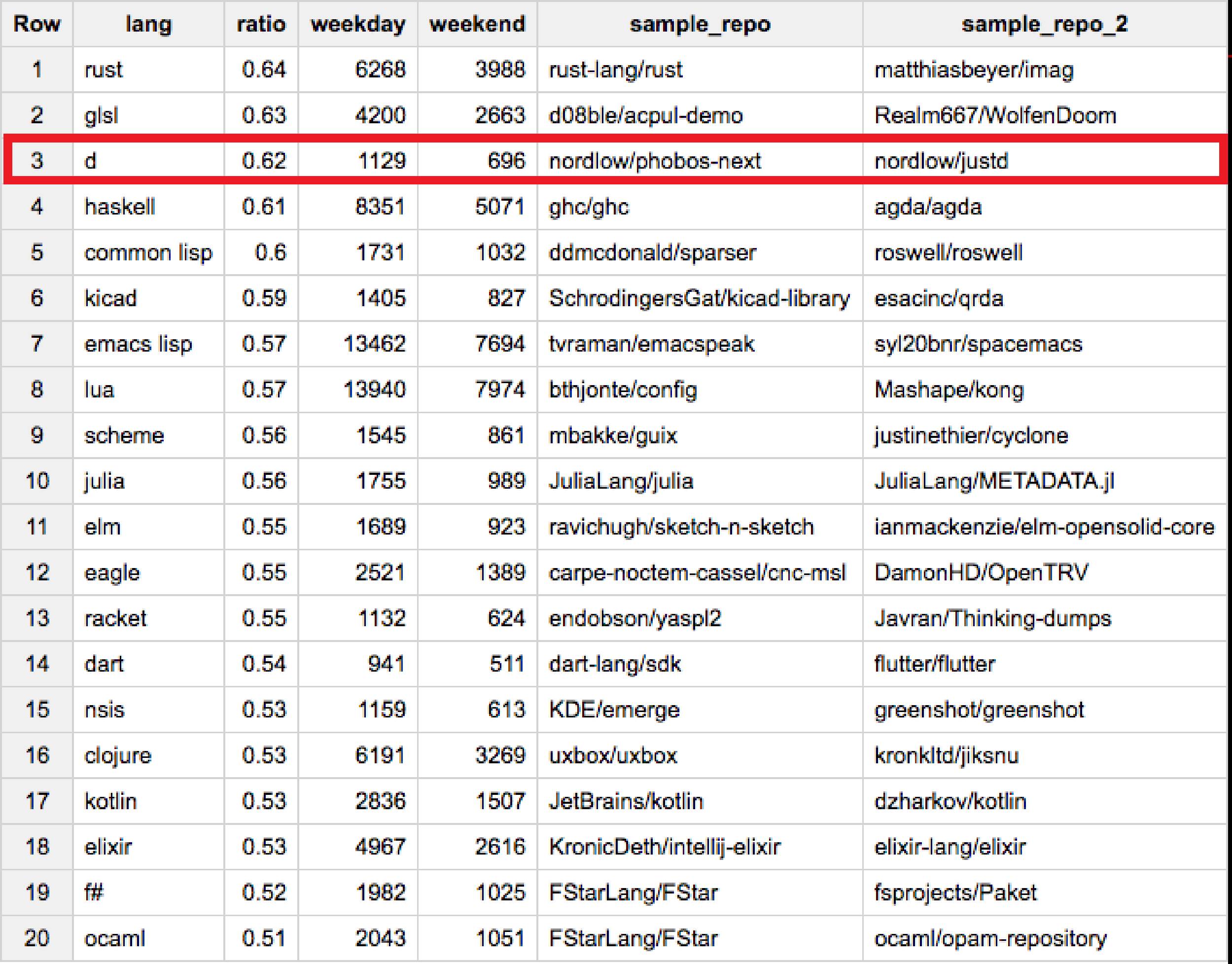
23	D	0.596%

- http://redmonk.com/



- https://medium.com/@hoffa/the-top-weekend-languages-according-to-githubs-code-6022ea2e33e8

The top weekend languages 2016:



Row	lang	ratio	weekday	weekend	sample_repo	sample_repo_2
1	rust	0.64	6268	3988	rust-lang/rust	matthiasbeyer/imag
2	glsl	0.63	4200	2663	d08ble/acpul-demo	Realm667/WolfenDoom
3	d	0.62	1129	696	nordlow/phobos-next	nordlow/justd
4	haskell	0.61	8351	5071	ghc/ghc	agda/agda
5	common lisp	0.6	1731	1032	ddmcdonald/sparser	roswell/roswell
6	kicad	0.59	1405	827	SchrodingersGat/kicad-library	esacinc/qrda
7	emacs lisp	0.57	13462	7694	tvraman/emacspeak	syl20bnr/spacemacs
8	lua	0.57	13940	7974	bthjonte/config	Mashape/kong
9	scheme	0.56	1545	861	mbakke/guix	justinethier/cyclone
10	julia	0.56	1755	989	JuliaLang/julia	JuliaLang/METADATA.jl
11	elm	0.55	1689	923	ravichugh/sketch-n-sketch	ianmackenzie/elm-opensolid-core
12	eagle	0.55	2521	1389	carpe-noctem-cassel/cnc-msl	DamonHD/OpenTRV
13	racket	0.55	1132	624	endobson/yaspl2	Javran/Thinking-dumps
14	dart	0.54	941	511	dart-lang/sdk	flutter/flutter
15	nsis	0.53	1159	613	KDE/emerge	greenshot/greenshot
16	clojure	0.53	6191	3269	uxbox/uxbox	kronkltd/jiksnu
17	kotlin	0.53	2836	1507	JetBrains/kotlin	dzharkov/kotlin
18	elixir	0.53	4967	2616	KronicDeth/intellij-elixir	elixir-lang/elixir
19	f#	0.52	1982	1025	FStarLang/FStar	fsprojects/Paket
20	ocaml	0.51	2043	1051	FStarLang/FStar	ocaml/opam-repository

Growing Ecosystem of

- https://dlang.org/orgs-using-d.html

AdRoll
طقس العرب
ArabiaWeather
AREX
ebay
ecratum
Emsi
funkwerk
GNEX
JUMIA FOOD
MAGIKCRAFT
NETFLIX
REMEDY
SARC
MARITIME SOFTWARE AND SERVICES
sociomantic
from dunnhumby
Symmetry
INVESTMENTS
That NEEDLE™
WEKA.IO

- http://wiki.dlang.org/Libraries_and_Frameworks
- https://wiki.dlang.org/IDEs
- http://code.dlang.org/
- https://wiki.dlang.org/Open_Source_Projects
- https://github.com/trending/d
- http://dconf.org

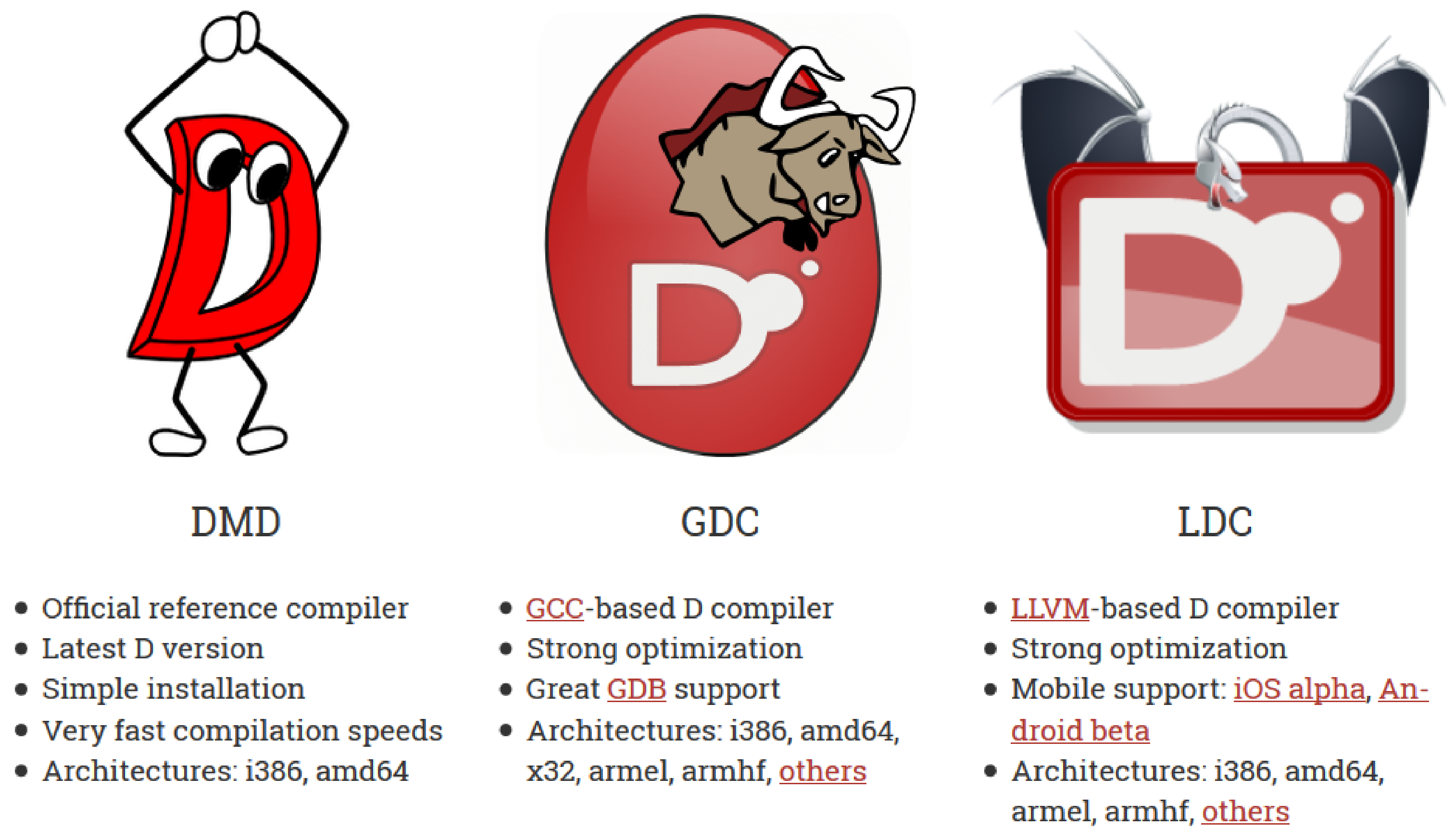
Official Github

- https://github.com/dlang

dmd	D compiler
phobos	The standard library of D
druntime	Low level runtime library for D
dub	Package and build management system for D
…	

2) Compilation

- https://wiki.dlang.org/Compilers
- https://wiki.dlang.org/DMD
- https://wiki.dlang.org/GDC
- https://wiki.dlang.org/LDC



DMD

- Official reference compiler
- Latest D version
- Simple installation
- Very fast compilation speeds
- Architectures: i386, amd64

GDC

- GCC-based D compiler
- Strong optimization
- Great GDB support
- Architectures: i386, amd64, x32, armel, armhf, others

LDC

- LLVM-based D compiler
- Strong optimization
- Mobile support: iOS alpha, Android beta
- Architectures: i386, amd64, armel, armhf, others

Trend

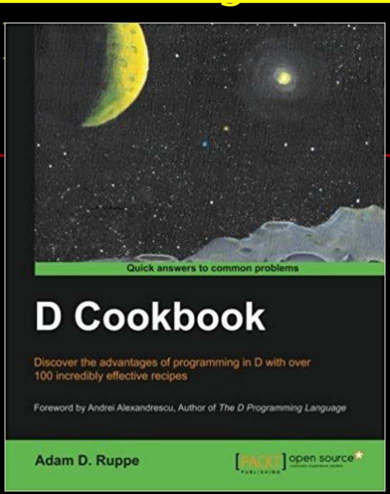
- https://gcc.gnu.org/ml/gcc-patches/2017-10/msg00030.html
  D Language Front-End Proposed For GCC 8,
  ~800k Lines of Code
  Waiting for GCC 9…

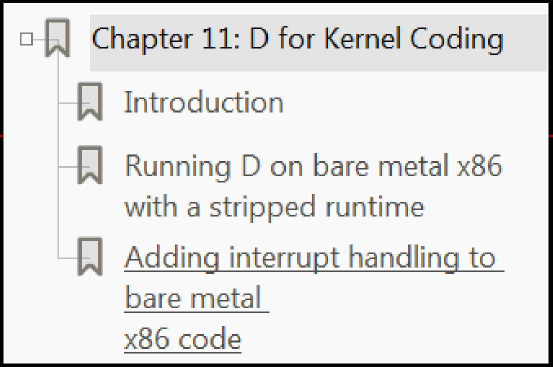
- D front-end in Clang?

- https://wiki.dlang.org/Vision/2018H1
  https://wiki.dlang.org/DIPs
  …

3) A potential candidate of system language

Bare Metal Programming

- 
Quick answers to common problems
D Cookbook
Discover the advantages of programming in D with over 100 incredibly effective recipes
Foreword by Andrei Alexandrescu, Author of The D Programming Language
Adam D. Ruppe
[PACKT] open source



- Chapter 11: D for Kernel Coding
  - Introduction
  - Running D on bare metal x86 with a stripped runtime
  - Adding interrupt handling to bare metal x86 code

- **https://gitlab.com/sarneaud/xanthe**
- **https://theartofmachinery.com/2017/02/28/bare_metal_d.html**
- **https://forum.dlang.org/post/ygbvnurvwezjtareevyo@forum.dlang.org //GitBook about D on embedded ARM Linux**
- **https://forum.dlang.org/post/ooydfdsteqrbtxmxzupj@forum.dlang.org //Embedded Linux really needs Dlang for the IOT market**
- **https://wiki.dlang.org/Programming_in_D_tutorial_on_Embedded_Linux_ARM_devices**
- **D on bare metal ARM**

4) A good fit for ARM

- https://wiki.dlang.org/Compilers

GDC

- complete support armel, armhf
- partial or bare-metal only support aarch64

LDC

- complete support armel, armhf
- near-complete support aarch64

Ongoing development

- Latest LLVM support
- LLD integration
- JIT-compiled functions
- …

D for Android

- https://github.com/joakim-noah/android/releases (in LDC now)

5) Pros & Cons

Pros

Features

- https://dlang.org/comparison.html
- https://digitalmars.com/d/2.0/comparison.html

Development Mode	community-driven
Productivity	a combination of C++/C/Java/Scala/Python…, auto/manually memory management
Binary-compatible with C	
System Language	pointer, inline assembler…
Interop	easily interface with legacy code in C/C++/Lua…
Programming Paradigms	including but not limited to imperative, object-oriented, metaprogramming, functional and concurrent
Built-in Unit Test	

All module scope variables are thread-local by default

…

Cons

- Lack of popular frameworks/libraries
- Not as mature as commercial products, e.g. Memory Management
- Further optimization of runtime
- Weak ecosystem when comparing with that of Java, C++, Go…
- …
- Still has a long way to go

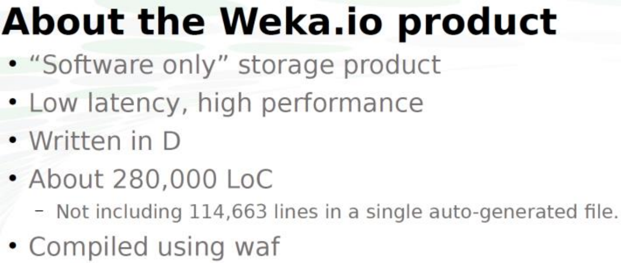
6) weka.io

- https://www.weka.io
- https://www.weka.io/why-weka/

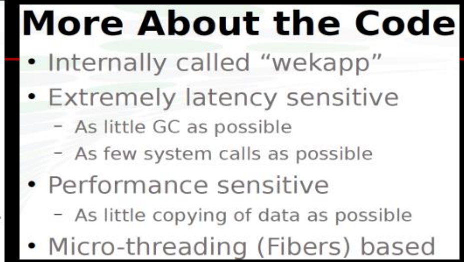
WEKA.IO

WORLD'S FASTEST PARALLEL FILE SYSTEM

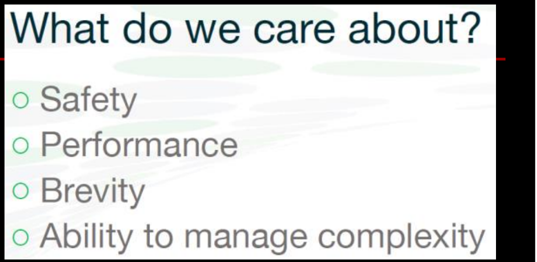
7x Better Than All-Flash NAS


About the Weka.io product

- "Software only" storage product
- Low latency, high performance
- Written in D
- About 280,000 LoC
  - Not including 114,663 lines in a single auto-generated file.
- Compiled using waf

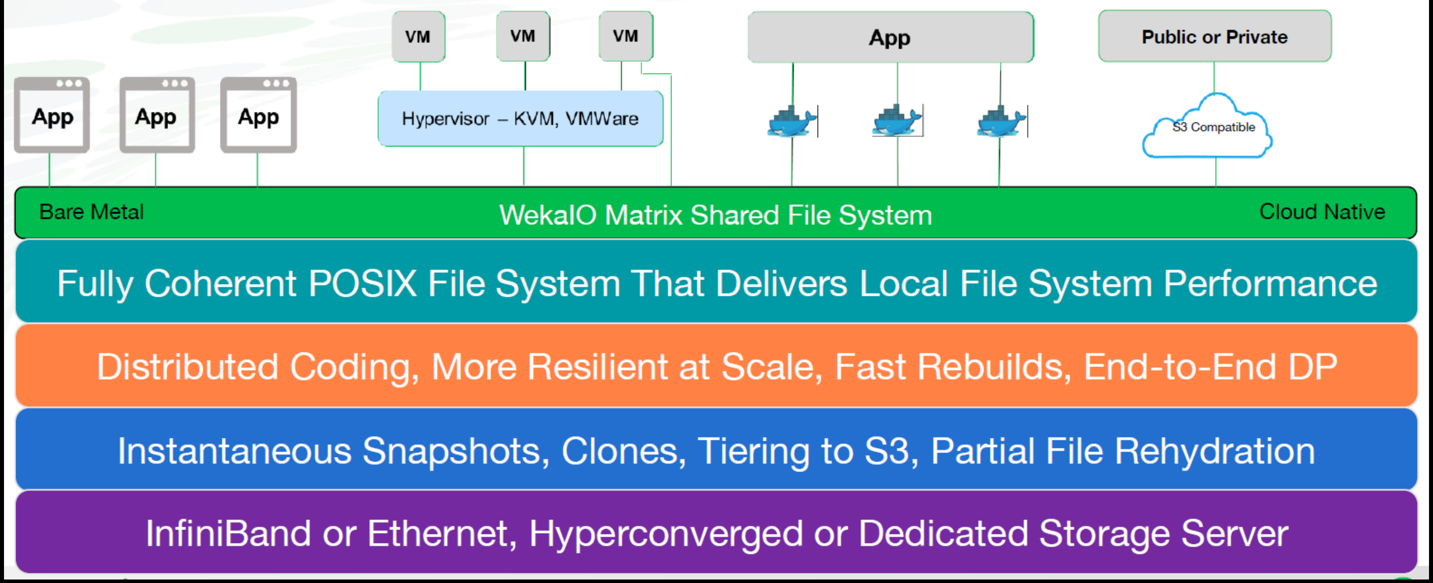

More About the Code

- Internally called "wekapp"
- Extremely latency sensitive
  - As little GC as possible
  - As few system calls as possible
- Performance sensitive
  - As little copying of data as possible
- Micro-threading (Fibers) based


What do we care about?

○ Safety
○ Performance
○ Brevity
○ Ability to manage complexity

Source: Announcing Mecca (DConf 2018)



Fully Coherent POSIX File System That Delivers Local File System Performance

Distributed Coding, More Resilient at Scale, Fast Rebuilds, End-to-End DP

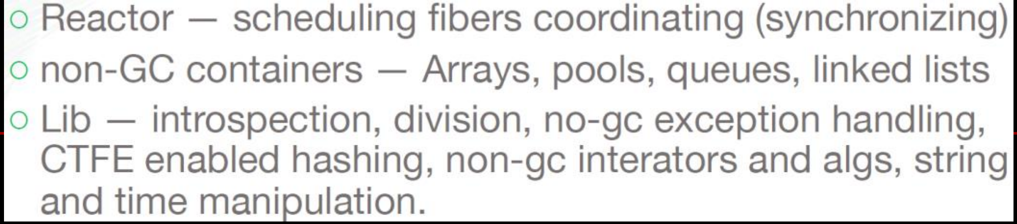
Instantaneous Snapshots, Clones, Tiering to S3, Partial File Rehydration

InfiniBand or Ethernet, Hyperconverged or Dedicated Storage Server

Source: Using D as the programming language of choice for large scale primary storage system (DConf 2018)

Project Mecca

- **https://github.com/weka-io/mecca/**

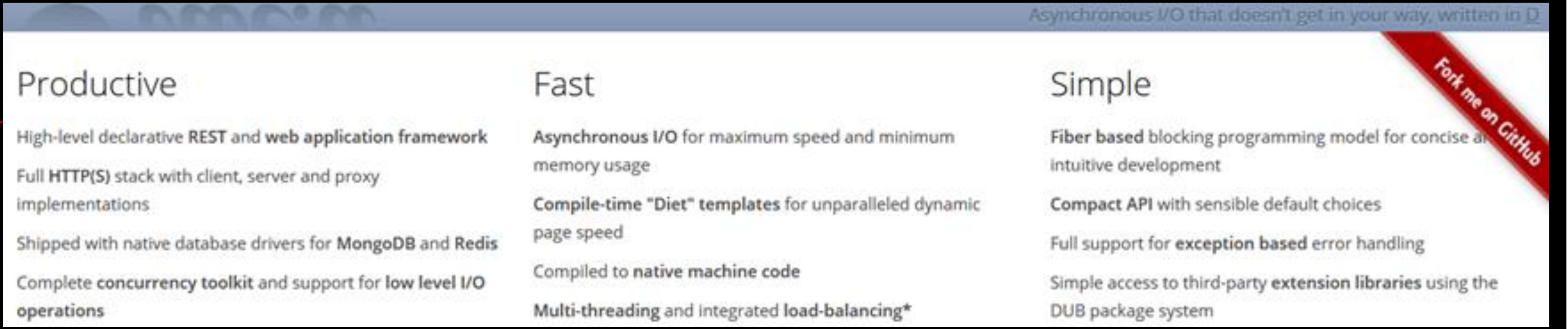


- ○ Reactor — scheduling fibers coordinating (synchronizing)
- ○ non-GC containers — Arrays, pools, queues, linked lists
- ○ Lib — introspection, division, no-gc exception handling, CTFE enabled hashing, non-gc interators and algs, string and time manipulation.

Source: Using D as the programming language of choice for large scale primary storage system (DConf 2018)

7) vibe.d

- http://vibed.org/



Asynchronous I/O that doesn't get in your way, written in D

Fork me on GitHub

Productive

High-level declarative **REST** and **web application framework**

Full **HTTP(S)** stack with client, server and proxy implementations

Shipped with native database drivers for **MongoDB** and **Redis**

Complete **concurrency toolkit** and support for **low level I/O operations**

Fast

Asynchronous I/O for maximum speed and minimum memory usage

Compile-time "Diet" templates for unparalleled dynamic page speed

Compiled to **native machine code**

Multi-threading and integrated **load-balancing***

Simple

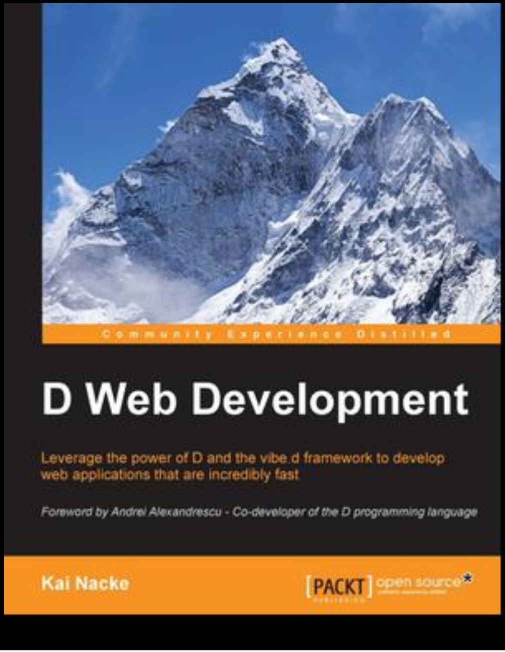
Fiber based blocking programming model for concise a intuitive development

Compact API with sensible default choices

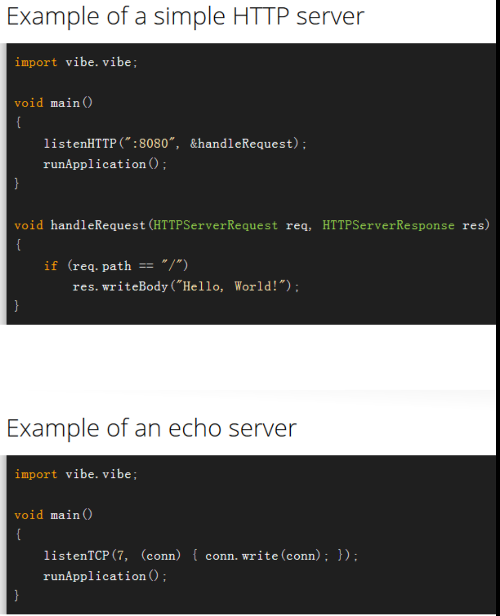
Full support for **exception based** error handling

Simple access to third-party **extension libraries** using the DUB package system

- http://vibed.org/features

- 

Community Experience Distilled
D Web Development
Leverage the power of D and the vibe.d framework to develop web applications that are incredibly fast
Foreword by Andrei Alexandrescu - Co-developer of the D programming language
Kai Nacke
[PACKT] open source



Example of a simple HTTP server

```
import vibe.vibe;

void main()
{
    listenHTTP(":8080", &handleRequest);
    runApplication();
}

void handleRequest(HTTPServerRequest req, HTTPServerResponse res)
{
    if (req.path == "/")
        res.writeBody("Hello, World!");
}
```

Example of an echo server

```
import vibe.vibe;

void main()
{
    listenTCP(7, (conn) { conn.write(conn); });
    runApplication();
}
```

8) HPC

- High Performance Computing
- Heterogeneous Parallel Computing

Mir

- https://github.com/libmir/

Separated Mir Projects

- **mir** -- Mir Algorithm, Mir Random, Sparse tensors, Hoffman
- **dcv** -- Computer Vision Library for D Programming Language
- **mir-algorithm** -- Core algorithm library and a home for Dlang multidimensional array package - ndslice
- **mir-glas** -- [Experimental] LLVM-accelerated Generic Linear Algebra Subprograms
- **mir-random** -- Advanced Random Number Generators
- **numir** -- NumPy-like API wrappers of Mir
- …

Coroutine/Fiber

- https://en.wikipedia.org/wiki/Coroutine
- https://en.wikipedia.org/wiki/Fiber_(computer_science)
- Coroutine landed in Clang/LLVM since May 2017

C++

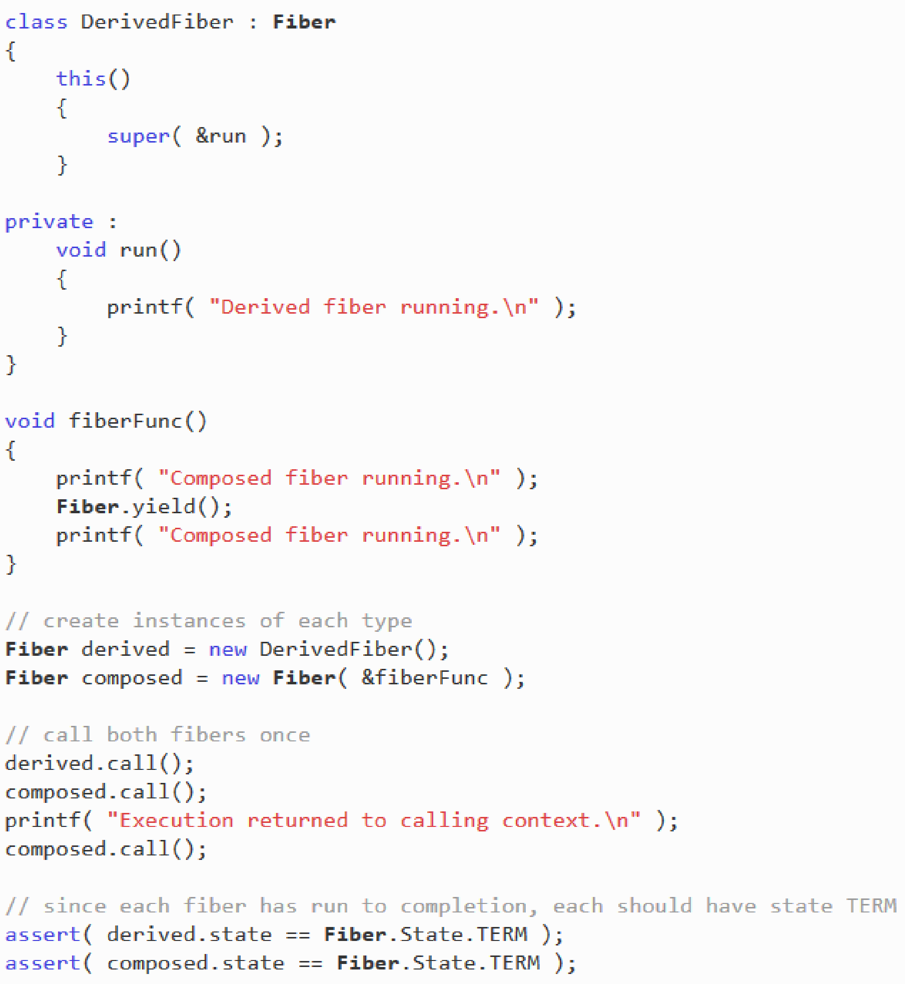
- moved out from C++17☹
- Boost.Coroutine

Go

- Goroutine
- CSP

D

- implements as standard library class Fiber http://dlang.org/phobos/core_thread.html#.Fiber

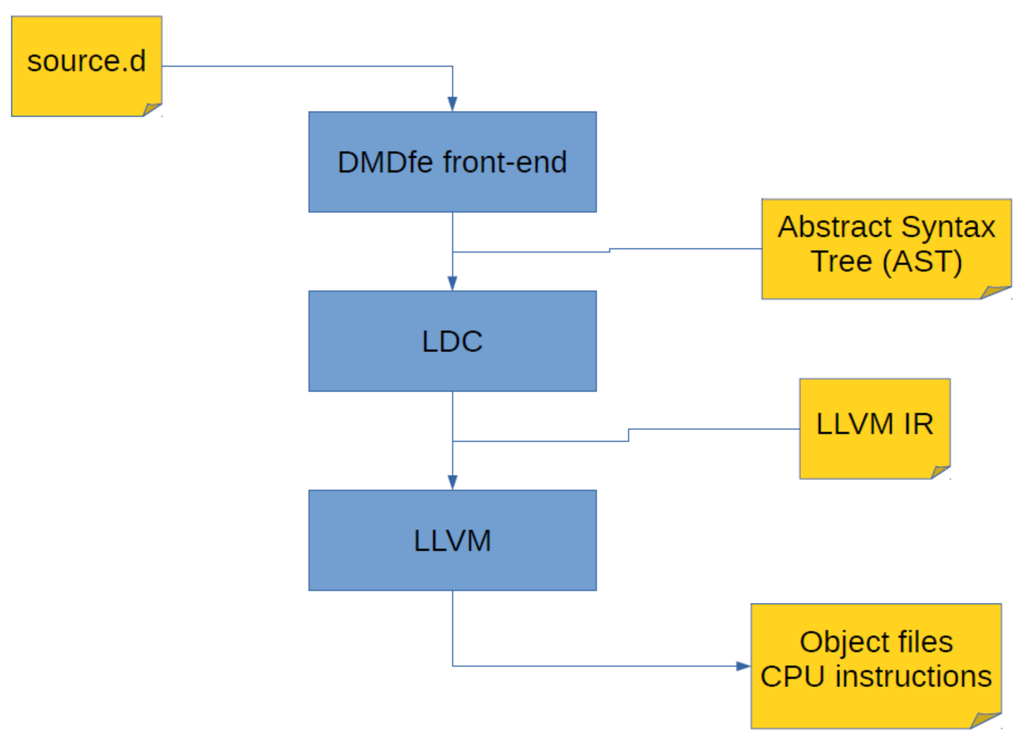


```
class DerivedFiber : Fiber
{
    this()
    {
        super( &run );
    }

private :
    void run()
    {
        printf( "Derived fiber running.\n" );
    }
}

void fiberFunc()
{
    printf( "Composed fiber running.\n" );
    Fiber.yield();
    printf( "Composed fiber running.\n" );
}

// create instances of each type
Fiber derived = new DerivedFiber();
Fiber composed = new Fiber( &fiberFunc );

// call both fibers once
derived.call();
composed.call();
printf( "Execution returned to calling context.\n" );
composed.call();

// since each fiber has run to completion, each should have state TERM
assert( derived.state == Fiber.State.TERM );
assert( composed.state == Fiber.State.TERM );
```

9) LDC

- https://github.com/ldc-developers/ldc

the LLVM-based D Compiler



Source: LLVM-backed goodies in LDC (DConf 2018)

CTFE (Compile Time Function Evaluation)

- **https://en.wikipedia.org/wiki/Compile_time_function_execution**
- **https://tour.dlang.org/tour/en/gems/compile-time-function-evaluation-ctfe**

DCompute

- **https://github.com/libmir/dcompute**

Native execution of D on GPUs and other Accelerators

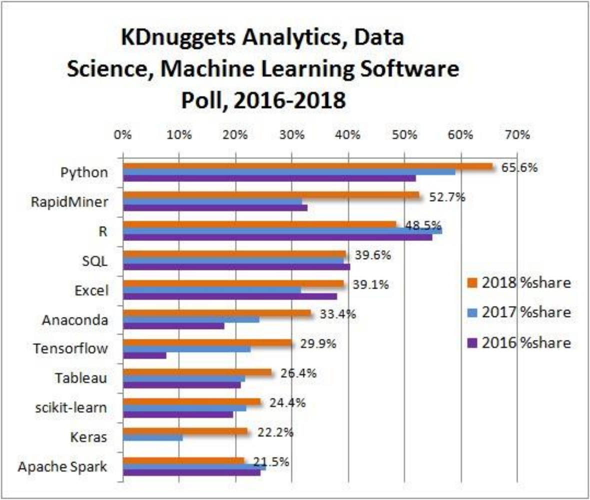
Targeting CUDA & OpenCL

@compute @kernel…

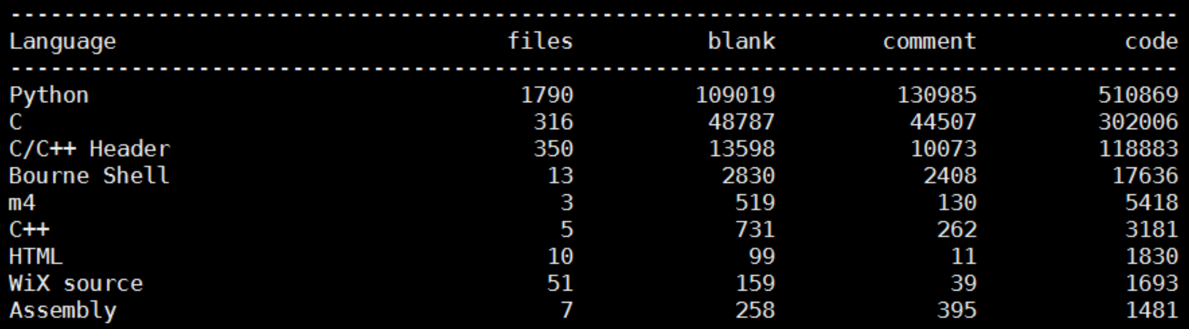
ldc2 -mdcompute-targets=cuda-500…

10) D & Python

- Pls refer to my presentation "OpenStack on ARM" at OpenInfra Days Beijing (on Jun 22, 2018)



CPython 3.7.0:



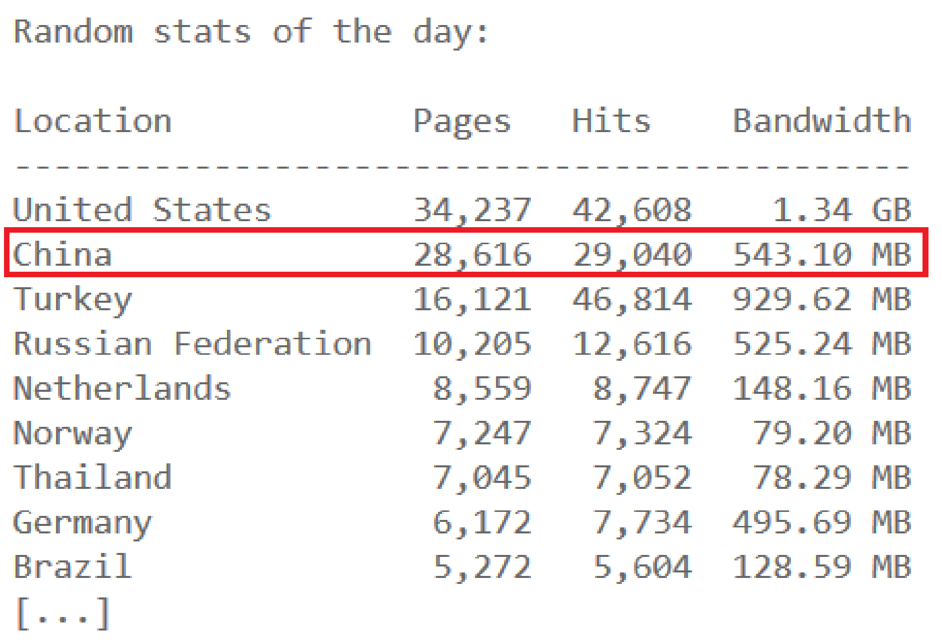
```
-------------------------------------------------------------------------------
Language                     files          blank        comment           code
-------------------------------------------------------------------------------
Python                        1790         109019         130985         510869
C                              316          48787          44507         302006
C/C++ Header                   350          13598          10073         118883
Bourne Shell                    13           2830           2408          17636
m4                               3            519            130           5418
C++                              5            731            262           3181
HTML                            10             99             11           1830
WiX source                      51            159             39           1693
Assembly                         7            258            395           1481
```

- https://github.com/ariovistus/pyd

Interoperability between Python and D

11) D in China

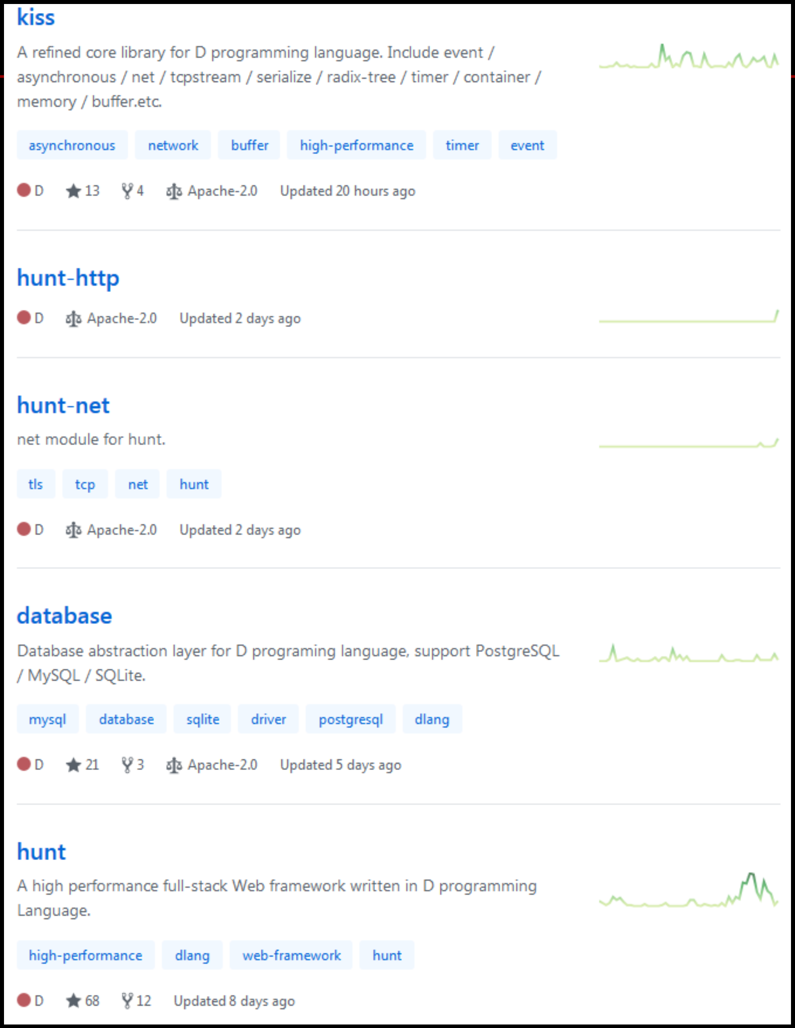
- https://www.d-programming-language-china.org/ (inactive)
- http://ddili.org/ders/d.en/index.html



```
Random stats of the day:

Location              Pages   Hits    Bandwidth
-----------------------------------------------
United States        34,237  42,608    1.34 GB
China                28,616  29,040  543.10 MB
Turkey               16,121  46,814  929.62 MB
Russian Federation   10,205  12,616  525.24 MB
Netherlands           8,559   8,747  148.16 MB
Norway                7,247   7,324   79.20 MB
Thailand              7,045   7,052   78.29 MB
Germany               6,172   7,734  495.69 MB
Brazil                5,272   5,604  128.59 MB
[...]
```

Putao

- http://www.putao.com/
- https://github.com/huntlabs



kiss

A refined core library for D programming language. Include event / asynchronous / net / tcpstream / serialize / radix-tree / timer / container / memory / buffer.etc.

asynchronous network buffer high-performance timer event

● D ★ 13 ⑂ 4 ⚖ Apache-2.0 Updated 20 hours ago

hunt-http

● D ⚖ Apache-2.0 Updated 2 days ago

hunt-net

net module for hunt.

tls tcp net hunt

● D ⚖ Apache-2.0 Updated 2 days ago

database

Database abstraction layer for D programing language, support PostgreSQL / MySQL / SQLite.

mysql database sqlite driver postgresql dlang

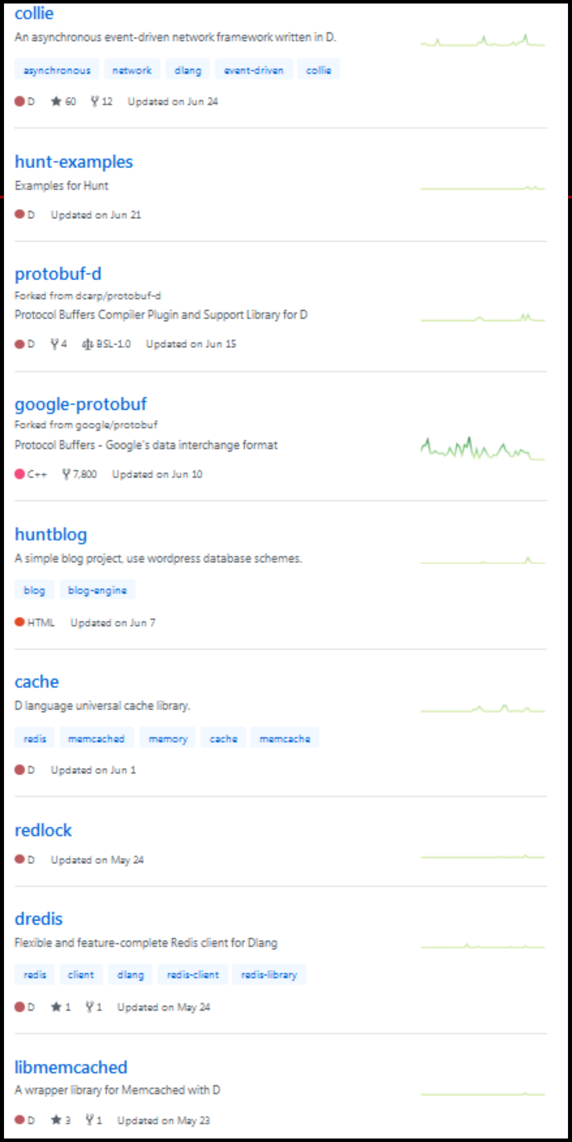
● D ★ 21 ⑂ 3 ⚖ Apache-2.0 Updated 5 days ago

hunt

A high performance full-stack Web framework written in D programming Language.

high-performance dlang web-framework hunt

● D ★ 68 ⑂ 12 Updated 8 days ago



collie

An asynchronous event-driven network framework written in D.

asynchronous network dlang event-driven collie

● D ★ 60 ⑂ 12 Updated on Jun 24

hunt-examples

Examples for Hunt

● D Updated on Jun 21

protobuf-d

Forked from dcarp/protobuf-d

Protocol Buffers Compiler Plugin and Support Library for D

● D ⑂ 4 ⚖ BSL-1.0 Updated on Jun 15

google-protobuf

Forked from google/protobuf

Protocol Buffers - Google's data interchange format

● C++ ⑂ 7,800 Updated on Jun 10

huntblog

A simple blog project, use wordpress database schemes.

blog blog-engine

● HTML Updated on Jun 7

cache

D language universal cache library.

redis memcached memory cache memcache

● D Updated on Jun 1

redlock

● D Updated on May 24

dredis

Flexible and feature-complete Redis client for Dlang

redis client dlang redis-client redis-library

● D ★ 1 ⑂ 1 Updated on May 24

libmemcached

A wrapper library for Memcached with D

● D ★ 3 ⑂ 1 Updated on May 23

II. Wrap-Up

- "Competitive Advantage with D"
  http://cppnow.org/2017-conference/announcements/2017/04/09/d-keynote.html
  http://ddili.org/AliCehreli_CppNow_2017_Competitive_Advantage_with_D.no_pause.pdf

Competitive Advantage with D

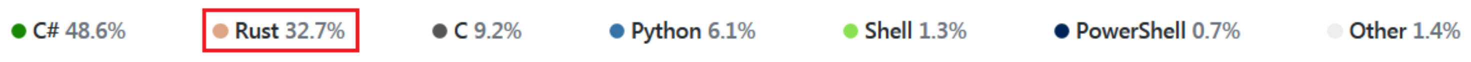
Ali Çehreli

C++Now 2017 • Aspen, Colorado

vs

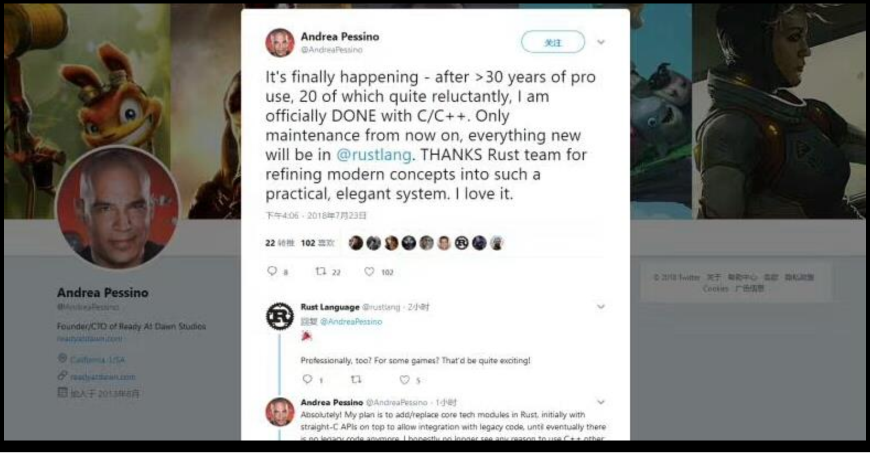
-

- https://github.com/Azure/iotedge



● C# 48.6% ● Rust 32.7% ● C 9.2% ● Python 6.1% ● Shell 1.3% ● PowerShell 0.7% ● Other 1.4%

- https://twitter.com/AndreaPessino/status1021532074153394176



Andrea Pessino
@AndreaPessino

It's finally happening - after >30 years of pro use, 20 of which quite reluctantly, I am officially DONE with C/C++. Only maintenance from now on, everything new will be in @rustlang. THANKS Rust team for refining modern concepts into such a practical, elegant system. I love it.

下午4:06 - 2018年7月23日

22 转推 102 喜欢

8 22 102

Rust Language @rustlang · 2小时
回复 @AndreaPessino

Professionally, too? For some games? That'd be quite exciting!

1 5

Andrea Pessino @AndreaPessino · 1小时
Absolutely! My plan is to add/replace core tech modules in Rust, initially with straight-C APIs on top to allow integration with legacy code, until eventually there is no legacy code anymore. I honestly no longer see any reason to use C++ other

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readyatdawn.com
加入于 2013年6月

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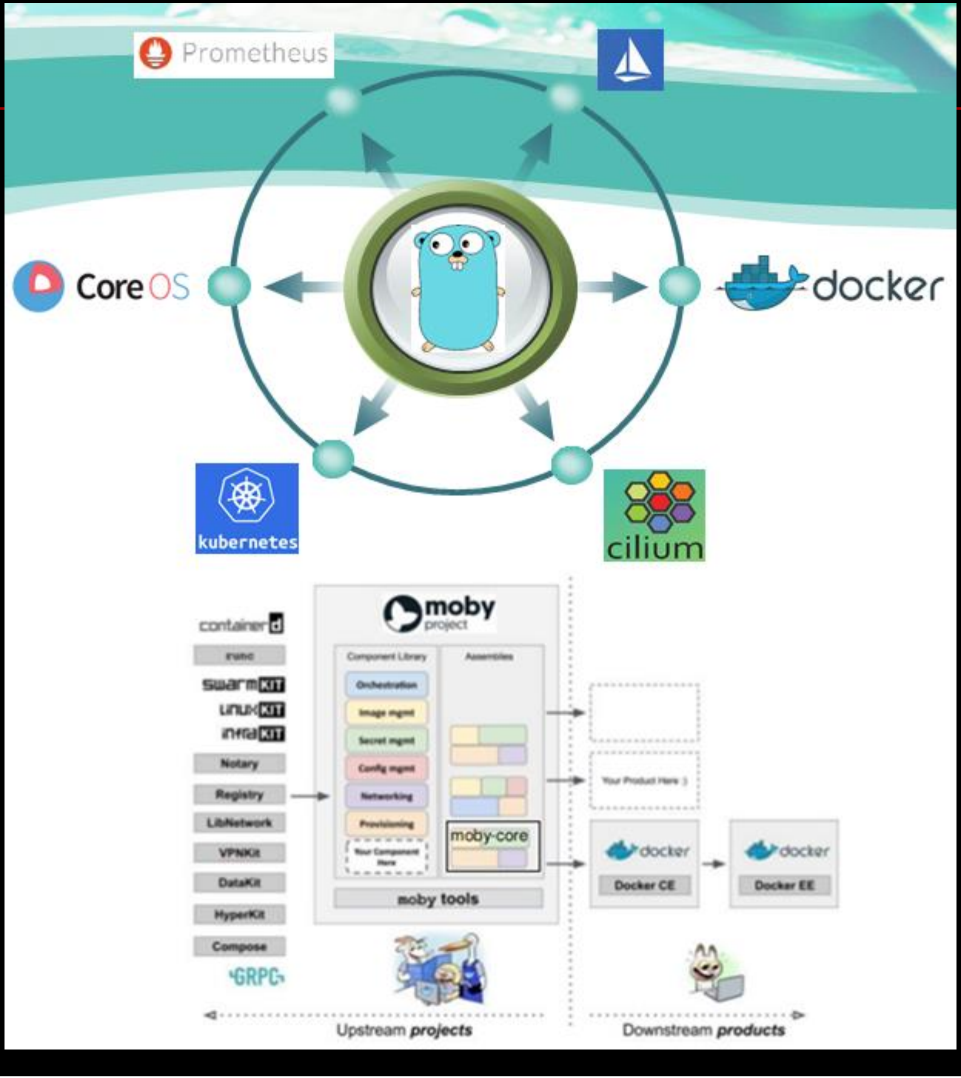
Cookies 广告信息

- **D for Cloud**
  Could challenge the Go-ruling Cloud Infrastructure?



Q & A

THANK YOU!

How about the first D Workshop in China?

Reference

Slides/materials from many and varied sources:

- http://en.wikipedia.org/wiki/
- http://www.slideshare.net/
- …