

# Hello Golang

A modern programming language

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Gopher

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[jenadevs](#) meetup at [Friedrich-Schiller-Universität Jena](#)

# About me

- Gopher since 2013
- Programmer at [Leipzig University Library](#)
- Co-Author of [Getting Started with Python Data Analysis](#)
- Consultant
- Trainer at [Python Academy](#)

# About me

Open source projects: [esbulk](#), [solrbulk](#), [microblob](#), [gluish](#), [metha](#), [marctools](#).

Presentations at [LPUG](#) about [pandas](#), [luigi](#), [neural nets](#).

Workshop on Go interfaces at [Golab](#), an European Go conference in Italy.

# My language log

BASIC, Pascal, Perl, *Bash*, Ruby, *Java*, C, C++, *PHP*, *JavaScript*,  
*Python*, *Go*.

# Outline

First: slides

- Go: its users and critics, language constructs
- Go and OO, Go and Concurrency
- The Go development workflow

Then: hands-on, if you want:

- Get Go installed
- Write a simple (web service | concurrent program) in Go

# Question: Is Go a modern language?

Go (programming language)

Programming Languages

+1



## Why does Go seem to be the most heavily criticised among the newer programming languages?

Related question: [Why has Google elected to rewind the software engineering clock at least 20 years with the Go programming language?](#) Same question goes for every "corporate" language?

Answer

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Dave Cheney liked



**Grazfather** @Grazfather · May 7

Writing **#Rustlang**: "Wtf. No. Fuck. Fuck you. Why? Please work!"

Writing **#Golang**: "Wow who would have thought I don't have to **hate** my life"



1



3

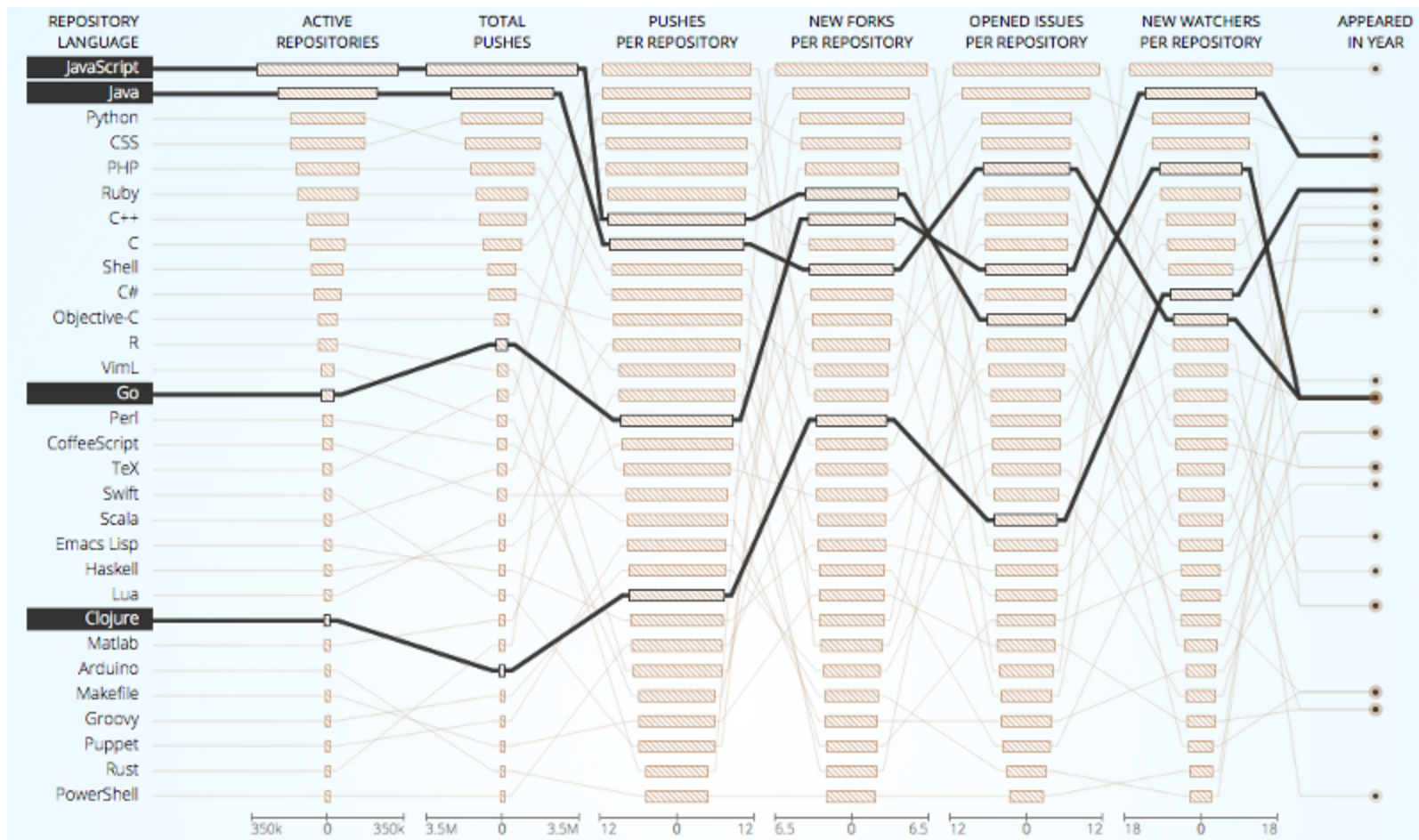


7



# GitHub Activity (2016)

From [GoLang](#) or the future of the dev:



# TIOBE

From June 2017:

Jun 2017	Jun 2016	Change	Programming Language	Ratings	Change
1	1		Java	14.493%	-6.30%
2	2		C	6.848%	-5.53%
3	3		C++	5.723%	-0.48%
4	4		Python	4.333%	+0.43%
5	5		C#	3.530%	-0.26%
6	9	▲	Visual Basic .NET	3.111%	+0.76%
7	7		JavaScript	3.025%	+0.44%
8	6	▼	PHP	2.774%	-0.45%
9	8	▼	Perl	2.309%	-0.09%
10	12	▲	Assembly language	2.252%	+0.13%
11	10	▼	Ruby	2.222%	-0.11%
12	14	▲	Swift	2.209%	+0.38%
13	13		Delphi/Object Pascal	2.158%	+0.22%
14	16	▲	R	2.150%	+0.61%
15	48	▲▲	Go	2.044%	+1.83%



# Golang is trash

## Golang is trash (2014):

But I think the bit that really captures the essence of golang, as well as the psuedointellectual arrogance of Rob Pike and everything he stands for, is this little gem:

Instructions, registers, and assembler directives are always in UPPER CASE to remind you that assembly programming is a fraught endeavor.

Wait, what? Are you being paternalistic or are you just an amateur? Writing in normal (that is, adult) assembly language is not fraught at all. While Mr. Pike was busying himself with Plan9, the rest of us

## [github.com/ksimka/go-is-not-good](https://github.com/ksimka/go-is-not-good) (1233 stars):

### What's this

---

This repository is a list of articles that complain about **golang**'s imperfection.

### Motivation

---

Seems like complaining about **go**'s flaws is becoming a trend. Any newbie must have a chance to read all the **go-is-bad** arguments before they go too far. So here it is.

# Why is Go not good?

- no generics
  - <http://jozefg.bitbucket.org/posts/2013-08-23-leaving-go.html> (Danny Gratzer 2013)
  - <http://how-bazaar.blogspot.ru/2013/04/the-go-language-my-thoughts.html> (Tim Penhey 2013)
  - <http://yager.io/programming/go.html> (Will Yager 2014)
  - <https://rule1.quora.com/Golang-Not-yet> (Jordan Zimmerman 2014)
  - <https://www.upguard.com/blog/our-experience-with-golang> (Mark Sheahan 2014)
  - <http://nomad.so/2015/03/why-gos-design-is-a-disservice-to-intelligent-programmers/> (Gary Willoughby 2015)
  - <https://kaushalsubedi.com/blog/2015/11/10/golang-sucks-heres-why/> (Kaushal Subedi 2015)
  - <http://blog.goodstuff.im/golang> (David Pollak 2015)
- stuck in 70's
  - <https://cowlark.com/2009-11-15-go/> (David Given 2009)
  - <https://uberpython.wordpress.com/2012/09/23/why-im-not-leaving-python-for-go/> (Yuval Greenfield 2012)
  - <http://www.darkcoding.net/software/go-lang-after-four-months/> (Graham King 2012)
  - <http://nomad.so/2015/03/why-gos-design-is-a-disservice-to-intelligent-programmers/> (Gary Willoughby 2015)
  - <http://blog.goodstuff.im/golang> (David Pollak 2015)

# Why is Go not good?

- bad dependency management
  - <https://rule1.quora.com/Golang-Not-yet> (Jordan Zimmerman 2014)
  - <http://nomad.so/2015/03/why-gos-design-is-a-disservice-to-intelligent-programmers/> (Gary Willoughby 2015)
  - <https://kaushalsubedi.com/blog/2015/11/10/golang-sucks-heres-why/> (Kaushal Subedi 2015)
  - <https://medium.com/@rgausnet/3-reasons-why-go-isnt-the-perfect-language-yet-25e0da5ec04c> (Ryan Gaus 2016)
- error handling
  - <https://uberpython.wordpress.com/2012/09/23/why-im-not-leaving-python-for-go/> (Yuval Greenfield 2012)
  - <http://how-bazaar.blogspot.ru/2013/04/the-go-language-my-thoughts.html> (Tim Penhey 2013)
  - <https://www.upguard.com/blog/our-experience-with-golang> (Mark Sheahan 2014)
  - <http://spaces-vs-tabs.com/4-weeks-of-golang-the-good-the-bad-and-the-ugly/> (Freddy Rangel 2015)
  - <http://blog.goodstuff.im/golang> (David Pollak 2015)
- weird mascot (gopher)
  - <http://magicmakerman.blogspot.ru/2013/07/why-googles-go-programming-language.html> (Magic Maker Man 2013)
  - <http://www.evanmiller.org/four-days-of-go.html> (Evan Miller 2015)

# Why is Go not good?

The list goes on and on:

- designed for stupid people
- no OOP
- no exceptions
- no versioning model
- too opinionated
- too simple

## So, why do I use it?

- I was curious about Ken Thompsons' [experiment](#).
- I like production code and low operational overhead (e.g. install, maybe config, run).
- With Go, I mostly think about the problem, not about the language.

# A small language

- 25 keywords

break	default	func	interface	<b>select</b>
<b>case</b>	defer	<b>go</b>	<b>map</b>	<b>struct</b>
chan	<b>else</b>	<b>goto</b>	<b>package</b>	<b>switch</b>
const	fallthrough	<b>if</b>	<b>range</b>	<b>type</b>
continue	<b>for</b>	<b>import</b>	<b>return</b>	<b>var</b>

# Hello World

```
package main

import "fmt"

func main() {
    fmt.Println("Hello 세계")
}
```

[Play.](#)

# Declaring variables

```
package main

import (
    "fmt"
    "time"
)

var timeout time.Duration
var N = 4

func main() {
    n, k := N, 2.0
    fmt.Printf("n=%d, k=%0.3f, timeout=%s", n, k, timeout)
}
```

[Play.](#)



# Visibility

- Lowercase private, uppercase public

# Every type has a zero value

```
package main

import "fmt"

func main() {
    var a float64
    var b int16
    var c string
    fmt.Printf("a=%v, b=%v, c=%v, len(c)=%v",
        a, b, c, len(c))
}
```

[Play.](#)

# Various numeric types

type	size in bytes
byte, uint8, int8	1
uint16, int16	2
uint32, int32, float32	4
uint64, int64, float64, complex64	8
complex128	16

- <https://golang.org/pkg/builtin/>

# Basic types

**bool**

**string**

**int int8 int16 int32 int64**

**uint uint8 uint16 uint32 uint64 uintptr**

**byte** *// alias for uint8*

**rune** *// alias for int32*  
*// represents a Unicode code point*

**float32 float64**

**complex64 complex128**

# Only one loop construct

```
package main

import "fmt"

const Prefix = ">> "

func main() {
    for i := 0; i < 5; i++ {
        log.Printf("%s %0d", Prefix, i)
    }
}
```

[Play](#). Break, continue as you expect.

# Slices

```
package main

import "fmt"

func main() {

    cities := []string{"Jena", "Weimar", "Erfurt"}

    for i, city := range cities {
        fmt.Println(i, city)
    }
}
```

# Functions

```
package main

import "fmt"

func Hello(name string) (string, error) {
    if len(name) < 2 {
        return "", fmt.Errorf("name too short")
    }
    return fmt.Sprintf("Hello %s", name), nil
}

func main() {
    greeting, err := Hello("a")
    fmt.Println(greeting, err)
}
```

[Play.](#)

# If needs no parentheses

```
package main

import "log"

func main() {
    a, b := 4, 3
    if a < b {
        log.Println("a smaller b")
    } else {
        log.Println("a not smaller b")
    }
}
```

[Play.](#)



# Keywords to go (13)

case	default		interface	select
chan	defer	go	map	struct
	fallthrough	goto		switch
				type

# Branching with switch, case and default

```
package main


import "fmt"

func main() {
    s := "A"
    switch s {
    case "A":
        fmt.Println("a")
    case "B":
        fmt.Println("b")
    default:
        fmt.Println("?")
    }
}
```

[Play.](#)

# Fallthrough

- A design mistake correction from the C language



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About 1,550 results (0.52 seconds)

**switch statement in C - TutorialsPoint**  
[https://www.tutorialspoint.com/cprogramming/switch\\_statement\\_in\\_c.htm](https://www.tutorialspoint.com/cprogramming/switch_statement_in_c.htm) ▼  
**Not every case needs to contain a break.** If no break appears, the flow of control will fall through to subsequent cases until a break is reached. A switch statement ...

**Not every case needs to contain a break IF no break - COMPUTER S ...**  
<https://www.coursehero.com> › ... › **COMPUTER S** › **COMPUTER S 340** ▼  
Mar 22, 2017 - **Not every case needs to contain a break.** IF no break appears, the flow of control will fall through to subsequent cases until a break is reached.

# Fallthrough

- Example, [ascii85](#)

```
var v uint32
switch len(src) {
default:
    v |= uint32(src[3])
    fallthrough
case 3:
    v |= uint32(src[2]) << 8
    fallthrough
case 2:
    v |= uint32(src[1]) << 16
    fallthrough
case 1:
    v |= uint32(src[0]) << 24
}
```

[Play.](#)

## Keywords to go (9)

chan	defer	go goto	interface map	select struct type
------	-------	------------	------------------	--------------------------

# Defer

- Defer is wonderful.

```
package main

func f() error {
    defer fmt.Println("exiting f")
    if rand.Float64() > 0.5 {
        fmt.Println("f failed")
    }
    return nil
}

func main() {
    f()
}
```

[Play.](#)

# Defer

- Use cases: closing file, connections, response bodies, profiling
- make code much more readable, but has performance implications

## Keywords to go (8)

chan

go  
goto

interface  
map

select  
struct

type



## Keywords to go (7)

chan

go

interface  
map

select  
struct

type



**problem?**

# Hashmaps

```
package main

import "fmt"

func main() {
    m := map[string]string{
        "Meetup": "jenadevs",
        "Location": "FSU Jena",
    }
    fmt.Println(m)
}
```

[Play.](#)

# Keywords to go (6)

		interface	select
	go		struct
chan			type

- Concurrency: go, chan, select
- OO: type, struct, interface

# OO in Go

- no classes
- composition over inheritance
- small interfaces
- no explicit declarations

# Custom types

- before we see compound types, let's look at something simpler

# Custom types

```
package main

import "fmt"

type Celsius float64

func main() {
    var temp Celsius
    fmt.Printf("below %v degree", temp)
}
```

[Play.](#)

# Functions on custom types

```
package main

import "fmt"

type Celsius float64

func (c Celsius) String() string {
    return fmt.Sprintf("%0.1f°", c)
}

func main() {
    var temp Celsius
    fmt.Printf("below %s degree", temp)
}
```

# Compound types

```
package main

import "fmt"

type Meetup struct {
    Name      string
    Location  string
}

func main() {
    meetup := Meetup{
        Name:      "jenadevs",
        Location: "FSU Jena",
    }
    fmt.Printf("%+v", meetup)
}
```

[Play.](#)



# Compound types (play)

```
package main

import "fmt"

type Address struct {
    City    string
    Street  string
}

type Meetup struct {
    Name      string
    Location  Address
}

func main() {
    meetup := Meetup{"jenadevs", Address{
        Street: "Fürstengraben 1",
        City:   "Jena"}}
    fmt.Printf("%+v", meetup)
}
```

# Defining Methods on Types

```
type Client struct {  
    scheme string  
    host    string  
    proto   string  
    ...  
}  
  
...  
  
func (cli *Client) ContainerList(...) (... , error) {  
    ...  
}
```

- [moby/client/client.go](#)
- [moby/client/container\\_list.go](#)

# Types

- basic types (int, float, complex64, string, rune, byte, bool)
- slices (variable sized array)
- maps (hashmaps)
- struct types (compound types)

# A few more types

A few more builtin types:

- array types (fixed size)
- pointer types (Pointers reference a location in memory where a value is stored rather than the value itself)
- function types (functions are first class objects)
- interface types
- channel types

# Arrays

- rarely used

```
package main

import "fmt"

func main() {
    var v [3]int64
    fmt.Println(v)
}
```

[Play.](#)

# Pointers

```
package main

import "fmt"

func main() {
    var x = 42
    fmt.Printf("%v", &x)
}
```

[Play.](#)

# Pointers

```
package main

import "fmt"

func main() {
    x := new(int32)
    fmt.Printf("%T", x)
}
```

[Play.](#)

# Pointers

You will see (use) pointer receivers on struct methods:

```
func (cli *Client) ContainerList ...
```

- required, if a method mutates values
- even, if it is just a single method, for consistency, all methods should use a pointer receiver



# Function types

- lots of fun
- closures

```
package main

import "fmt"

func main() {
    f := func(s string) string {
        return fmt.Sprintf("<%s>", s)
    }
    fmt.Println(f("functional"))
}
```

[Play.](#)

# Function types

```
package main

type Converter func(string) string

func Convert(value string, f Converter) string {
    return f(value)
}

func main() {
    // ...
}
```

[Play.](#)

# Function types

```
type Converter func(string) string
```

Any function with the signature `func(string) string` will implement Converter.

# Interface types

- set of methods
- satisfied implicitly

# Interface types

```
package main

type Starter interface {
    Start() error
}

type Container struct {
    ID string
}

func (c Container) Start() error {
    // ...
}

...
```

[Play.](#)

# Interface types

| The bigger the interface, the weaker the abstraction.

# Interface types

- Go has small interfaces
- Example: `package io`

```
type Reader interface {  
    Read([]byte) (n int, err error)  
}  
  
type Writer interface {  
    Write([]byte) (n int, err error)  
}  
  
type ReadWriter interface {  
    Reader  
    Writer  
}
```

# Interface types

Can small interfaces be useful?

- [Explore IO](#) workshop



# IO

... satisfied implicitly. But that's actually not the most important thing about Go's interfaces. The really most important thing is the culture around them that's captured by this proverb, which is that the smaller the interface is the more useful it is.

`io.Reader`, `io.Writer` and the empty interface are the three most important interfaces in the entire ecosystem, and they have an average of 2/3 of a method.

# Empty interface

```
package main

import "fmt"

func main() {
    var x interface{}
    x = 5
    fmt.Printf("%v, %T\n", x, x)
    x = "Hello"
    fmt.Printf("%v, %T\n", x, x)
}
```

# Type assertion

```
package main

import "fmt"

func IsString(v interface{}) bool {
    _, ok := v.(string)
    return ok
}

func main() {
    fmt.Println(IsString(23))
    fmt.Println(IsString("23"))
}
```

[Play.](#)

# Polymorphism

- via interfaces
- no explicit declaration

```
package main

import "fmt"

type Number struct{ x int }

func (n Number) String() string { return fmt.Sprintf("<Number %d", n.x) }

func main() {
    five := Number{5}
    fmt.Println(five)
}
```

[Play.](#)

# Interface advantages

- no dependence between interface and implementation
- easy testing
- avoids overdesign, rigid hierarchy of inheritance-based OO

The source of all generality in the Go language.

- <https://talks.golang.org/2014/research.slide#20>

(Requires some boilerplate, e.g. `sort.Interface`)

# Concurrency

- based on Communicating Sequential Processes (CSP), 1978
- avoids explicit locks

Do not communicate by sharing memory; instead, share memory by communicating.

# CSP

In Hoare's CSP language, processes communicate by sending or receiving values from named unbuffered channels. Since the channels are unbuffered, the send operation blocks until the value has been transferred to a receiver, thus providing a mechanism for synchronization.

# Concurrency

Three elements:

- goroutines
- channels
- select statement



# Concurrency: goroutines

- the go keyword start a function in a separate lightweight thread

# Concurrency: goroutines

```
package main

import (
    "fmt"
    "time"
)

func f() {
    time.Sleep(1 * time.Second)
    fmt.Println("f")
}

func main() {
    go f()
    fmt.Println("main")
    time.Sleep(2 * time.Second)
    fmt.Println("main")
}
```

[Play.](#)

# Concurrency: goroutines

- easy to start (many)

```
package main

import (
    "fmt"
)

func main() {
    N := 1000
    for i := 0; i < N; i++ {
        go func() {
            x := 0
            x++

        }()
    }
    fmt.Println("done")
}
```

[Play.](#)

# Concurrency: channels

- How to communicate between goroutines: enter channels.
- Channels: typed conduits for synchronisation and communication

# Concurrency: channels

```
package main

import "fmt"

func main() {
    ch := make(chan string)
    go func() {
        ch <- "Hello"
    }()
    fmt.Println(<-ch)
}
```

# Concurrency: channels

```
package main

// ...

func a(ch chan string) {
    for msg := range ch {
        fmt.Println(msg)
    }
}

func main() {
    ch := make(chan string)
    go a(ch)
    ch <- "Hello"
    ch <- "World"
    close(ch)
    time.Sleep(1 * time.Second)
}
```

[Play.](#)

# Channels

```
package main

import "fmt"

func main() {
    c := make(chan string)
    go func() {
        c <- "Hello"
        c <- "World"
    }()
    fmt.Println(<-c, <-c)
}
```



# Select statement

- select statement is similar to a switch but works with channels

The select statement lets a goroutine wait on multiple communication operations. A select blocks until one of its cases can run, then it executes that case.



# Select statement

```
func main() {  
    ch := make(chan int)  
    go func() {  
        select {  
        case <-time.After(1 * time.Second):  
            log.Fatal("timeout")  
        case v := <-ch:  
            log.Println(v)  
            return  
        }  
    }()  
    time.Sleep(1100 * time.Millisecond)  
    ch <- 42  
    time.Sleep(1 * time.Second)  
}
```

[Play.](#)

# Tooling

Commonly referred to as the Go tool. It runs code (compiles to a temporary file):

```
$ go run main.go
```

# Tooling

Before you build code:

```
$ go fmt main.go
```

Or use: `goimports` - your favorite editor will have suitable plugins.

# Tooling

Build binary:

```
$ go build -o prog main.go
```

Cross compilation is easy.

# Tooling

Testing:

```
$ go test ./...
```

Testing and Benchmark helpers included.

# Tooling

Testing:

```
$ go vet ./...
```

Testing and Benchmark helpers included.

# Tooling

Get additional libraries:

```
$ go get github.com/fatih/structs
```

Dependency management is not great yet.

# Standard library

- net/http
- flag
- io
- xml, json
- archive



# Cool Projects

- docker, k8s
- NES simulator
- <https://github.com/gizak/termui>
- <https://github.com/peco/peco>
- <https://github.com/coreos/etcd>
- <https://github.com/chrislusf/seaweedfs>
- <https://github.com/minio/minio>
- <http://nsq.io/>

# Web frameworks

- gorilla
- echo
- ...

## More to learn

- ref/spec, efficient go, blog, tour
- videos, gophercons, dotgo
- books, tutorials

# Docker API

List containers, create or remove them:

- <https://gist.github.com/miku/db09463fb5637a987e3f6dce8f2e839d>

# Docker API

```
$ go run create.go
2017/06/08 15:31:47 Pulling from library/alpine
2017/06/08 15:31:47 Digest: sha256:0b94d1d1b5e ..
2017/06/08 15:31:47 Status: Image is up to date ..
2017/06/08 15:31:47 created: 0b2a66483 ...

hello world
2017/06/08 15:31:49 removing: 0b2a66483067c520b761 ...
```

# Docker API

```
$ go run list.go  
sha256:a298d5ca31220b888b5 ...  
sha256:a41a7446062d197dd4b ...
```

# Docker Volume API

```
28 → sigs := make(chan os.Signal, 1)
29 → signal.Notify(sigs, os.Interrupt, os.Kill)
30
31 → // var Usage = func() {
32 → // →fmt.Fprintf(os.Stderr, "Usage %s [options]\n", os.Args[0])
33 → // →flag.PrintDefaults()
34 → // }
35
36 → flag.Parse()
37
38 → _, err := os.Lstat(*ipfsMountPoint)
39 → if err != nil {
40 → → fmt.Fprintf(os.Stderr, "%v\n%s does not exists, can't start..\n Please use ipfs command to
41 → → os.Exit(1)
42 → }
43
44 → d := driver.New(*ipfsMountPoint)
45 → h := volume.NewHandler(d, &Handler{
46 → → // NewHandler initialization
47 → → if err := h.ServeUnix("root", "ipfs"); err != nil {
```

api.go vendor/github.com/docker/go-sockman...  
79 → }  
80  
81 type actionHandler func  
82 type mountActionHandler  
83 type unmountActionHandler  
84  
85 // NewHandler initialization  
86 func NewHandler(driver Driver) \*Handler {  
87 → h := &Handler{driver, sdk.NewHandler(manifest)}  
88 → h.initMux()  
89 → return h  
90 → }  
91  
92 func (h \*Handler) initMux() {  
93 → h.handle(createPath, func(req Request) Response {  
94 → → return h.driver.Create(req)  
95 → })  
96 → h.handle(listPath, func(req Request) Response {  
97 → → return h.driver.List(req)  
98 → })  
99 → h.handle(getPath, func(req Request) Response {  
100 → → return h.driver.Get(req)  
101 → })  
102 → h.handle(removePath, func(req Request) Response {  
103 → → return h.driver.Remove(req)  
104 → })  
105 → h.handle(pathPath, func(req Request) Response {  
106 → → return h.driver.Path(req)  
107 → })  
108 → h.handle(mountPath, func(req Request) Response {  
109 → → return h.driver.Mount(req)  
110 → })  
111 → h.handle(unmountPath, func(req Request) Response {  
112 → → return h.driver.Unmount(req)  
113 → })  
114 → h.handle(capabilitiesPath, func(req Request) Response {  
115 → → return h.driver.Capabilities(req)  
116 → })  
117 → }  
118 }  
119  
120 func NewHandler(d...  
121 }  
122 }  
123 }  
124 }  
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129 }  
130 }  
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# Docker Plugins API

- [https://docs.docker.com/engine/extend/plugin\\_api/](https://docs.docker.com/engine/extend/plugin_api/)

Example:

- <https://github.com/vieux/docker-volume-sshfs>



# Go vs Python

- <https://gist.github.com/miku/f7ac5873f6a29a096fde>

# Workshop

- <http://localhost:6060/doc/install>
- <http://localhost:6060/doc/code.html>

# Workshop Examples

- hello world (1)
- request a web page (2)
- request a list of web pages (3)
- concurrently request a list of web pages (4)
- simple web service (5)

# Workshop (1)

Set `$GOPATH` to `~/go` .

```
$ mkdir $GOPATH/src/github.com/user/hello
```

Create a file called `hello.go` - insert code, save, run.

## Workshop (2)

- request a web page with `http.Get`

## Workshop (3)

- request a list of web pages

## Workshop (4)

- concurrently request a list of web pages

# Workshop (5)

- various servers