Google

The Go Programming Language

An Introduction

Wednesday April 6th, 2016

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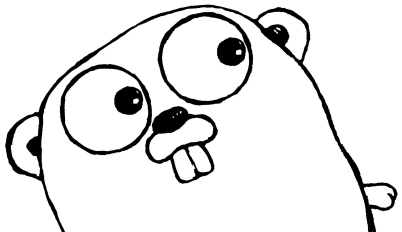


Overview

Introduction

Basics

Data Structures

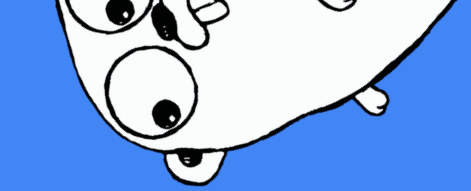
Concurrency

Interfaces

Writing Good Go Code

The Fun Stuff

Resources



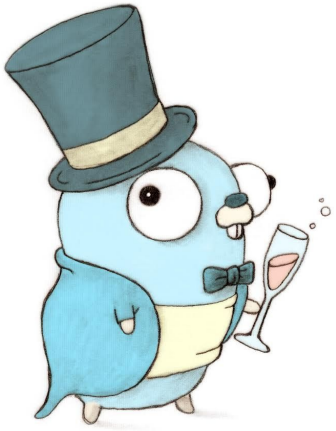
Introduction

Background

History

High-Level Overview

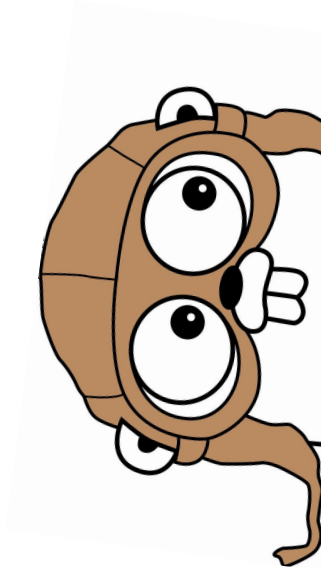
Background



Literally nothing

Stuff I've Built in Go

- ECE Project
  - [https://github.com/bcspragu/ReachabilityAnalyzer]
- Radiotation
  - [https://github.com/bcspragu/Radiotation]
- Gobots
  - [https://github.com/bcspragu/Gobots]
- Blog

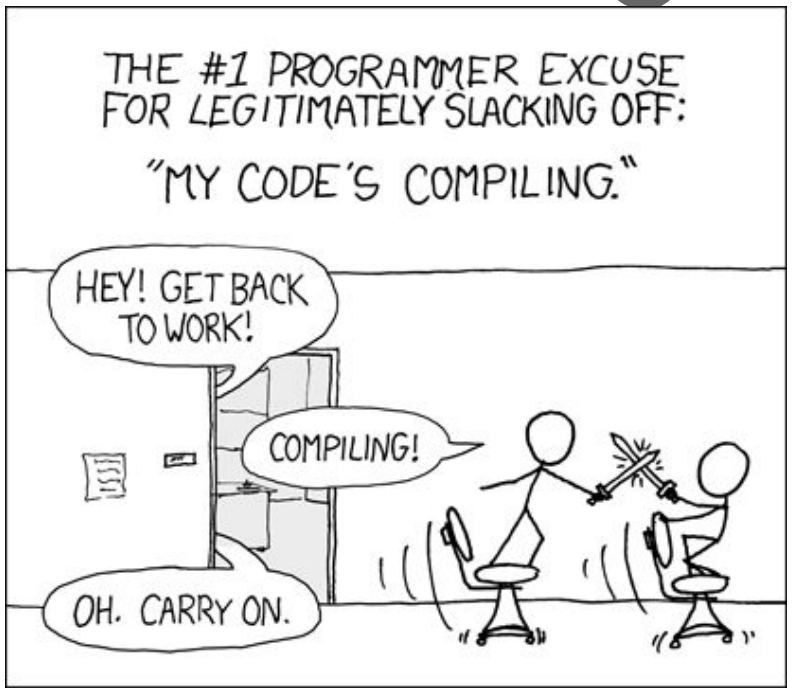


```
Foo foo = Foo.newBuilder().setFoosity(Foo.SOME_FOO).build();
```

```
foo:Foo *myFoo = new foo::Foo(foo::FOO_INIT)
```

History

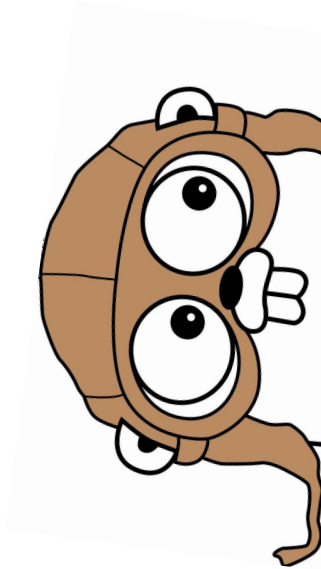
What does Google need?



So... what did they come up with?

Go’s Main Traits

- Compiles quickly
- Concurrency built-in
- Garbage-collected
- Statically-typed
- Runs on pretty much everything
- “Object-oriented”
  - But no classes
  - Or inheritance



Basics

Hello World

Declaring Variables

Control Structures

Functions

Packages

Hello World

```
package main

import "fmt"

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

Variables

```
package main

import "fmt"

func main() {
   var i, j int = 1, 2
   k := 3
   c, python, java := true, false, "no!"
  // Prints 1 2 3 true false no!
   fmt.Println(i, j, k, c, python, java)
}
```

Types

```
import (
    "fmt"
    "math/cmplx"
)

var (
    ToBe   bool       = false
    MaxInt uint64     = 1<<64 - 1
    z      complex128 = cmplx.Sqrt(-5 + 12i)
)

func main() {
    const f = "%T(%v)\n"
    fmt.Printf(f, ToBe, ToBe) // bool(false)
    fmt.Printf(f, MaxInt, MaxInt) // uint64(18446744073709551615)
    fmt.Printf(f, z, z) // complex128((2+3i))
}
```

Functions can be variables/types too

```
func adder() func(int) int {
    sum := 0
    return func(x int) int {
        sum += x
        return sum
    }
}
```

Zero values

```
import "fmt"

func main() {
   var i int
   var f float64
   var b bool
   var s string
   // Prints 0 0 false ""
   fmt.Printf("%v %v %v %q\n", i, f, b, s)
}
```

Type Conversions

```
import (
   "math"
)

func main() {
   var x, y int = 3, 4
   var f float64 = math.Sqrt(float64(x*x + y*y))
   var z uint = uint(f)
}
```

Constants

```
import "fmt"

const Pi = 3.14

func main() {
    const World = "世界"
    fmt.Println("Hello", World)
    fmt.Println("Happy", Pi, "Day")

    const Truth = true
    fmt.Println("Go rules?", Truth)
}
```

For Loops

```
import "fmt"

func main() {
   sum := 0
   for i := 0; i < 10; i++ {
       sum += i
   }
   fmt.Println(sum)
}
```

“While” Loops

```
import "fmt"

func main() {
   sum := 1
   for sum < 1000 {
       sum += sum
   }
   fmt.Println(sum)
}
```

Infinite Loops...what

```
package main

func main() {
   for {
   }
}
```

If Statements

```
import (
    "fmt"
    "math"
)

func sqrt(x float64) string {
    if x < 0 {
        return sqrt(-x) + "i"
    }
    return fmt.Sprint(math.Sqrt(x))
}
```

Fancy If Statements

```
import (
   "math"
)

func pow(x, n, lim float64) float64 {
   if v := math.Pow(x, n); v < lim {
       return v
   }
   return lim
}
```

Switch

```
import (
    "runtime"
)

func main() {
    switch os := runtime.GOOS; os {
    case "darwin":
         // Do Mac Stuff
    case "linux":
         // Do Stallman stuff
    default:
         // Do freebsd, openbsd,
         // plan9, windows... stuff
    }
}
```

More Switch

```
import (
    "fmt"
    "time"
)

func main() {
    t := time.Now()
    switch {
    case t.Hour() < 12:
          fmt.Println("Good morning!")
    case t.Hour() < 17:
          fmt.Println("Good afternoon.")
    default:
          fmt.Println("Good evening.")
    }
}
```

Defer

```
import "fmt"

func main() {
   defer fmt.Println("world")

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

Packages

```
import (
	"bytes"
	"encoding/gob"
	"errors"
	"fmt"
	"log"
	"sort"
	"strings"
	"time"

	"zombiezen.com/go/capnproto2"

	"github.com/bcspragu/Gobots/botapi"
	"github.com/boltdb/bolt"
)
```

Data Structures

Structs

Arrays

Slices

Maps

Structs

```
import "fmt"

type Vertex struct {
    X int
    Y int
}

func main() {
    v := Vertex{1, 2}
    v.X = 4
    fmt.Println(v.X)
}
```

Structs ‘n Pointers

```
import "fmt"

type Vertex struct {
    X int
    Y int
}

func main() {
    v := Vertex{Y: 2}
    p := &v
    p.X = 1e9
}
```

Methods

```
type Vertex struct {
    X, Y float64
}

func (v Vertex) Abs() float64 {
    return math.Sqrt(v.X*v.X + v.Y*v.Y)
}

func (v *Vertex) Scale(f float64) {
    v.X = v.X * f
    v.Y = v.Y * f
}
```

More Methods

```
type MyFloat float64

func (f MyFloat) Abs() float64 {
    if f < 0 {
        return float64(-f)
    }
    return float64(f)
}
```

Arrays

```
import "fmt"

func main() {
   var a [2]string
   a[0] = "Hello"
   a[1] = "World"
   fmt.Println(a[0], a[1])
   fmt.Println(a)
}
```

Slices

```
import "fmt"

func main() {
   primes := []int{2, 3, 5, 7, 11, 13}

   for i := 0; i < len(primes); i++ {
       fmt.Printf("primes[%d] == %d\n", i, primes[i])
   }
}
```

Slicing Slices

```
import "fmt"

func main() {
   s := []int{2, 3, 5, 7, 11, 13}

   fmt.Println("s[1:4] ==", s[1:4]) // s[1:4] == [3 5 7]

   fmt.Println("s[:3] ==", s[:3]) // s[:3] == [2 3 5]

   fmt.Println("s[4:] ==", s[4:])  // s[4:] == [11 13]
}
```

Making Slices

```
import "fmt"

func main() {
    // Also used for maps and channels
    a := make([]int, 5)
}
```

Nil Slices and Adding Elements

```
import "fmt"

func main() {
   var s []int
   if s == nil {
       // Do stuff
   }
   s = append(s, 1)
}
```

For … range

```
var pow = []int{1, 2, 4, 8, 16, 32, 64, 128}

func main() {
    for i, v := range pow {
        // Access i and v here
    }
    for _, value := range pow {
        // If you only need the value
    }
    for i := range pow {
        // If you only need the index
    }
}
```

Maps

```
type Vertex struct {
    Lat, Long float64
}

var m map[string]Vertex

func main() {
    m = make(map[string]Vertex)
    m["Bell Labs"] = Vertex{
        40.68433, -74.39967,
    }
}
```

More Maps

```
type Vertex struct {
    Lat, Long float64
}

var m map[string]Vertex

func main() {
    m = make(map[string]Vertex)
    m["Bell Labs"] = Vertex{
        40.68433, -74.39967,
    }
    if e, ok := m["Menlo Park"]; ok {
        // Do something with e
    }
    delete(m, "Bell Labs")
}
```

Interfaces

An example

The Empty Interface: interface{}

Usage in Standard Library

Interfaces

```
import “math"

type Abser interface {
	Abs() float64
}

func main() {
	var a Abser
	f := MyFloat(-math.Sqrt2)
	v := Vertex{3, 4}

	a = f  // a MyFloat implements
Abser
	a = &v // a *Vertex implements
Abser
}
```

```
type MyFloat float64

func (f MyFloat) Abs() float64 {
	if f < 0 {
		return float64(-f)
	}
	return float64(f)
}

type Vertex struct {
	X, Y float64
}

func (v *Vertex) Abs() float64 {
	return math.Sqrt(v.X*v.X +
v.Y*v.Y)
}
```

The Empty interface{}

```
import "fmt"

func do(i interface{}) {
    switch v := i.(type) {
    case int:
        fmt.Printf("Twice %v is %v\n", v, v*2)
    case string:
        fmt.Printf("%q is %v bytes long\n", v, len(v))
    default:
        fmt.Printf("I don't know about type %T!\n", v)
    }
}
```

interface{} in the Standard Library

```
// In the encoding/json package
func Marshal(v interface{}) ([]byte, error)
func Unmarshal(data []byte, v interface{}) error

// In the reflect package
func DeepEqual(x, y interface{}) bool
func ValueOf(i interface{}) Value
```

Interfaces in the Standard Library

```
// In the fmt package
type Stringer interface {
    String() string
}

// In the io package
type Reader interface {
        Read(p []byte) (n int, err error)
}
type Writer interface {
        Write(p []byte) (n int, err error)
}
```

Concurrency

Goroutines

Channels

Select Statement

Goroutines

```
import (
	"fmt"
	"time"
)

func say(s string) {
	for i := 0; i < 5; i++ {
		time.Sleep(100 * time.Millisecond)
		fmt.Println(s)
	}
}

func main() {
	go say("world")
	say("hello")
}
```

Channels

```
func sum(s []int, c chan int) {
    sum := 0
    for _, v := range s {
        sum += v
    }
    c <- sum // send sum to c
}
```

```
func main() {
    s := []int{7, 2, 8, -9, 4, 0}

    c := make(chan int)
    go sum(s[:len(s)/2], c)
    go sum(s[len(s)/2:], c)
    x, y := <-c, <-c // receive from c

    fmt.Println(x, y, x+y)
}
```

The Select Statement

```
func fibonacci(c, quit chan int) {
    x, y := 0, 1
    for {
        select {
        case c <- x:
            x, y = y, x+y
        case <-quit:
            fmt.Println("quit")
            return
        }
    }
}
```

Writing Good Go Code

Idiomatic Go

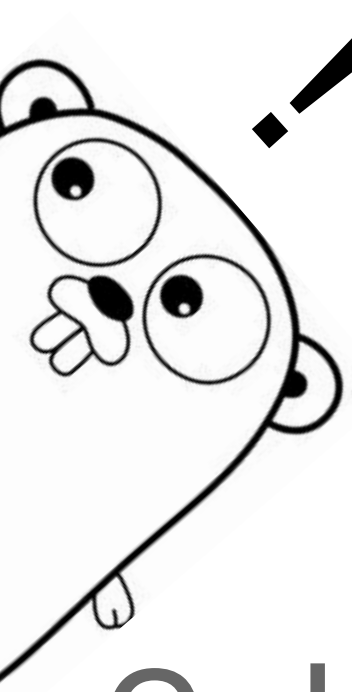
Testing

Using the tooling

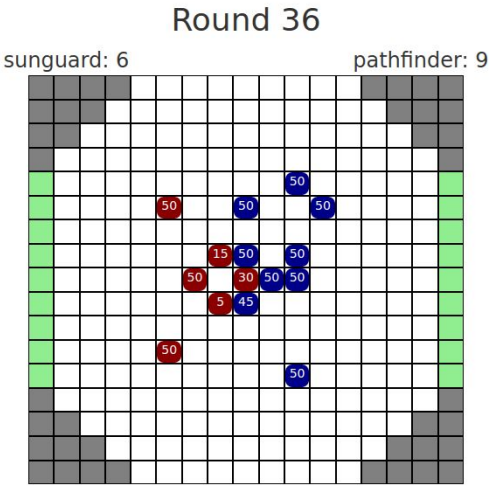
Google

The Fun Stuff

Built to play



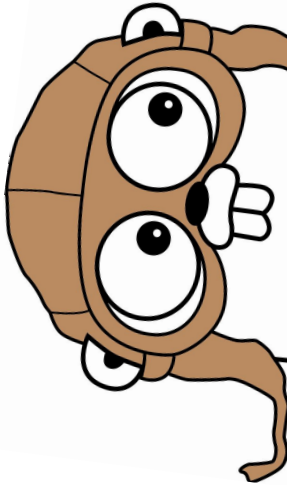
Gobots!



Useful Resources and Tools

From the Go Authors

- Installing Go
  - https://golang.org/doc/install
- Effective Go - Goes through each feature and when to use them
  - https://golang.org/doc/effective_go.html
- Standard Library Documentation (also available via `go doc`)
  - https://golang.org/pkg/
- Go Frequently Asked Questions
  - https://golang.org/doc/faq
- Official Go Blog
  - https://blog.golang.org/



From...other places

- Documentation for building a Gobot
  - https://godoc.org/github.com/bcspragu/Gobots/game
  - Rules for RobotGame, which GobotGame is based on: https://robotgame.net/rules
- Info on using io.Reader
  - https://www.datadoghq.com/blog/crossing-streams-love-letter-gos-io-reader/
- All sorts of Go examples
  - https://gobyexample.com

What’s next?

Questions?