Golang Programming

Introduction to Go

Go is an open source programming language that makes it easy to build simple, reliable, and efficient software.

Go web site at golang.org

Course Schedule

- [Oct 2, 2021] Introduction to Go
- [Oct 3, 2021] Program structure, data types, operators, control-flow statements, functions – *Homework 1 (algorithmic problem)*
- [Oct 9, 2021] Composite types, functions, error handling
- [Oct 10, 2021] Methods – *Homework 2 (Github JSON client)*
- [Oct 16, 2021] Interfaces. Domain Driven Design. – *face-to-face in Proxiad office*
- [Oct 17, 2021] Testing with Go – *Emil Georgiev, face-to-face in Proxiad office – Homework 3 (implementing a domain service and repository using TDD / BDD)*
- [Oct 23, 2021] Goroutines and Channels
- [Oct 24, 2021] Concurrency with Shared Variables – *Homework 4 (concurrent web scrapping)*

Course Schedule

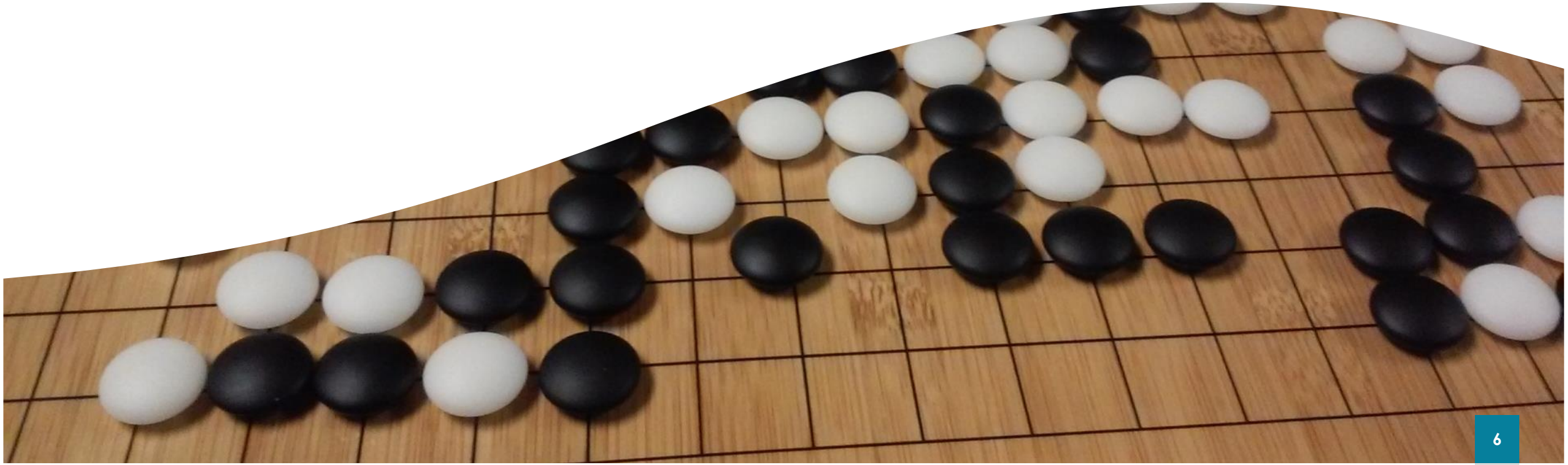
- [Oct 30, 2021] Working with SQL databases
- [Oct 31, 2021] Building network clients, servers, and web services (REST) – *Homework 5 (defining a Web API for your course project)*
- [Nov 6, 2021] Building web services with gRPC
- [Nov 7, 2021] Modules and dependency management using go mod – *Projects mentoring*
- [Nov 13, 2021] Code generation. Go 2 generics.
- [Nov 28, 2021] Projects demonstration

Where to Find The Code and Materials?

https://github.com/iproduct/coursegopro

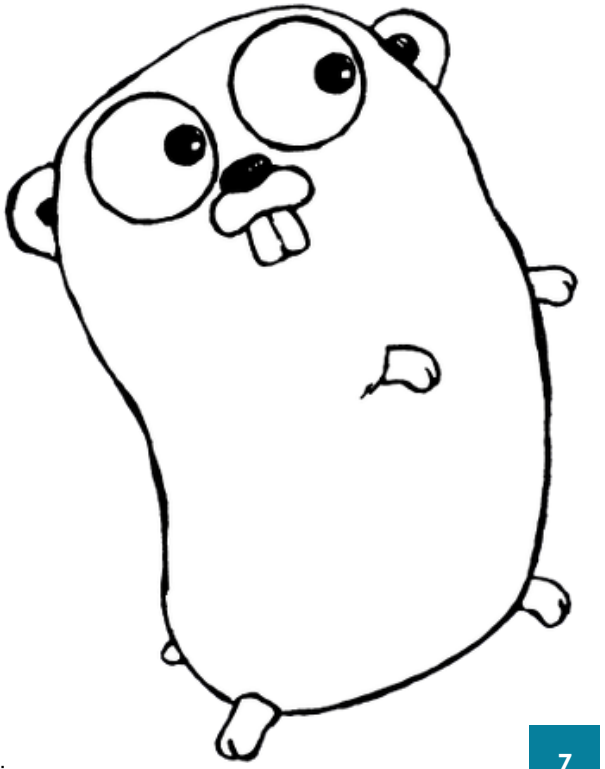
Why Go?

History, main features, advantages



Origins of GO

- Go was conceived in September 2007 by Robert Griesemer, Rob Pike, and Ken Thompson, at Google.
- It was publically announced in November 2009, and version 1.0 was released in March 2012.
- Go is widely used in production at Google and in many other organizations and open-source projects.



Aims of Go

- The aim of Go language, was to fill the same niche today that C fit into in the '80s.
- According to Moore's law, the number of transistors on a CPU can be expected to double roughly every 18 months => now more cores
- It is a low-level language for multiprocessor development.
- Experience with C taught that a successful systems programming language ends up being used for application development.
- Go incorporates a number of high-level features, allowing developers to use it for things like web services or desktop applications, as well as very low-level systems.

Who Uses Go?

- Docker, a set of tools for deploying Linux containers
- Ethereum, blockchain for the *Ether* cryptocurrency
- InfluxDB, an open source database specifically to handle time series data with high availability and high performance requirements.
- Juju, a service orchestration tool by Canonical, packagers of Ubuntu
- Kubernetes container management system
- OpenShift, a cloud computing platform as a service by Red Hat
- Terraform, an open-source, multiple cloud infrastructure provisioning

Who Uses Go?

- Cloud Foundry, a platform as a service
- Container Linux (formerly CoreOS), a Linux-based operating system that uses Docker containers and rkt containers.
- Couchbase, Query and Indexing services within the Couchbase Server
- Dropbox, migrated some of their critical components from Python to Go
- Heroku, for Doozer, a lock service
- MongoDB, tools for administering MongoDB instances
- Netflix, for two portions of their server architecture
- Uber, for handling high volumes of geofence-based queries

Why Go?

- *Minimalism* - Go language specification is only 50 pages, with examples, easy to read. Core language consists of a few **simple, orthogonal** features that can be combined in a relatively small number of ways.
- *Code transparency* - your need to understand your code:
  - you **always** need to know **exactly what** your coding is doing;
  - you **sometimes** need to **estimate the resources** (time and memory) it uses;
  - one standard code format, automatically generated by the **fmt** tool.
- *Compatibility* - Go 1 has succinct and strict compatibility guarantees for the core language and standard packages. BSD-style license.
- *Performance* - compiled language, single standalone binary, low latency garbage collection, optimized standard libraries, fast build, scales well.

Go Main Features

- *Static typing* and *run-time efficiency* (like C++)
- *Syntax and environment patterns* more common in dynamic languages
- *Readability*, *usability* and *simplicity*
- *Fast compilation* times
- *High-performance networking* and *multiprocessing*
- Optional *concise variable declaration* and initialization through *type inference* (x := 0 not int x = 0; or var x = 0;).
- Remote *package management (go get)* and online *package documentation*.

Distinctive Approaches to Particular Problems

- Go is *strongly* and *statically* typed with no implicit conversions, but the syntactic overhead is small by using simple type inference in assignments together with untyped numeric constants.
- An *interface* system in place of *virtual inheritance*, and *type embedding* instead of *non-virtual inheritance*.
- Structurally typed *interfaces* provide *runtime polymorphism* through *dynamic dispatch*.
- Programs are constructed from *packages* that offer clear code separation and allow efficient management of dependencies.
- Built-in concurrency primitives: light-weight processes *(goroutines)*, *channels*, and the *select* statement

Distinctive Approaches to Particular Problems

- A toolchain that, by default, produces statically linked *native binaries without external dependencies*.
- Built-in frameworks for *testing* and *profiling* are small and easy to learn, but still fully functional.
- It's possible to *debug* and *profile* an optimized binary running in production through an HTTP server.
- Go has *automatically generated documentation* with *testable examples*.

Built-in Types

- Strings are provided by the language; a string behaves like a slice of bytes, but is immutable.
- Hash tables are provided by the language. They are called maps.

Pointers and References

- Go offers pointers to values of all types, not just objects and arrays. For any type T, there is a corresponding pointer type *T, denoting pointers to values of type T.
- Arrays in Go are values. When an array is used as a function parameter, the function receives a copy of the array, not a pointer to it. However, in practice functions often use slices for parameters; slices are references to underlying arrays.
- Certain types (maps, slices, and channels) are passed by reference, not by value. That is, passing a map to a function does not copy the map; if the function changes the map, the change will be seen by the caller. In Java terms, one can think of this as being a reference to the map.

Error Handling

- Instead of exceptions, Go uses errors to signify events such as end-of-file;
- And run-time panics for run-time errors such as attempting to index an array out of bounds.

Object-Oriented Programming

- Go does not have classes with constructors. Instead of instance methods, a class inheritance hierarchy, and dynamic method lookup, Go provides structs and interfaces.
- Go allows methods on any type; no boxing is required. The method receiver, which corresponds to this in Java, can be a direct value or a pointer.
- Go provides two access levels, analogous to Java's public and package-private. Top-level declarations are public if their names start with an upper-case letter, otherwise they are package-private.

Functional Programming. Concurrency

- Functions in Go are first class citizens. Function values can be used and passed around just like other values and function literals may refer to variables defined in a enclosing function (closure).
- Concurrency: Separate threads of execution, goroutines, and communication channels between them, channels, are provided by the language.

Omitted Features

- Go does not support implicit type conversion. Operations that mix different types require an explicit conversion. Instead Go offers Untyped numeric constants with no limits.
- Go does not support function overloading. Functions and methods in the same scope must have unique names. As alternatives, you can use optional parameters.
- Go has some built-in generic data types, such as slices and maps, and generic functions, such as append and copy. However, there is no mechanism for writing your own generic functions.

Installing Go

Download, installation, environment setup

Installation and Setup

- Download the Binary from: **https://golang.org/dl/**
- Windows - MSI installer. Installer should put the c:\Go\bin directory in your PATH environment variable.
- Create your workspace directory – e.g. %USERPROFILE%\go
- Setting environment variables under Windows – GOPATH (must not be the same path as your Go installation), GOTMPDIR, etc. Ex (Windows 10):
  - Open a command prompt (Win + r then type cmd) or a powershell window (Win + i).
  - Type: `setx GOPATH %USERPROFILE%\go`
  - OR (Go 1.13): `go env -w GOPATH=c:\go-work`
- Test your installation

Hello World in Go

```
package main

import "fmt"

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

```
C:\> cd %USERPROFILE%\go\src\hello

C:\Users\Gopher\go\src\hello> go build

C:\Users\Gopher\go\src\hello> hello
Hello, world!
```

Workspace Structure

```
bin/
    hello                   # command executable
    outyet                  # command executable
src/
    github.com/golang/example/
            .git/                   # Git repository metadata
            hello/
                hello.go            # command source
            outyet/
                main.go             # command source
                main_test.go        # test source
            stringutil/
                reverse.go          # package source
                reverse_test.go     # test source
    golang.org/x/image/
            .git/                   # Git repository metadata
            bmp/
                reader.go           # package source
                writer.go           # package source
    ... (many more repositories and packages omitted) ...
```

File Edit View Navigate Code Refactor Run Tools Git Window Help labs - functions\main.go

labs > lab2 > functions > main.go

Add Configuration... Git:

Project

labs D:\CourseGO\git\coursego\labs
- lab1
  - hello
    - hello.go
  - httpclient
    - client.go
  - httpserver
    - server.go
  - variables
    - variables.go
- lab2
  - countdups
    - data.txt
    - main.go
  - functions
    - main.go
  - loops
    - loops.go
  - types
    - types.go
- lab4
- External Libraries
- Scratches and Consoles

hello.go | client.go | server.go | variables.go | countdups\main.go | functions\main.go | loops.go | types.go

```
1  package main
2
3  import ...
6
7  func printf(format string, args ...interface{}) (int, error) {
8      _, err := fmt.Printf(format, args...)
9      return len(args), err
10 }
11
12 func main() {
13     argsLen, err := printf( format: "%v, %v\n",  args...: "abcd", 42)
14     if err == nil {
15         printf( format: "Number args: %d\n", argsLen)
16     } else {
17         printf( format: "Error: %v\n", err)
18     }
19
20     // closure demo
21     count := 0
22     inc := func() int {
23         count++
24         return count
25     }
26
27     incBy := func(n int) int {
28         count += n
29         return count
30     }
31
32     printf( format: "%d\n", inc())
33     printf( format: "%d\n", incBy( n: 5))
34 }
35
```

4 1

Project configurations files can be added to Git
View Files Always Add Don't Ask Again

main()

Problems Git Terminal TODO Event Log

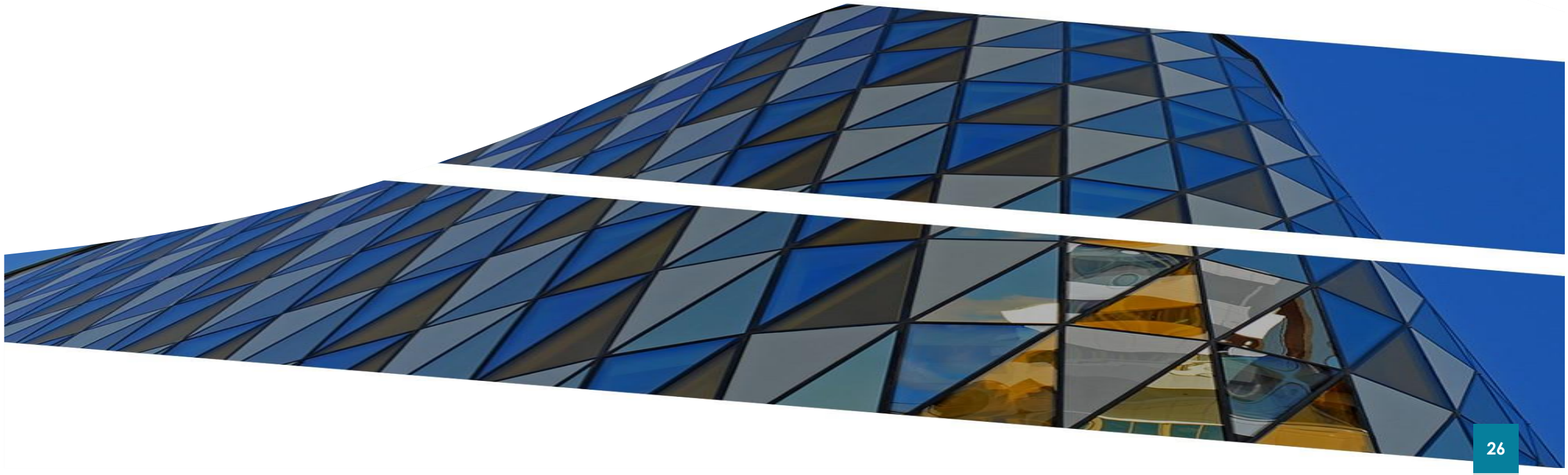
Project configurations files can be added to Git // View Files // Always Add // Don't Ask Again (41 minutes ago)

21:15 CRLF UTF-8 Tab master

Type here to search ENG 15:26 16.1.2021 г.

Go Basic Syntax

Download, installation, environment setup



The Structure of a Go Source File

Go code is arranged in **packages**, which fill the roles of both libraries and header files in C

```
package main

import "fmt"

func main() {

      fmt.Println("Hello, world!")

}
```

Every program must contain a **main** package, which contains a **main()** function, which is the program entry point

fmt package has been imported, any of its exported **types, variables, constants**, and **functions** can be used, prefixed by the package name; packages are imported when the code is linked, rather than when it is run; **access control** in Go is available only at package level.

Println() exported (public) function prints the text on the console

Creating Simple Library Package

```go
// Package stringutil contains utility functions for working with strings.
package stringutil

// Reverse returns its argument string reversed rune-wise left to right.
func Reverse(s string) string {
    r := []rune(s)
    for i, j := 0, len(r)-1; i < len(r)/2; i, j = i+1, j-1 {
        r[i], r[j] = r[j], r[i]
    }
    return string(r)
}
```

Using It

```
package main

import "fmt"
import "github.com/iproduct/coursego/simple/stringutil"

func main() {
    s := "Hello Go World!"
    fmt.Println(s)
    fmt.Println(stringutil.Reverse(s))
}
```

More Examples: Let's Write Some Code

- Variables
- Loops
- Functions
- Enums
- Structures and Methods
- Interfaces
- Polymorphism
- Casting
- Errors
- Http Client and Server

Recommended Literature

- The Go Documentation - https://golang.org/doc/
- The Go Bible: Effective Go - https://golang.org/doc/effective_go.html
- David Chisnall, *The Go Programming Language Phrasebook*, Addison Wesley, 2012
- Alan A. A. Donovan, Brian W. Kernighan, *The Go Programming Language*, Addison Wesley, 2016
- Nathan Youngman, Roger Peppé, *Get Programming with Go*, Manning, 2018
- Naren Yellavula, *Building RESTful Web Services with Go*, Packt, 2017

Thank's for Your Attention!

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