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

- Introduction to Go
- Program structure, data types, operators, control-flow statements, functions
- Composite types, functions, error handling
- Methods
- Interfaces. Domain Driven Design
- Testing with Go
- Goroutines and Channels
- Concurrency with Shared Variables

Course Schedule

- Working with SQL databases
- Building network clients, servers, and web services (REST)
- Building web services with gRPC
- Building web services with GraphQL
- Go 2 generics
- Modules and dependency management

Where to Find The Code and Materials?

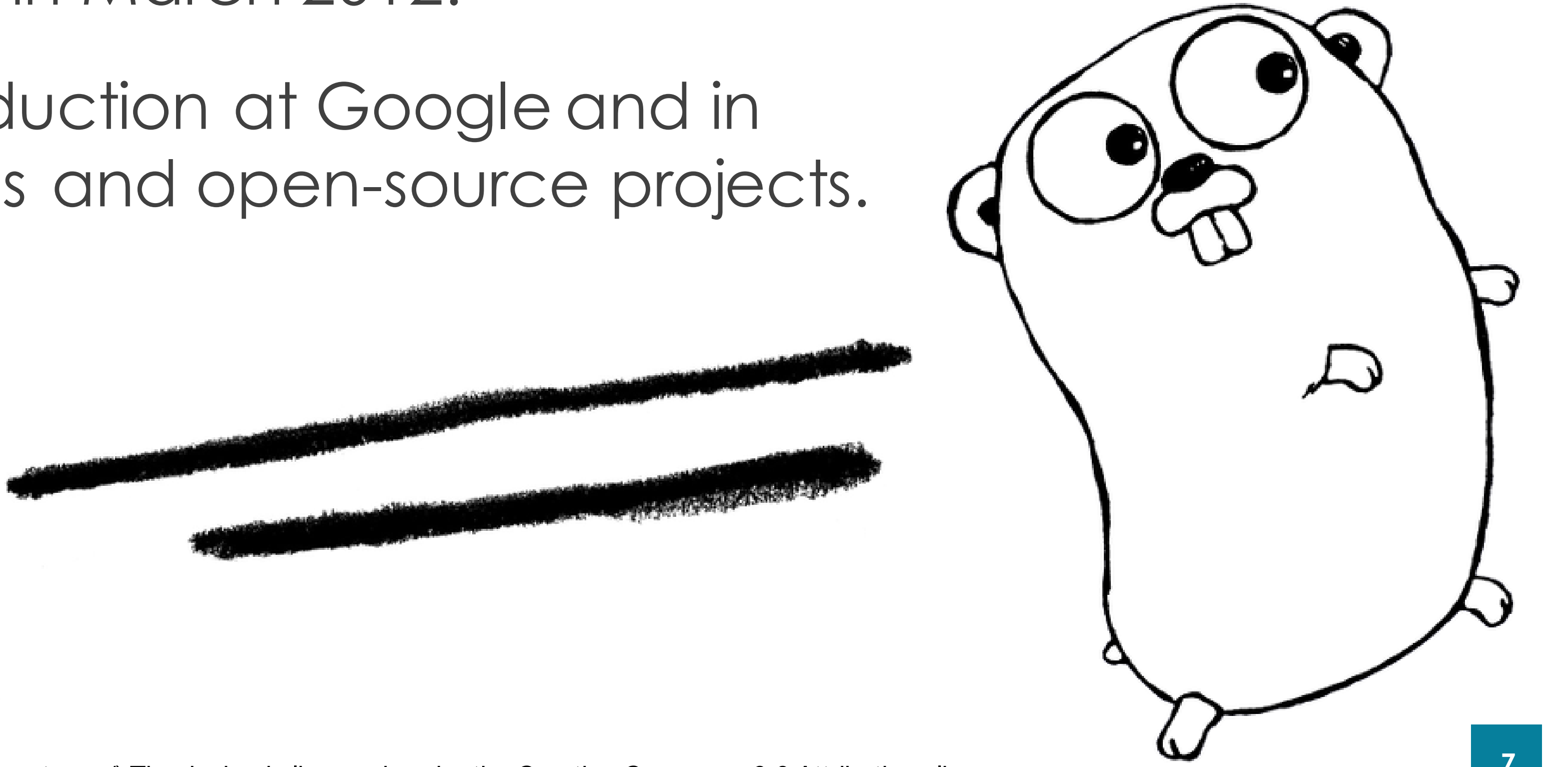
https://github.com/iproduct/coursego

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.



The Go gopher was designed by Renee French. (http://reneefrench.blogspot.com/) The design is licensed under the Creative Commons 3.0 Attributions license.

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.

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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.

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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.

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Installing Go

Download, installation, environment setup

Installation and Setup

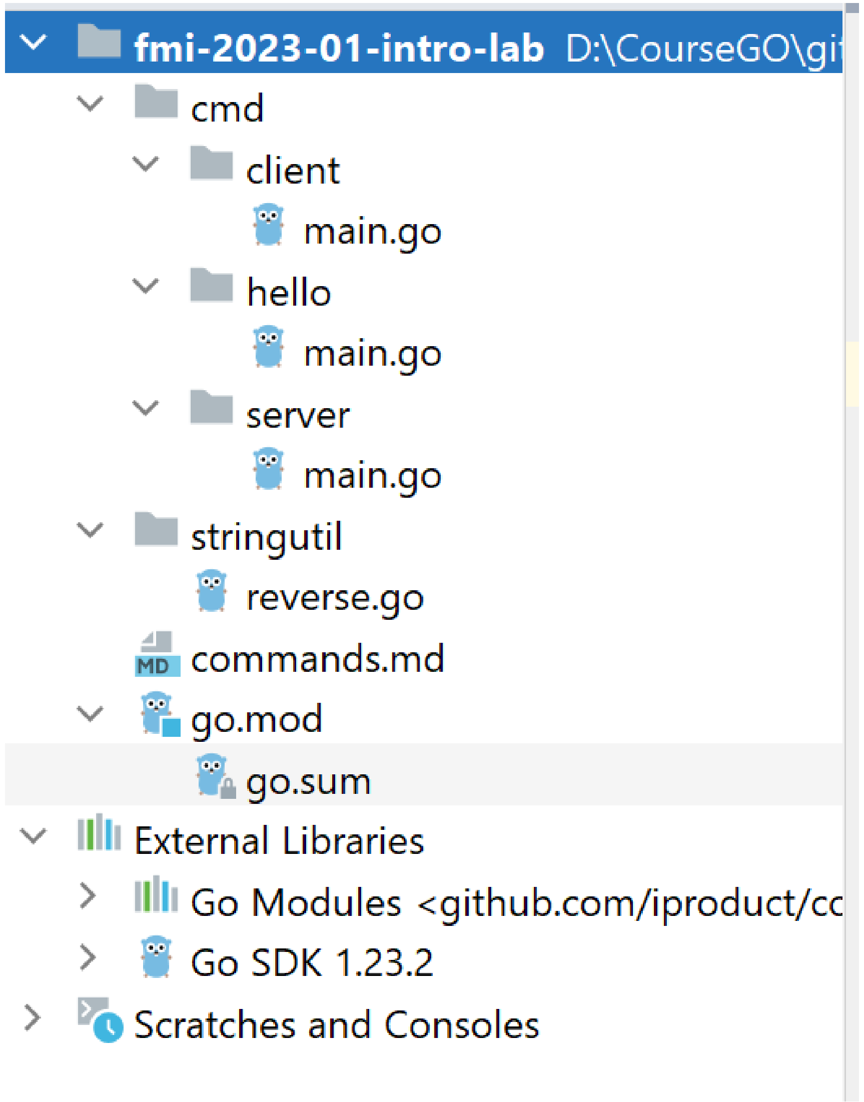
- Download the Binary from: **https://golang.org/dl/**
- Windows - MSI installer. Installer should put the c:\Go\bin directory in your PATH environment variable.
- Create your workspace directory – e.g. %USERPROFILE%\go
- Setting environment variables under Windows – GOPATH (must not be the same path 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 1.23.x): `go env -w GOPATH=c:\go-work`
- Test your installation

Hello World in Go – main.go

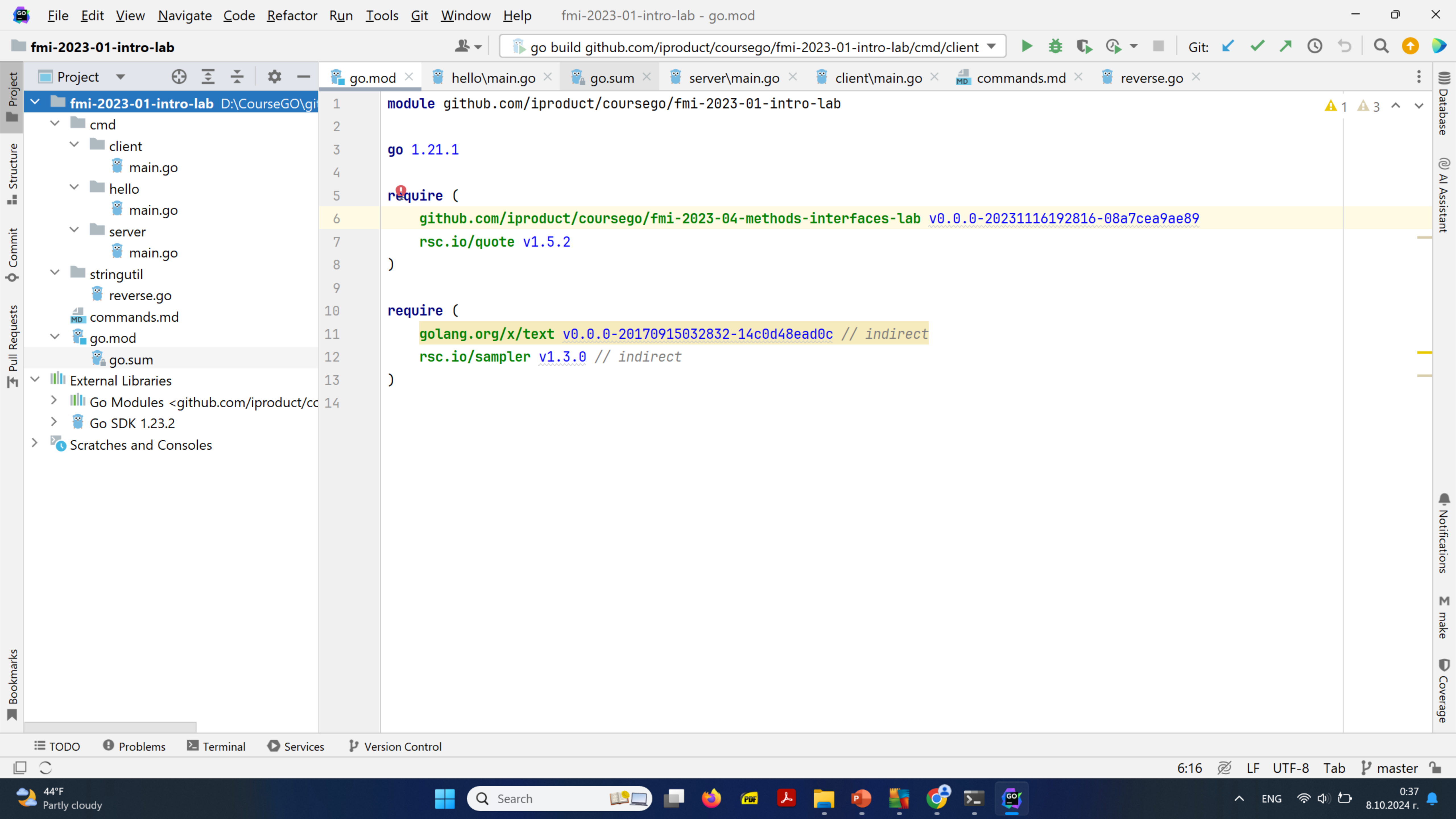
```
package main

import "fmt"

func main() {

        fmt.Println("Hello, world!")

}
```

```
cd C:\CourseGO\git\coursego\fmi-2023-01-intro-lab\cmd\hello

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

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

Go Project Structure



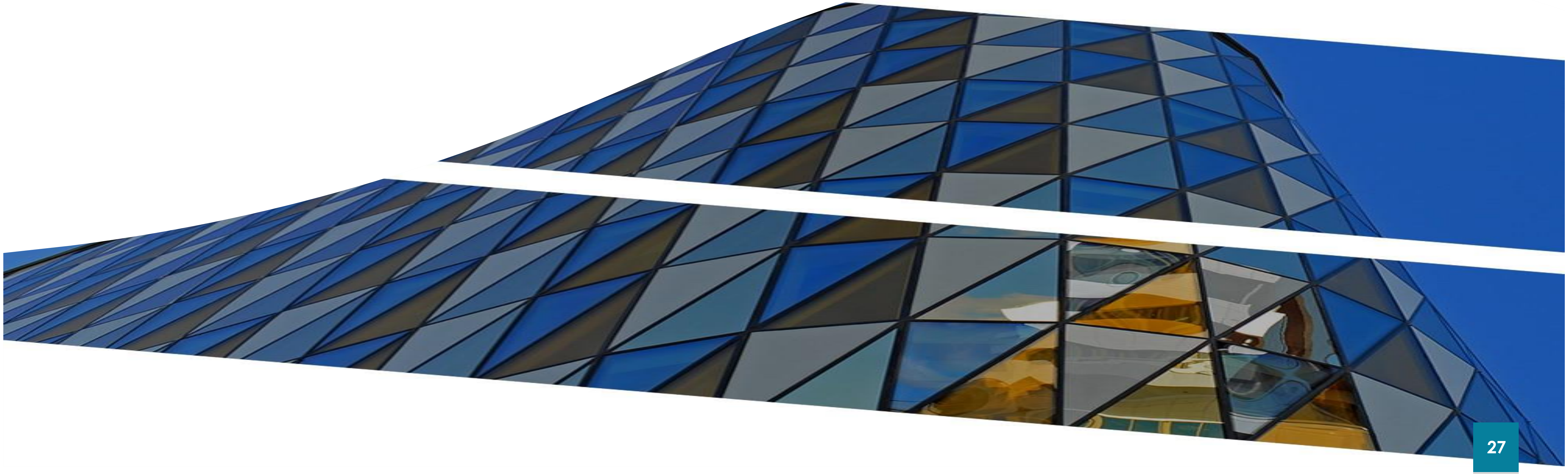
```
fmi-2023-01-intro-lab  D:\CourseGO\gi
    cmd
        client
            main.go
        hello
            main.go
        server
            main.go
    stringutil
        reverse.go
    commands.md
    go.mod
        go.sum
External Libraries
    Go Modules <github.com/iproduct/cc
    Go SDK 1.23.2
Scratches and Consoles
```



```
module github.com/iproduct/coursego/fmi-2023-01-intro-lab

go 1.21.1

require (
	github.com/iproduct/coursego/fmi-2023-04-methods-interfaces-lab v0.0.0-20231116192816-08a7cea9ae89
	rsc.io/quote v1.5.2
)

require (
	golang.org/x/text v0.0.0-20170915032832-14c0d48ead0c // indirect
	rsc.io/sampler v1.3.0 // indirect
)
```

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

```
// 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

```go
package main

import "fmt"
import "github.com/iproduct/coursegopro/01-intro/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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