Roadmap Reference

Here's some roadmap reference to learn https://roadmap.sh/pdfs/go.pdf

---

Go

Why Use Go ? There's Node JS

It is a compiled driven language, progress in the directory according to the
https://www.openmymind.net/assets/go/go.pdf
we can develop the application we want using this dir

```
mkdir {{parent_dir}}/go/src
```

Using the go programming language we can try to create the main function.
Using the main package example code

```go
package main

func main() {
  println("Helo World")
}
```

After we write the code we can compile with

```
go run main.go
```

or if you want to create the executable files you can create the go build main.go.

```
go build main.go
```

then we can have the executable of the source code of hello world program.

That's basically the process so we can try to write the Makefile.

Running every Section

To run every section of this writing excercices you can try to type this.

```
make build run
```

Generally I write the make file just like below snippets

```
build:
	cd ./bin/; go build ../src/main.go;

run:
	cd ./bin; ./main; cd ..
```

so the directory of every exercices should be

```
.
└── {{Exercices Name}}
    └── go
        ├── bin
        │   └── main
        ├── Makefile
        └── src
            └── main.go
```

That way we can try to run the compiled program using Makefile.

Running locally documentation

documentation at

```
godoc -http=:6060
```

Go Modules

It's an additional features into which to simplify the package for Go Workspace Program.

Go Workspace

Go Workspace is opinionated for efficiency and organized project with the team. There's certain convention in the go workspace. Example for using the Folder

```
.
├── bin -------------------> for binary files
│   └── main ---------------> the binary files
├── Makefile ---------------> where to create the makefile
├── pkg -------------------> using the package (archived files)
└── src -------------------> source code
    └── github.com --------> the control integration provider maybe github or
gitlab
      └── <username> ------> the username in that provider
        └── <folder with the code for project or repo> ----> the username in
that provider
```

The pkg folder is to put the file of compiled archived library so we don't need to recompile.

Go Help Command

```
go help
```

Environment Variables

Two Important Environment Variables

```
GOPATH = workspace
GOROOT = binary installation of Go
```

Just Type

```
go env
```

Create the module.

First of all we need to create the module in the project directory with this command

```
go mod init <name of the module>
```

Auto Formatting the Files

So Go have this features with the command `fmt` so all code will look the same. Just run

```
go fmt <dir/files you want to format>
```

So for examples if we create the files `src/main.go` like this

```
package main

import ( "fmt" )

func main() {
fmt.Println("Hello World") --> this is bad
}
```

It can get some troubles if we work we a team so we can go

```
go fmt src/main.go
```

It will automatically format the code for us just like below snippets.

```
package main

import ( "fmt" )

func main() {
  fmt.Println("Hello World") --> this is better
}
```

Go Modules

Go Modules is to managing the packages we install, so if our software is dependant about a software we should just configure it with the go modules.

ref: https://go.dev/blog/using-go-modules

OCT 15th WISUDA KA OKA.

Initialize

creates a new module

```
go mod init
```

We can create the file dir for the module:

```
mkdir new-exercises
```

then after creating the directory we go into that directory.

```
cd new-exercises
```

then launch into programming code editor

```
touch hello.go && nvim hello.go

```

and after that module we can put the code in the `hello`.go

```
package hello

func Hello() string {
  return "Hello, World"
}
```

and create more such as `hello_test`.go

```
package hello

import "testing"

func TestHello(t *testing.T) {
  want := "Hello, World"
          if got := Hello(); got != want {
            t.Error
          }
}
```

when creating the go-modules we should create the namespacing such as bin/ src/

such as this below.

```
go mod init new-exercises.com/gricowijaya/new-exercises
```

after that we can get the go.mod file.

we can try to cat the go`.`mod file

Adding the dependency

```
go get github.com/rsc/quote
```

then do testing the module is running or not

```
go test
```

then after it's all good we can modify the file `hello`.go file

in the hello file is we can create the import file and after that we can do go mod init

```
package hello

import "rsc.io/quote"

func Hello() string {
  return "Hello, World"
}
```

There are direct dependencies and indirect dependencies. --> search more about this.

If we want to get all package list then we can create

```
go list -m all
```

To get all the packages

NOTES : both go`.mod` and go`.sum` must be checked in the version control

Upgrading the dependency

We should list the file first such as using this command:

```
go list -m all
```

after that we can also get the try to get the content of the go`.mod` file :

```
cat go.mod
```

for example we want to upgrade the `rsc.io/sampler`

just type

to get the latest

```
go get rsc.io/sampler
```

to specify the version

```
go get rsc.io/sampler@v0.3.0
```

Packages

To Use the standard library you can use this link to read the documentation

https://pkg.go.dev/std

_ (throwing null error)

every program have package main and func main();

for example:

```
package main

import ( "fmt" )

func main() {
  n, _ := fmt.Println("Hello, world", 42, true)
  fmt.Println(n)

  // the _ is returning null error (if there's an error);
}
```

Short Declaration operator

example in the `short-declaration-operator/` directory

The Short Declaration Variables is allowing to write code and

example

```
x := 42 // declare and assign

fmt.Println(x)

y := 100 + 24 // making the expression for a statement

fmt.Println(y)
```

Identifiers

Identifiers --> is the program entities such as variables and types.
An identifiers is a sequence of one or more letters and digits.
It must be a letter;

There predeclared identifiers

The var Keyword

The var keyword for var is just to get the value for shortage for variabels.
There's also a zero value.

```go
package main

import ("fmt")

// declare and assign
var y = 49

func main() {
  x := 42
  fmt.printLn
}
```

Data Type

To get the type we can use the

```go
fmt.Printf("%T", y);
```

The Data type in Go is static not dynamic like Javascript.

It Has Primitive and Composite Data types (Array, Strings etc).

Zero Value

Declare a variable to be a certain type.

```go
package main

import ("fmt")

var y string

func main() {
  fmt.Println("start", y, "ending"); // output : start y ending
}

// assign into zero value
y = "Chaca"
```

Fmt Package

The Format package or `fmt` has many methods such as `Print`, `Println`, `Printf`, `Scanf`

To take input:

```
package main

import ("fmt)

var y int;

func main() {
  fmt.Scanf("%y"); // stdin
  fmt.Println(y); // stdout
}
```

Converting type

In the go programming language is kinda like the casting feature in C but
in Go it's called converting which used for changing data types to Type

```
type Integer int

import ("fmt")


func main() {
  var i int;
  i = 1;
  fmt.Printf("%T",i); // output :int
  i = Integer(i)
  fmt.Printf("%T",i); // output :string
}
```

Details on The Numeric Types

In the Numeric Types we can try to create such as uint8 (unsigned integer 8-bit) int8 etc

https://www.geeksforgeeks.org/data-types-in-go/

String

In Go Programming Language String is just a set of empty seqeunces of bytes.
The predeclared string type is called `string` there are a slice of bytes.

```go
package main

import("fmt")

func main() {
  s := "Hello World"
  fmt.Println(s);
  fmt.Println("%T\n", s);

  bytesString := []byte(s); // print the slice of bytes
  fmt.Println(bytesString);
  fmt.Println("%T\n", bytesString);
}
```

Constants

Which is the keyword `const` we can try to implement the const in this snippets

```go
package main

import("fmt")

const a = 1;
const b = 2;
const c = 3;

func main() {
  fmt.Println(a);
  fmt.Println(b);
  fmt.Println(c);
}
```

Another way to declare this is just like below.

```go
package main

import("fmt")

const (
  a int = 1
  b float64 = 2
  c string = 3
)
```

Iota

Is a special character that can be used sas an auto
it can be writtensuch as using the code below

```
package main
import("fmt")

const (
  a = iota
  b
  c
)

const (
  d
  c
  e
)

func main() {
  fmt.Println("a\n"); // output : 0
  fmt.Println("b\n"); // output : 1
  fmt.Println("c\n"); // output : 2
  fmt.Printf("%T\n", a); // output : int
  fmt.Printf("%T\n", b); // output : int
  fmt.Printf("%T\n", c); // output : int
}
```

Bit Shifting

We can transform the bit number into int with some of this technique.
Using Iota let's try to create it !

```
package main

import (
  "fmt"
)

const

func main() {
  x := 2
  fmt.Printf("[x] == %d\t\t%b\n", x, x); // output : %d is short for decimal
and %b is for binary

  y := x << 1 //  assign shited x by 1 into y
  fmt.Printf("[x] == %d\t\t%b\n", y, y); // output : %d is short for decimal
and %b is for binary
}
```

Why we should learn about the bit shifting ? Let's take an example here:

```
package main

import (
  "fmt"
)

func main() {

  kb := 1024
  mb := 1024 * kb
  gb := 1024 * mb

  fmt.Println("\t[decimal]\t\t[binary]");
  fmt.Printf("[kb] == %d\t\t%b\n", kb, kb); // output :
  fmt.Printf("[mb] == %d\t\t%b\n", mb, mb); // output :
  fmt.Printf("[gb] == %d\t\t%b\n", gb, gb); // output :
}
```

The output from the program above is like the below snippets

```
[decimal]              [binary]
[kb] == 1024           10000000000
[mb] == 1048576      100000000000000000000
[gb] == 1073741824  1000000000000000000000000000000
```

that is with a declarable variable with iota we can manipulate the program
so it'll be more automated declaration by the go compiler, because the kb mb gb
is incremented by default with iota declaration for example of code we can
write just like the below code.

```
package main

import (
  "fmt"
)

// built with iota
const (
  _ = iota;
  kb = 1 << ( iota * 10  )
  mb = 1 << ( iota * 10 )
  gb = 1 << ( iota * 10 )
)

func main() {
  fmt.Println("\t[decimal]\t\t[binary]");
  fmt.Printf("[kb] == %d\t\t%b\n", kb, kb);
  fmt.Printf("[mb] == %d\t\t%b\n", mb, mb);
  fmt.Printf("[gb] == %d\t%b\n", gb, gb);
}
```

it will create the same output from the program before but as we can see it is
a good practice by using iota in shifting an incremental values rather
than declare a variables, but it is a personal preferences.

For more Bit Hacking we can also reference to this article :

https://medium.com/learning-the-go-programming-language/bit-hacking-with-go-e0acee258827

Exercises

In Go we can write the assign a comparation between a value such as <= >= etc.
The code is just like below.

```
package main

import("fmt")

func main() {
  a := ( 42 == 42) // output : true
  b := ( 42 <= 43) // output : true
  c := ( 42 >= 43) // output : false
  d := ( 42 != 43) // output : true
  e := ( 42 <  43) // output : true
  f := ( 42 >  43) // output : false

  fmt.Println(a, b, c, d, e, f);
}
```

In the code above we can assign the value of a `b c d e f` for getting the
boolean value of the condition is true or false

TYPED and UNTYPED Constants

We can expand the program above using the TYPED and UNTYPED values.
the Procedure we need to create is just like this.

1. We need to set the constant variable first.
2. Assign the variable into using the typed and untyped variabels

```
package main

import("fmt")

const (
  a = 42 // UNTYPED constant -- flexibility for the compiler beware they can
read this as a string.
  b int = 43 // TYPED constant -- more precise type for the compiler.
)

func main() {
  fmt.Println(a, b);
  fmt.Printf("%T, %T", a, b); // if we want to see the data type of the
variables
}
```

Control Flow in Go

In Go Programming Language we can use the control flow to create the such loop

A Loop contain a init, condition, and post. You may ask, what are those ?

init stands for initialization variables, condition is for conditioning the
variables in the looping section such as how to do want control this looping
(because of course we don't want a infinite looping program) and post is control
is to update the condition so the init also will be updated.

For Loop

```
package main

import("fmt")

func main() {
  for i := 1; i < 4; i++ {
    fmt.Printf("loop iteration of %d\n", i );
  }
}
```

The output for the program above is will be like

```
loop iteration of 1
loop iteration of 2
loop iteration of 3
```

Well the above program is a simple program which will run just word of
'loop iteration of {number of iteration}'

Meanwhile go there are so many ways to write iteration.
In the go environment we can use many keyword for using iteration

Switch Case

Create the switch case in the go programming language there's a feature of it which is called `fallthrough`.

fallthrough is just like when the condition is true then told the program to continue.

The value of switch expression

```
package main

import("fmt");

func main(){
  n := 2;
  switch nx {
    case 1:
      fmt.Println("Case 1");
      fallthrough
    case 2:
      fmt.Println("Case 2");
      fallthrough
    default:

  }
}
```

Usage of break and continue

The usage of break and continue in the go programming is that they can be used as a control condition for loops

For example

```
package main

import("fmt")

func main() {
  for i := 1; i < 3 ; i++ {
    if i == 3 {
      break;
    }

    fmt.Println("it's already broken in ", i);
  }
}
```

Array

Declaring an array in go programming language can be written in different method such as in programming is an 0 based index

```go
package main

import("fmt")

func main() {
  array := [3]string{"one", "two", "three"}
  fmt.Print(array); // output [one two three]
}
```

We also can use the var keyword just like the below snippets

```go
package main

import("fmt")

func main() {
  var number_of_array = [3]int{1, 2, 3}
  fmt.Println(number_of_array[1]) // output = 2
}
```

for accessing the array we can use the loops such as for in range or regular for loops just like the snippets below:

```go
package main

import("fmt")

func main() {
  var number_of_array = [10]one{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
  for i := 1; i <=10 ; i++ {
    fmt.Println(`using the for loop`, array[i]);
  }

  for _, value := range number_of_array {       // use a blank identifiers
    fmt.Println(`using the for in range loop `, value);
  }
}
```

you can choose however you like to loops the array either with the regular for loops or the for in range loop

Arrays are useful but use slices instead.

one more example

```
package main

import("fmt")

func main() {
  var x[3]int
  var y[10]int
  fmt.Printf("%t", x)
  fmt.Printf("%t", y.len)
}
```

To get a length of an array we can use the `len` function.

Slices

Slices is one of the Aggregate data types which sometime called structure types which is composite data types which called structure.
Which is a composite literal.

```
package main

import("fmt")

func main() {
  // x := []type{values} COMPOSITE literal
  x := []int{1 , 2, 3, 4, 5, 6} // x is a slice ([]) of int
  fmt.Println(x);
}
```

To loop over a value in a slice we can try to create just like the below functions

```
package main

import("fmt")

func main() {
  //
  x := []int{1 , 2, 3, 4, 5, 6} // x is a slice ([]) of int
  fmt.Println(x);

  for index, value := range x {
    fmt.Printf("This is the element of %d is %d", index, value)
  }
}
```

After we try to create the slices of slice using the `:` (colon operator)

```
package main

import("fmt")

func main() {
  //
  x := []int{10, 20, 30, 40, 50, 60} // x is a slice ([]) of int
  fmt.Println(x[1:2]); // output will be 20 because will get the element that
start from index 1 up to element that before index 2 which is 20
}
```

In Slice we also can append to a slice which we can add the value into it.

```
package main

import("fmt")

func main() {
  x := []int{10, 20, 30, 40, 50, 60} // x is a slice ([]) of int
  fmt.Println("before append", x)
  x = append(x, 80, 70, 90 )          // append 80, 70, 90 into x
  fmt.Println("after append", x)

  y := []int{1,45,433,432,678}
  x  = append(x, y...)

  fmt.Println("After appended with y ", y)

  x = append(x[:5], x[6:]...) // remove the element between the 5th and 6th
index
  fmt.Println("After remove the element ", x)

}
```

Multi Dimensional Slice

We can declare the multi dimensional slice just like the main slice declaration for the go programming language except with a slices in side the slices for example:

```
package main

import("fmt")

func main() {
  x := []int{10, 20, 30, 40, 50, 60} // x is a slice ([]) of int
  y := []int{1,45,433,432,678}

  z := [][]int{x, y}
  fmt.Println("multi dimensional slices ", z) // output will be [[10, 20, 30,
40, 50, 60] [1, 45, 433, 432, 678]]
}
```

think of it just like a spreadsheet to better visualization

```
[
  [10, 20, 30, 40, 50, 60],
  [1, 45, 433, 432, 678]
]
```

Map

What is maps is a key value store which is store some value based on the key.

Language specification

```
package main

import("fmt")

func main() {
  m := map[string]int{
    "James" : 32,
    "Miss Money": 28,
  }

  fmt.Println(n);
  fmt.Println(m["James"]) // output : 32
  fmt.Println(m["Barnabas"]) // output : 0 -> because the value is not stored
in the maps

  v, ok := m["Barnabas"]      // use the comma ok idiom
  fmt.Println(m["Barnabas"]) // output : 0
  fmt.Println(v)             // output : 0
  fmt.Println(ok)            // output : false

  // we can combine it with an if statme just like this
  if v, ok := m["Barnabas"]; ok {
    fmt.Println("It's in there")
  }
}
```

Map

Hold references to an underlying data structure it can be distinguish a missing
entry of value.

```go
package main

import("fmt")

funct main() {
  m := map[string]int{
    "James":32,
    "Miss Moneypenny":27,
  }
  fmt.Println(m)
  fmt.Println(m["James"])
  fmt.Println(m["Barnabas"])

  v, ok := m["Barnabas"]
  fmt.Println(v)
  fmt.Println(ok)

  if v, ok := m["Barnabas"]; ok { fmt.Println(v) }
```

Adding Element & Range

```go
package main

import("fmt")

func main() {
  m := map[string]int{
    "James":32,
    "Miss Moneypenny":27,
  }
  fmt.Println(m)
  fmt.Println(m["James"])
  fmt.Println(m["Barnabas"])

  v, ok := m["Barnabas"]
  fmt.Println(v)
  fmt.Println(ok)

  m["Todd"] = 44
  if v, ok := m["Barnabas"]; ok { fmt.Println(v) }

  for k, v := range m {
    fmt.Println("Print the ", k, v);
  }

  xi := []int{4,2,3,4,1,54}

  for i, v := range xi {
    fmt.Println(i, v);
  }
}
```

Delete from a Map

```go
package main

import("fmt")

func main() {
  m := map[string]int{
    "James":32,
    "Miss Moneypenny":27,
  }
  fmt.Println(m)
   delete(m, "James")

   delete(m, "Ian Fleming")

  fmt.Println(m["Miss Moneypenny"])
  fmt.Println(m["Ian Fleming"])

  if v, ok := m["Miss Moneypenny"]; ok {
    fmt.Println("value", v);
    delete(m, "Miss moneypennny")
  }
}
```

Structs

Struct is a data structure that consists of different Data Type which can be aggrogated

```go
package main
import("fmt")

type person struct {
  first string
  last string
}

func main() {
    p1 := person {
      first: "James",
      last: "Bond",
    }

    p2 := person {
      first: "Miss"
      first: "Moneypenny"
    }

    fmt.Println(p1)
    fmt.Println(p2)
}
```

Embedding Type

To approaching the OOP in Go we can try to create just like this.

```go
package main
import("fmt")

type person struct {
  first string
  last string
}

type secretAgent struct {
  person
  ltk bool // license to kill
}

func main() {

    sa1 := secretAgent{
      person: person {
        first: "James",
        last: "Bond",
      },
      ltk: true,
    }

    p2 := person {
      first: "Miss"
      first: "Moneypenny"
    }

    fmt.Println(p1)
    fmt.Println(p2)
}
```

Anonymous Structs

If We need a struct in little area.

```
import("fmt")

type person struct {
}

func main() {

    p1 := struct {
      first string
      last string
      age int
    }{
      first: "James",
      last: "Name",
      age: 32 ,
    }

    fmt.Println(p1)
}
```

Functions

We Can use packages or functions which we can use to programming.

The Function parameters

```
func (r receiver) identifiers(parameters) (return(s))) {...}
```

```
func foo() {
  fmt.Println("Hello From Foo")
}
```

We can pass parameter using the pass by value for example

```
func name(s string) {
  fmt.Println("Hello my name is ", s)
}
```

To return a value we can create how to use the

```
func woo()
```

Variadic Parameters

```go
package main

import "fmt"

func main() {
  foo(1, 2, 3);
}

// foo is a variadic function.
// It can be called in the following ways:
// foo()
func foo(args ...int) {
  fmt.Println(args)
}
```

Methods

Adding methods into a type of struct can be easily done with passing the type of struct into the function hence we can get the type method.

```go
package main

import (
  "fmt"
)

// we can create the struct of person
type person struct {
  first string
  last string

}

// then we can create the struct of secretAgent that inherit from person
type secretAgent struct {
  person
  ltk bool
}

// pass the secret agent type into the function speak
// the purposes of this is to create any value with the the type of secret
Agent have the method of speak
func (s secretAgent) speak() {
  fmt.Println("I am ", s.first, s.last, " and I have the licencse to kill value
of ", s.ltk);

}

// the main function
func main() {
  // value of secretAgent type have the access the method of speak
  firstSecretAgent := secretAgent {
    // assign the value
    person: person {
      "James",
      "Bond",
    },
    ltk:true, // set to true because he is a secret agent
  }
  // print the values of firstSecretAgent variables
  fmt.Println(firstSecretAgent)

  // run the method of speak for secret agent
  firstSecretAgent.speak();
}
```

Polymorphism

basically polymorphism is running the same method with different type.
As a human have a method of speak hence a person is a human and a secret agent
is a person which impelemting the method of human into secret agent.

```go
package main

import (
  "fmt"
)

type person struct {
  first string
  last string
}

type secretAgent struct {
  person
  ltk bool
}


// anybody or type who have the method of speak is implement an human interface
// keyword identifier type
type human interface {
  speak()
}

func bar(h human) {
  fmt.Println("i called human ", h);
}

//-----------------------------------------------
// BELOW is the same method but different type

// any value with the the type of secret Agent have the method of speak
func (s secretAgent) speak() {
  fmt.Println("I am ", s.first, s.last, " and I have the licencse to kill value
of ", s.ltk);

}

// let's add the person to the method for speak so it's implementing the human
interface
func (p person) speak() {
  fmt.Println("I am ", p.first, p.last, " and I am a person");
}

func main() {
  firstSecretAgent := secretAgent {
    person: person {
      "James",
      "Bond",
    },
    ltk:true,
  }

  firstPerson := person {
    first: "Dr. ",
    last: "Octopus",
  }

  fmt.Println(firstSecretAgent);
  fmt.Println(firstPerson);
  firstSecretAgent.speak();

  // first Person is a type of person but it has a function of person
  // so we can pass the parameter of first person into a human parameter.
  bar(firstPerson);
}
```

Anonymous Func

An anonymous funcion is a function without a name. Why do we need this type of function?
because an anonymous function is also called function literal. It ellows us
to assigned to the function into a variable. so when we want to do some small
process we can create to the function.

For Example of anonymous func is just like down below

```
package main

import("fmt")

func main() {
  foo()

  // this is another anonymous function with no argument passed
  func() {
    fmt.Println("Anonymous func")
  }() // include the parenthses which pass nothing

  // this is another anonymous function with argument passed
  print42 := func(x int) {
    fmt.Printf("Anonymous func which take args of x = %d", x);
  }(42) // include the parenthses which pass nothing

  // because we need to output of the value of 42 then this print 42
  print42(); }

func foo() {
  fmt.Println("foo() Function Hello World")
}
```

From the above function we can get the `print42`
to print Anonymous `func which take args of x 42`

This also called function expression

Returning Function

We can try to create a function that returns a function but first of all
Why we would wanna do that ? First off all it's fun but second of all it'll
be good for the callback functions

```go
package main
import("fmt")

func main() {
  stringThis := foo()
  fmt.Println(stringThis)

  x := bar()
  fmt.Printf("%T\n", x)       // going to return a func int() which is the type
of x
  fmt.Printf("%d\n", x())     // return 451

}

func foo() string {
  s := "Hello World"
  return s
}

// function bar is a will return a function that returns an intkj
func bar() func() int {
  return func() int {
    return 451
  }
}
```

Callback

Callback function is a function that receives an argument of a type that is
a function for example:

```go
package main

import ("fmt")

func main() {
  ii := []int{1,3,4,1,5,6}
  fmt.Println("Hello, World");
  s := sum(ii...)
  s2 := even(sum, ii...) // pass the function of sum and also the ii slice
  s3 := odd(sum, ii...)  // check the function
  fmt.Println(s)
  fmt.Println("All even Numbers", s2)
  fmt.Println("All odd Numbers", s3)
}

func sum(xi ...int) int {
  fmt.Printf("%T\n", xi) // output : slice of int
  total := 0
  for _, value := range xi {
    total += value
  }
  return total
}

// passing a function of variadic parameter of int
// sum of all even number
func even(f func(xi ...int) int, vi ...int) int{
  var yi []int
  for _, value := range vi {
    if value % 2 == 0 {
      yi = append(yi, value);
    }
  }

  return f(yi...) // getting the unilimited number of slice of int
}

// passing a function of variadic parameter of int
// sum of all odd number
func odd(f func(xi ...int) int, vi ...int) int{
  var yi []int
  for _, value := range vi {
    if value % 2 != 0 {
      yi = append(yi, value);
    }
  }

  return f(yi...) // getting the unilimited number of slice of int
}
```

Closure

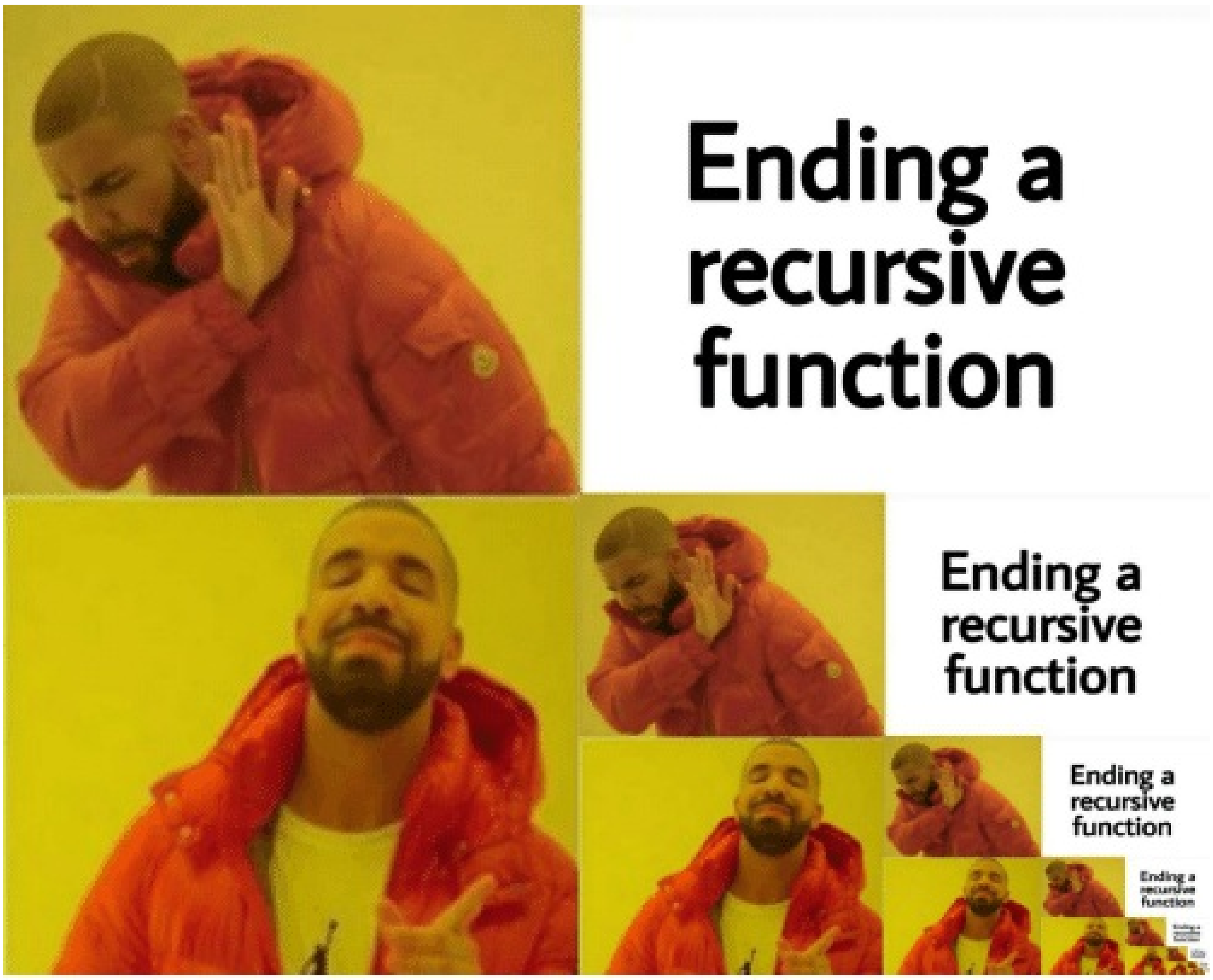
The closure scope in golang such local and global. If there's a code block
in a code block then we cannot use it globally. for example we will create :
a incrementor function that'll help us to understand the closure.

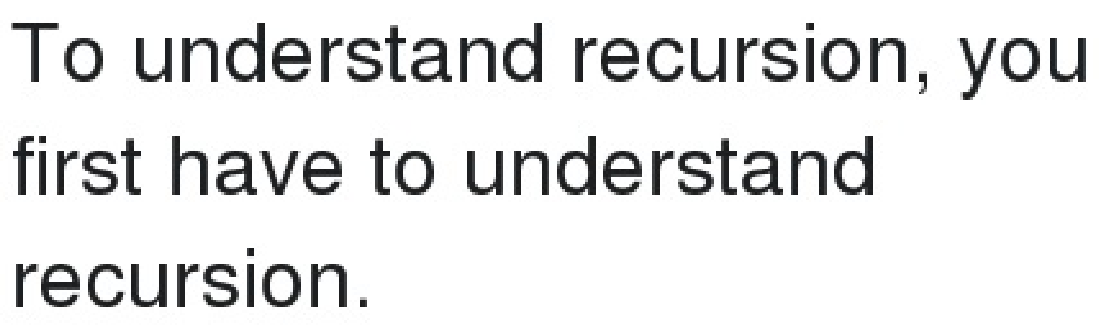
```
package main

import("fmt")

func main() {
  i := incrementor() // i variable is a function expression of incrementor()
  j := incrementor() // j variable is a function expression of incrementor()

  fmt.Println("i func expression", i()) // output : 1
  fmt.Println("j func expression", j()) // output : 1
  fmt.Println("j func expression", j()) // output : 2 (x + 1)
  fmt.Println("j func expression", j()) // output : 3 (x + 1)
  fmt.Println("j func expression", j()) // output : 4 (x + 1)
  fmt.Println("j func expression", j()) // output : 5 (x + 1)
  fmt.Println("j func expression", j()) // output : 6 (x + 1)
}


// this function will return a function that return an int
func incrementor() func() int {
  // this `x` variable below will be valid until a few line
  // each time this function is called then golang will
  // create a new address for the x variable
  // that's why even if this is a local function it still
  // can increment the value of the value of x
  var x int
  return func() int{
     x++ // increment the x + 1;
     return x
  }
}
```

The Description of the code is already at the code comments

Recursion

What is recursion to be exact ? Basically look at this meme.


Ending a recursive function
Ending a recursive function
Ending a recursive function
Ending a recursive function


To understand recursion, you first have to understand recursion.

Recursion is will have the memory impact from the users because it will loop to call a function
There's are many ways to loop a program in a programming paradigm such as for loop
while loop do-while loop for in range. One of them is to trick them using recursion.

Recursion is a function that will call itself that will using how to return
the function that they see a lot of different things of a function. For Example
we can create the factorial function which will be demonstrated like the code below:

```go
package main

import("fmt")

// using recursive function
func factorialRecursive(n int) int {
  fmt.Println("Process ", n, " * ", n - 1)
  // stop the function for calling itself after we hit n == 0
  if n == 0 { return 1}
  return n * factorialRecursive(n - 1) // return the factorial by calling it
self
}

// using loops
func factorialLoop(n int) int {
  var x int
  // initialise the value x into 1 why ? because we will multiply the x with n
  // if we not assign x into 1 then we won't get the value.
  x = 1

  // initialize the incremental variable (i) then assign n into variable i
  // why ? because we will decrement the value of n after it multiply by
itself.
  for i := n; n > 0 ; n-- {
    x *= n
    fmt.Printf("i[%d] x[%d] n[%d]\n", i, x, n) // trace the value on i, x, and
n
  }

  // return the value of x which is the result of factorial of n
  return x
}

func main() {
  n := factorialRecursive(5);
  fmt.Println("The factorialRecursive value of 5 is = ", n)
  x := factorialLoop(5);
  fmt.Println("The factorialLoop value of 5 is = ", x)
}
```