# GO Workspaces:

In Go, programs are kept in a directory hierarchy that is called a workspace.

A workspace is root directory of your Go applications.

A workspace contains three subdirectories at its root:

src - source files organized as packages.

pkg - Go package objects.

bin - Compiled objects of each module executable programs, i.e., binaries.

When we do import "<package-name>" Go looks for these packages in $GOROOT/src or $GOPATH/src directories.

If a precompiled package object is found, Go uses that instead. Executables link all those compiled objects based on the modules used in the src code.

go install - creates package objects

go build - creates executables

go run - to compile and run

GOPATH - location of go workspaces.

Every go program should be part of a package.

If we define the package as package main, when we run such code, it creates an executable.

Every .go file in the same folder must have the same package name.

All identifiers will be exported to other packages if the first letter of the identifier name starts with an uppercase.

main function - entry point of execution

go.mod - first line is the name or URL or the import path of the go module

go mod tidy - adds any extra dependencies needed by the OS, architecture or the build.

go.sum is just for validation purposes. It has the expected cryptographic checksums of the content of specific module versions, so that we know if there is any change in the dependent module.

# Pointers:

Pointer - is a memory address to the variable it points to.

Go by default is pass by value, to change it to pass by reference, use pointers.

Pointers allows us to pass references to variables instead of passing the actual variables.

Passing the pointer allows us to effect the changes to the actual variable, whereas pass by value will not change the actual variable.

Difference between pointer receiver and value receiver is:

value receiver - pass by value

pointer receiver - pass by reference

*Meaning of pass by value:*

*When you pass an argument to a function, a copy of argument is created and that copy is passed to the function.   
 To pass the original value, use pointers. This helps in saving memory as we avoid creating unnecessary copies while calling functions.*

# Interfaces:

1. Similar to Struct, where Struct holds variables, Interface holds method signatures.
2. It is about behaviour of the object.
3. Interface is a tool for composition.   
   Composition: “has-a”, Inheritance: “is-a”
4. Tool for abstraction. instead of designing our abstractions in terms of what kind of data our types can hold, we design our abstractions in terms of what actions our types can execute.
5. Interfaces make the function agnostic (or flexible) about the exact type of object it receives. All that matters is what methods it has. In other words, if an object satisfies an interface, we can be sure that it implements all the methods defined in the interface.
6. a pointer type may call the methods of its associated value type, but not vice versa

Interface helps to achieve run time polymorphism, i.e.,call is resolved at run time.

An interface is two things:

It is a set of methods,

but it is also a type

Types of Int, String, array are all concrete, as in, you know exactly what it is and what you can do with it.

Interface is abstract type

the type and value of the interface are dynamic.

it takes the type of the underlying struct which implements this interface, i.e., you can assign an expression to an interface only if its type satisfies the interface.

Empty Interface:

Interface with zero methods. It is a general container type.

A slice holds the reference to an array. Similarly, interfaces dynamically hold a reference to the underlying type which implements the interface.

v interface{} 🡪 here ‘v’ is not any type, it is interface{} type.  
When a function is defined as func xyx(v interface{}) ,   
Go runtime converts the passed argument value to the type interface{}.

Just like Slice points to the underlying array, Interface points to two things:  
1. To the underlying type of the argument  
2. To the actual data of the argument.

4. there are no exceptions in go, only errors

Defers happen Last in First out

Recover is only helpful with Defers. Defer + anonymous fn + recover

6. Though Go is statically typed language, while declaring a variable you can omit the data type of it,

as go uses type inference. It infers the datatype from the data we assing to variable.

In Go, variables are always initialized to a well-defined value, if no value is sepcified, the zero

value is picked.

7. Difference between array and slice

Array is immutable.

Slice syntax - var mySlice3 := make([]int, 4, 4)

8. Polymorphism in Go is achieved with the help of interfaces.

# Struct:

Struct is a datatype in golang which contains the blueprint of data the structure will hold.

Used to store Records.

The data consists of field names and the datatypes of the fields

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Variadic functions

A variadic function accepts an infinite number of arguments and all these arguments are stored in a slice.

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Slices and Arrays differences

Slices are sequences of typed data. Abstraction on top of array.

Array elements are indexed. Arrays are inflexible as they have fixed size. So an Abstraction is built on top of array which is Slice.

A slice is not an array. A slice describes a piece of an array.

Slice points to the underlying array and the capacity of slice is the size of the array.

Slice has 3 elements:  
1. Pointer to the underlying array  
2. Length of the slice  
3. Capacity of the slice.

So slicing operation in slice is as good as accessing array elements.

If you want to go beyond the slice capacity, you need to use copy function.

# Maps

Maps are associative data types.

The biggest problem in golang is to differentiate between actual zero value and the default zero value.

# Methods:

Methods and Functions differences

var\_name.method\_name()

function\_name(var\_name)

Same method\_name can be used for different variables, but the function name

should be unique.

Methods can be chained.

a pointer type may call the methods of its associated value type, but not vice versa

# Naming Convention:

Files: all lowercase, separate with “\_”

Starting with “.” Or “\_” are ignored

Ending with \_test are run by go test

Functions: CamelCase

Constants: All Caps, separated with “\_”

Variables: Boolean variables should start with Has, Is etc.

Identifier, is a fancy word for variable name.

Short variable names work well when the distance between their declaration and last use is short.

Use long variable names, if the variable is used in multiple places.

Don’t include the name of the type in the name of your variable.

Constants should describe the value they hold, not how that value is used.

Single letter variables for loops and branches  
Single words for parameters and return values  
Multiple words for functions and package level declarations  
Single words for methods, interfaces, and packages.

# Channels:

Channels are communication channels for goroutines.

You can write to the channels and wait on the channel to read input from the channel.

If you read from empty channel, it's a deadlock.

Channel read is a blocking operation.

Follow the direction of the arrow to understand Reads and Writes.

msg := <-messages // Channel Read

messages <- "ping" // Channel Write

Difference between channels and buffered channels:

Buffer size: the number of elements that can be sent to the channel without the send blocking. By default, a channel has a buffer size of 0 (you get this with make(chan int)). This means that every single send will block until another goroutine receives from the channel. A channel of buffer size 1 can hold 1 element until sending blocks.

Channels are blocking as they only store one item, Only one item can be read or write at a time.  
If you want to send a value to the channel, it is blocked till another goroutine receives this value. For buffered channel you have a buffer of values. Only if the buffer is full, it gets blocked, i.e., deadlock.

Select statements lets you wait on channel operations.  
To have non-blocking channel operations, use select with default, default case would be non-blocking.

Routing in golang

To implement a server, we need two things: Port and routes.

flow of control for a HTTP request looks like:

Router => Middleware Handler => Application Handler

1. Router in golang - ServeMux

which is a HTTP request router, It matches the URL of each incoming request against a list of

registered patterns and calls the handler for the pattern that most closely matches the URL.

2. Middleware - Shared functionality that you want to run for many (or even all) HTTP requests.

Middleware should satisfy http.Handler interface

Build a chain of handlers containing both middleware handler and normal application handler,

which can be registered with a router.

3. Handlers are responsible for writing response headers and bodies.

Any object can be a handler, so long as it satisfies the http.Handler interface.

It must have a ServeHTTP method with the following signature: ServeHTTP(http.ResponseWriter, \*http.Request)

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Errors:

An error is return value in golang which is returned if something unexpected happened.

"error" is builtin type in golang.

type error interface {

Error() string

}

How to create a new error type:

any type that implements Error() function is an "error" type.

errors.New("Custom error type")

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Marshalling, Unmarshalling <---> Encoding, Decoding:

Marshalling - Go objects to JSON, It returns a []byte of JSON data

Encoding -

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Goroutines

Goroutines are cheap. Because of the runtime‚Äôs ability to multiplex goroutines onto a small pool

of threads (which you don‚Äôt have to manage), hundreds of thousands, millions of goroutines are easily accommodated.

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Panic Defer Recover

Defer gets executed just before the function returns or in case of panic

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**CONCURRENCY:**

Concurrency is handling multiple things at same time.

Concurrency is DEALING with multiple things at once,   
Parallelism is DOING multiple things at once.

Concurrent programming is - programs fight for the cpu time

Parallel programming - independent CPU times are available for the programs.

Parallel programming is to specifically refer to the simultaneous execution of concurrent tasks on different processors or cores.

Thus, all parallel programming is concurrent, but not all concurrent programming is parallel.

Reference - https://www.mineiros.io/blog/guide-to-multihreading-and-multiprocessing

What is a Process:

A process is an instance of a program.

A computer program in languages like C, java or Go, it is just a text file. As the computer only understands binary instructions composed of 0s and 1s, the code needs to be compiled to machine language. When a compiled program is sent to OS to handle, OS allocates:

memory address space (where process’s heap and stacks will be located),

program counter,

PID (process id).

A process has at least one thread known as primary thread, primary thread can create multiple other threads. When the primary thread is done with its execution, process exits.

In nutshell, a process is a program in the memory.

Thread:

Thread is a light-weight process inside a process. It is the actual executor of a piece of code. It has access to memory provided by the process, OS resources, and other things.

A stack is created at runtime and is normally of a fixed size, preferably 1-2 MB. While the stack of a thread can be used by only that thread and will not be shared with other thread. A heap is a property of a process and it is available to use by any thread. Heap is a shared memory space where data from one thread can be access by other threads as well. Threads share the heap, but can have their own stack.