

Let's Go!

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What is Go?

Go is a **compiled**, **concurrent**, **garbage-collected**,
statically typed language developed at

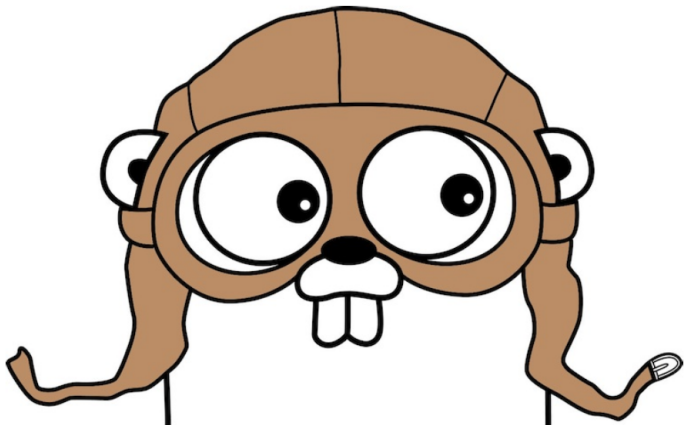


Features of Go

- Open-source Project
- Created at Google
- Compiled language
- Easy concurrency support via goroutines
- Package Management
- Static typing
- Features powerful standard library
- Garbage collection called goLand
- Concurrency support
- Great libraries
- Easy and readable code

GO

see a bit of `code`!



Hello, World!

- Programs start running in package main.
- It is good style to use the factored import statement.
- A name is exported if it begins with a capital letter.

```
1 package main
2
3 import (
4     "fmt"
5     "math"
6 )
7
8 // import "fmt"
9 // import "math"
10
11 func main() {
12     fmt.Printf("Now you have %v problems.\n", math.Sqrt(7))
13 }
14
```

Variables

- The var instruction declares a list of variables
- The type is informed at the end
- The var instruction could includes initializers, 1 per variable. In this case, the type could be ommited

```
$ go run variables.go  
0 false false false
```

variables.go

```
1 package main  
2  
3 import "fmt"  
4  
5 var c, python, java bool  
6  
7 func main() {  
8     var i int  
9     fmt.Println(i, c, python, java)  
10 }
```

```
$ go run variables-with-initiali  
1 2 true false no!
```

variables-with-initializers.go

```
1 package main  
2  
3 import "fmt"  
4  
5 var i, j int = 1, 2  
6  
7 func main() {  
8     var c, python, java = true, false, "no!"  
9     fmt.Println(i, j, c, python, java)  
10 }
```

Short Variable Declarations

- Inside a function, the short attribution instruction `:=` can be used instead of a var declaration

```
$ go run short-variable-declarations.go  
1 2 3 true false no!
```

short-variable-declarations.go

```
1 package main  
2  
3 import "fmt"  
4  
5 i, j := 1, 2  
6 func main() {  
7     k := 3  
8     c, python, java := true, false, "no!"  
9  
10    fmt.Println(i, j, k, c, python, java)  
11 }  
12
```

Constants

- Constants are declared like variables but with keyword `const`
- Can not use the syntax `:=`

```
$ go run constants.go  
Hello world! Happy 3.14 Day! Go rules?
```

```
constants.go  
1 package main  
2  
3 import "fmt"  
4 const Pi = 3.14  
5  
6 func main() {  
7     const World = "world! "  
8     fmt.Print("Hello ", World)  
9     fmt.Print("Happy ", Pi, " Day! ")  
10  
11     const Truth = true  
12     fmt.Print("Go rules? ", Truth)  
13 }
```


Functions

- Type comes after the parameter name, like variables
- Shorten (x int, y int) to (x, y int)

`func Hello(name string) string`

Diagram illustrating the components of a Go function signature:

- `func`: Function keyword
- `Hello`: Function name
- `(name string)`: Parameter list (parameter name followed by parameter type)
- `string`: Return type

```
$ go run functions.go
55
```

functions.go

```
1 package main
2
3 import "fmt"
4
5 func add(x int, y int) int {
6     return x + y
7 }
8
9 func main() {
10     fmt.Println(add(42, 13))
11 }
12
```

Multiple Return Values

- A function can have multiple return values

```
$ go run multiple-results.go  
world hello
```

multiple-results.go

```
1 package main  
2  
3 import "fmt"  
4  
5 func swap(x, y string) (string, string) {  
6     return y, x  
7 }  
8  
9 func main() {  
10     a, b := swap("hello", "world")  
11     fmt.Println(a, b)  
12 }  
13
```

Looping For

- Go has only one looping construct, the for loop
- No parentheses required, braces are always required
- The init and post statements are optional

```
$ go run for.go
45
```

for.go

```
1 package main
2
3 import "fmt"
4
5 func main() {
6     sum := 0
7     for i := 0; i < 10; i++ {
8         sum += i
9     }
10    fmt.Println(sum)
11 }
```

```
$ go run for-continuu
1024
```

for-continued.go

```
1 package main
2
3 import "fmt"
4
5 func main() {
6     sum := 1
7     for ; sum < 1000; {
8         sum += sum
9     }
10    fmt.Println(sum)
11 }
```

For is Go's "while" and forever

- Semicolon can be removed and you will have while
- for can run forever

```
$ go run for-is-go-while.go  
1024
```

for-is-gos-while.go

```
1 package main  
2  
3 import "fmt"  
4  
5 func main() {  
6     sum := 1  
7     for sum < 1000 {  
8         sum += sum  
9     }  
10    fmt.Println(sum)  
11 }
```

```
$ go run forever.go  
process took too long
```

forever.go

```
1 package main  
2  
3 func main() {  
4     for {  
5     }  
6 }
```

if Condition

- No parentheses required, braces are always required

if.go

```
1 package main
2
3 import (
4     "fmt"
5     "math"
6 )
7
8 func sqrt(x float64) string {
9     if x < 0 {
10         return sqrt(-x) + "i"
11     }
12     return fmt.Sprintf(math.Sqrt(x))
13 }
14
15 func main() {
16     fmt.Println(sqrt(2), sqrt(-4))
17 }
18
```

if-with-a-short-statement.go

```
1 package main
2
3 import (
4     "fmt"
5     "math"
6 )
7
8 func pow(x, n, lim float64) float64 {
9     if v := math.Pow(x, n); v < lim {
10         return v
11     }
12     return lim
13 }
14
15 func main() {
16     fmt.Println(
17         pow(3, 2, 10),
18         pow(3, 3, 20),
19     )
20 }
21
```

Switch

- only runs the selected case, not all the cases that follow
- break statement is not required

switch-evaluation-order.go

```
1 package main
2
3 import (
4     "fmt"
5     "time"
6 )
7
8 func main() {
9     fmt.Println("When's Saturday?")
10    today := time.Now().Weekday()
11    switch time.Saturday {
12    case today + 0:
13        fmt.Println("Today.")
14    case today + 1:
15        fmt.Println("Tomorrow.")
16    case today + 2:
17        fmt.Println("In two days.")
18    default:
19        fmt.Println("Too far away.")
20    }
21 }
22
```

switch-with-no-condition.go

```
1 package main
2
3 import (
4     "fmt"
5     "time"
6 )
7
8 func main() {
9     t := time.Now()
10    switch {
11    case t.Hour() < 12:
12        fmt.Println("Good morning!")
13    case t.Hour() < 17:
14        fmt.Println("Good afternoon.")
15    default:
16        fmt.Println("Good evening.")
17    }
18 }
19
```

Defer

- Semicolon can be removed and you will have while
- for can run forever

```
$ go run for-is-go-while.go  
1024
```

for-is-gos-while.go

```
1 package main  
2  
3 import "fmt"  
4  
5 func main() {  
6     sum := 1  
7     for sum < 1000 {  
8         sum += sum  
9     }  
10    fmt.Println(sum)  
11 }
```

```
$ go run forever.go  
process took too long
```

forever.go

```
1 package main  
2  
3 func main() {  
4     for {  
5     }  
6 }
```

Stacking Defer

- Deferred function calls are pushed onto a stack

defer-multi.go

```
1 package main
2
3 import "fmt"
4
5 func main() {
6     fmt.Println("counting")
7
8     for i := 0; i < 10; i++ {
9         defer fmt.Println(i)
10    }
11
12    fmt.Println("done")
13 }
14
```

```
counting
done
9
8
7
6
5
4
3
2
1
0
```


Pointers

- Syntax for pointers is the same as in C or C++
- But unlike C, Go has no pointer arithmetic.

```
pointers.go
1 package main
2
3 import "fmt"
4
5 func main() {
6     i, j := 42, 2701
7
8     p := &i           // point to i
9     fmt.Println(*p) // read i through the pointer
10    *p = 21           // set i through the pointer
11    fmt.Println(i)  // see the new value of i
12
13    p = &j           // point to j
14    *p = *p / 37     // divide j through the pointer
15    fmt.Println(j) // see the new value of j
16 }
17
```

Structs

- A struct is a collection of fields
- Struct fields are accessed using a dot
- Struct fields can be accessed through a struct pointer
- You can list just a subset of fields by using the Name: syntax
- The special prefix & returns a pointer to the struct value

Structs

struct-literals.go

```
1 package main
2
3 import "fmt"
4
5 type Vertex struct {
6     X, Y int
7 }
8
9 var (
10     v1 = Vertex{1, 2} // has type Vertex
11     v2 = Vertex{X: 1} // Y:0 is implicit
12     v3 = Vertex{}     // X:0 and Y:0
13     p  = &Vertex{1, 2} // has type *Vertex
14 )
15
16 func main() {
17     v1.X = 3
18     q := &v1
19     q.Y = 5
20     fmt.Println(v1, p, v2, v3)
21 }
22
```

```
{3 5} &{1 2} {1 0} {0 0}
```

Program exited.

Arrays

- The type $[n]T$ is an array of n values of type T
- An array's length is part of its type, so arrays cannot be resized

array.go

```
1 package main
2
3 import "fmt"
4
5 func main() {
6     var a [2]string
7     a[0] = "Hello"
8     a[1] = "World"
9     fmt.Println(a[0], a[1])
10    fmt.Println(a)
11
12    primes := [6]int{2, 3, 5, 7, 11, 13}
13    fmt.Println(primes)
14 }
15
```

```
Hello World
[Hello World]
[2 3 5 7 11 13]

Program exited.
```

Slicing

- Slicing of arrays is done the same way as in Python
- Slices are like references to arrays

slices-pointers.go

```
1 package main
2
3 import "fmt"
4
5 func main() {
6     names := [4]string{
7         "John",
8         "Paul",
9         "George",
10        "Ringo",
11    }
12    fmt.Println(names)
13
14    a := names[0:2]
15    b := names[1:3]
16    fmt.Println(a, b)
17
18    b[0] = "XXX"
19    fmt.Println(a, b)
20    fmt.Println(names)
21 }
```

```
[John Paul George Ringo]
[John Paul] [Paul George]
[John XXX] [XXX George]
[John XXX George Ringo]
```

Program exited.

Slice Literals Length and Capacity

- A slice literal is like an array literal without the length
- The length and capacity of a slice `s` can be obtained using the expressions `len(s)` and `cap(s)`
- There are also many more built-in functions like `make` and `append` that can be used with slices

Slice Literals Length and Capacity

slice-len-cap.go

```
1 package main
2
3 import "fmt"
4
5 func main() {
6     s := []int{2, 3, 5, 7, 11, 13}
7     printSlice(s)
8
9     // Slice the slice to give it zero length.
10    s = s[:0]
11    printSlice(s)
12
13    // Extend its length.
14    s = s[:4]
15    printSlice(s)
16
17    // Drop its first two values.
18    s = s[2:]
19    printSlice(s)
20 }
21
22 func printSlice(s []int) {
23     fmt.Printf("len=%d cap=%d %v\n", len(s), cap(s), s)
24 }
```

len=6 cap=6 [2 3 5 7 11 13]

len=0 cap=6 []

len=4 cap=6 [2 3 5 7]

len=2 cap=4 [5 7]

Program exited.

Range

- The range form of the for loop iterates over a slice or map
- two values are returned for each iteration, the index and the element at that index
- If you only want the index, you can omit the second variable

Range

range-continued.go

```
1 package main
2
3 import "fmt"
4
5 func main() {
6     pow := make([]int, 10)
7     for i := range pow {
8         pow[i] = 1 << uint(i) // == 2**i
9     }
10    for i, v := range pow {
11        fmt.Printf("2**%d = %d\n", i, v)
12    }
13 }
14
```

```
2**0 = 1
2**1 = 2
2**2 = 4
2**3 = 8
2**4 = 16
2**5 = 32
2**6 = 64
2**7 = 128
2**8 = 256
2**9 = 512
```

Program exited.

Maps

- A map maps keys to values
- The zero value of a map is nil. A nil map has no keys, nor can keys be added
- The make function returns a map of the given type, initialized and ready for use
- We can also initialize maps using map literals

Maps

maps.go

```
1 package main
2
3 import "fmt"
4
5 type Vertex struct {
6     Lat, Long float64
7 }
8
9 func main() {
10     m := make(map[string]Vertex)
11     m["Bell Labs"] = Vertex{40.68433, -74.39967}
12     fmt.Println(m["Bell Labs"])
13 }
14
```

map-literals-continued.go

```
1 package main
2
3 import "fmt"
4
5 type Vertex struct {
6     Lat, Long float64
7 }
8
9 var m = map[string]Vertex{
10     "Bell Labs": {40.68433, -74.39967},
11     "Google":    {37.42202, -122.08408},
12 }
13
14 func main() {
15     fmt.Println(m)
16 }
17
```

Maps

Insert or update an element in map `m`:

```
m[key] = elem
```

Retrieve an element:

```
elem = m[key]
```

Delete an element:

```
delete(m, key)
```

Test that a key is present with a two-value assignment:

```
elem, ok = m[key]
```

If `key` is in `m`, `ok` is `true`. If not, `ok` is `false`.

Function Values

- Function values may be used as function arguments and return values

function-values.go

```
1 package main
2
3 import (
4     "fmt"
5     "math"
6 )
7
8 func compute(fn func(float64, float64) float64) float64 {
9     return fn(3, 4)
10 }
11
12 func main() {
13     hypot := func(x, y float64) float64 {
14         return math.Sqrt(x*x + y*y)
15     }
16     fmt.Println(hypot(5, 12))
17
18     fmt.Println(compute(hypot))
19     fmt.Println(compute(math.Pow))
20 }
```

13

5

81

Program exited.

Function Closures

- A closure is a function value that references variables from outside its body

function-closures.go

```
1 package main
2
3 import "fmt"
4
5 func adder() func(int) int {
6     sum := 0
7     return func(x int) int {
8         sum += x
9         return sum
10    }
11 }
12
13 func main() {
14     pos, neg := adder(), adder()
15     for i := 0; i < 10; i++ {
16         fmt.Println(
17             pos(i),
18             neg(-2*i),
19         )
20     }
21 }
```

```
0 0
1 -2
3 -6
6 -12
10 -20
15 -30
21 -42
28 -56
36 -72
45 -90
```

Program exited.

Questions?

