Dmitrii Kumancev · Follow

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Hi friends!
Today I suggest you to familiarize yourself with recommendations on writing clean code in Go. We will understand the peculiarities of the language by examples and apply the main syntactic constructions in practice.

We're off!

Working with Data

The Distinction between make and new

Make and new are built-in mechanisms for memory allocation. They are used in different situations and have their own characteristics.

- **new** initializes a zero value for the given type and returns a pointer to that type.
- **make** is exclusively used for creating and initializing slices, maps, and channels, returning a non-zero instance of the specified type.
- The main difference between them lies in the fact that **make** returns an initialized type ready for use after creation, while **new** returns a pointer to the type with its zero value.

```
a := new(chan int) // a has type *chan int
b := make(chan int) // b has type chan int
```

Hidden Data in Slices

A slice is a variable-length array that can store elements of a single type, internally represented as a reference to the underlying array.

When working with slices, there is often a need to “cut” them into smaller pieces. As a result, the resulting slice will reference the original array. It is crucial not to forget about this, as otherwise, the program may experience unpredictable memory consumption.

```
// Poor practice - unpredictable memory consumption
func cutSlice() []byte {
 slice := make([]byte, 256)
 fmt.Println(len(slice), cap(slice), &slice[0]) // 256 256 <0x…>
 return slice[:10]
}
func main() {
 res := cutSlice()
 fmt.Println(len(res), cap(res), &res[0]) // 10 256 <0x…>
}
```

Let's examine this characteristic through specific examples:
To prevent this error, it is essential to ensure that the copy is made from a temporary slice:

```
// Good practice - data copied from a temporary slice
func cutSlice() []byte {
 slice := make([]byte, 256)
 fmt.Println(len(slice), cap(slice), &slice[0]) // 256 256 <0x…>
 copyOfSlice := make([]byte, 10)
 copy(copyOfSlice, slice[:10])
 return slice[:10]
}
func main() {
 res := cutSlice()
 fmt.Println(len(res), cap(res), &res[0]) // 10 256 <0x…>
}
```

Functions

Functions with Multiple Returns

In the Go programming language, functions can return multiple values, a feature known as "multiple returns." This language feature allows functions to not only return a result but also additional values, such as errors or other necessary data.

Here is an example of declaring a function with multiple returns in Go:

```
package main
import "fmt"
func swap(a, b int) (int, int) {
 return b, a
}
func main() {
 x, y := swap(1, 2)
 fmt.Println(x, y) // 2 1
a, _ := swap(3, 4)
 fmt.Println(a) // 4
}
```

In the provided example, the `*swap*` function takes two arguments of type `*int*` and returns two values of the same type, swapping the positions of the input variables.

It is also possible to ignore one or more of the returned values using the blank identifier (`_`).

Functions with multiple returns are particularly useful when there is a need to return multiple results, such as when working with errors or parallel data processing.

The following `***openFile***` function returns two values, one of which is an error or ***nil*** in case of its absence:

```
func openFile(name string) (*File, error) {
 file, err := os.Open(name)
 if err != nil {
 return nil, err
 }
 return file, nil
}
```

Interfaces

In Go, interfaces represent a set of methods that define an object's behavior. They allow abstraction from a specific implementation and enable working with various data types. In other words, interfaces only define a certain functionality but do not implement it themselves.

> ***Using Interfaces Correctly***
> 💡*Remember this important rule:*
> *Avoid defining interfaces before their usage. Without a real example, it's challenging to determine whether they are genuinely necessary, not to mention the methods they should contain.*

```
package worker // worker.go

type Worker interface { Work() bool }

func Foo(w Worker) string { … }
```

```
package worker // worker_test.go

type secondWorker struct{ … }
func (w secondWorker) Work() bool { … }
```

```
…
if Foo(secondWorker{ … }) == "value" { … }
```

Below is an example of an incorrect approach when working with interfaces:

```
// Poor practice
package employer

type Worker interface { Worker() bool }

type defaultWorker struct{ … }
func (t defaultWorker) Work() bool { … }

func NewWorker() Worker { return defaultWorker{ … } }
```

The correct solution from the Go perspective is to return the specific type and allow *`Worker`* to mimic the *`employer's`* implementation:

```
// Good practice
package employer

type Worker struct { … }
func (w Worker) Work() bool { … }

func NewWorker() Worker {
 return Worker{
 …
 }
}
```

Concurrency and Parallelism

Tracking Goroutines

Goroutines are inexpensive to launch and operate, but they come with a finite cost in terms of memory usage — you cannot create an infinite number of them. Unlike variables, the Go runtime cannot detect when a goroutine will no longer be used.

A detailed exploration of goroutines I'll tell you about it next time — for now you can look up other sources about it.

> 💡 ***Remember this important rule:***
> *Every time you use the `go` keyword in your program to launch a goroutine, you must know how and when it will finish. Not knowing the answers to these two questions can lead to memory leaks.*

Let’s consider an example to illustrate this mistake:

```
func leakGoroutine() {
 ch := make(chan int)
 go func() {
   received := <-ch
   fmt.Println("Received value:", received)
 }
}
```

Here, the ***`leakGoroutine`*** function launches a goroutine that blocks reading from the ***`ch`*** channel. As a result, nothing will be sent to it, and it will never close. The goroutine will be blocked indefinitely, and the call to the ***`fmt.Println`*** function will never happen.

Detecting Leaks

Engineers at Uber, actively involved in Go development, created a goroutine leak detector — the `goleak` package, designed to integrate with modular tests. Let’s look at an example of using this tool in practice.

Suppose there is a function ***`leakGoroutine`*** with a goroutine leak:

```
func leakGoroutine() {
 go func() {
   time.Sleep(time.Minute)
 }()
  return nil
}
```

And a test for this function:

```go
func TestLeakGoroutine(t *testing.T) {
  defer goleak.VerifyNone(t)

  if err := leakGoroutine(); err != nil {
    t.Fatal("Fatal message")
 }
}
```

When running the tests, an error message appears, indicating *"found unexpected goroutines,"* along with the stack trace of the problematic goroutine, its state, and identifier.

This tool can be valuable in program development as it helps reduce the time spent identifying and resolving memory leaks.

Error Handling and Recovery

Errors in Go are represented by the `error` interface, which defines the `Error() string` method. Any type implementing this method can be used as an error.

```go
type error interface {
 Error() string
}
```

Handling Errors Correctly

Ignoring errors can lead to undefined behavior and complicate code debugging. Let's consider the correct way to handle errors using a file operation as an example:

```go
// Poor practice
file, err := os.Open("filename.txt")
if err == nil {
 // file operations
}
```

```go
// Good practice
file, err := os.Open("filename.txt")
if err != nil {
 log.Fatal(err) // error handling
```

```
}
defer file.Close() // deferred function call to close the file
```

Without Panicking, but with Recovery

The classic way to report an error is to return the *`error`* type. However, what should be done in cases where quick recovery is not possible? In such situations, the built-in *`panic`* function comes to the rescue. It terminates the program and outputs a customizable error message.

Here's an example of a simple function with panic:

```go
package main

import "fmt"

func examplePanic() {
 panic("Panic - program terminated")
 fmt.Println("Function examplePanic successfully completed")
}

func main() {
 examplePanic()
 fmt.Println("Function main successfully completed")
}
```

When a panic occurs, the function terminates, and any remaining deferred functions are executed using *`defer`*, along with unwinding the stack of goroutines. In real-world development, situations leading to panics should be avoided as they jeopardize the smooth operation of the program. Fortunately, the Go authors anticipated this drawback and created a panic recovery mechanism — *`recover`*. It allows halting the unwinding of the stack and returning control to the developer.

To demonstrate the operation of this mechanism, let's refer to the example:

```go
package main

import "fmt"

func Recovery() {
 if recoveryResult := recover(); recoveryResult != nil {
 fmt.Println(recoveryResult)
 }
```

```
  fmt.Println("Recovery…")
 }

 func Panic() {
  defer Recovery()
  panic("Panic")
  fmt.Println("Function Panic successfully completed")
 }

 func main() {
  Panic()
  fmt.Println("Function main successfully completed")
 }
```

Upon code execution, we get the following output:

```
Panic
Recovery…
Function main successfully completed
```

Note that the `*Panic*` function does not complete after the panic. This is because the deferred function `*Recovery*` is called via `*defer*`, which restores the program's operation. Subsequently, execution is handed back to `*main*`, where the entire code is successfully completed.

Conclusion

Code quality relies not just on the programming language but also on the developer's skills. By applying the discussed examples and adhering to general principles, you can enhance the quality of your software.

This article aims to inspire readers to implement these practices in Go development, creating programs that are easily understandable, even for beginners. Always remember, clean code is the path to a successful project!

> **That's it! I hope my article was interesting and informative for you 😎😜**

Don't forget about my github: https://github.com/DmitriiKumancev

See you soon!❤️

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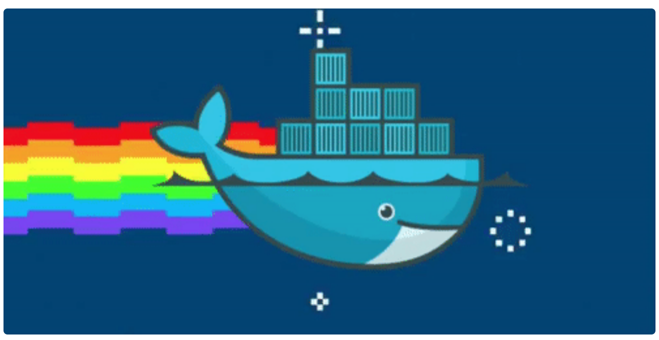

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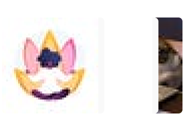

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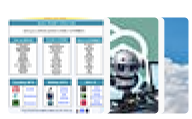

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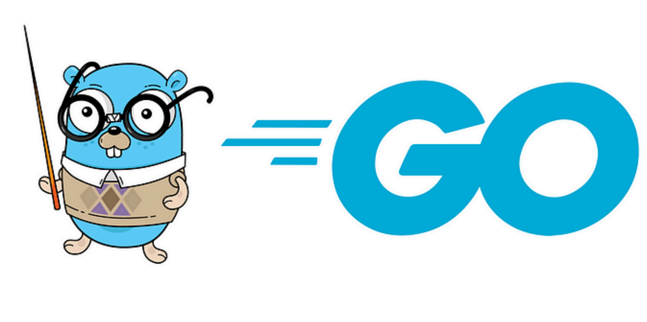

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