GoLang
A Programming Language Case Study

7 November 2018

Kyle Jon Aure
CS Major, WSU - Rochester

Table of Contents

Introduction

Go is a programming language developed by Google Employees.

To help differentiate the word 'go' from the language `Go` many people say `GoLang` instead.

People who develop in Go often refer to themselves as `Gophers`.

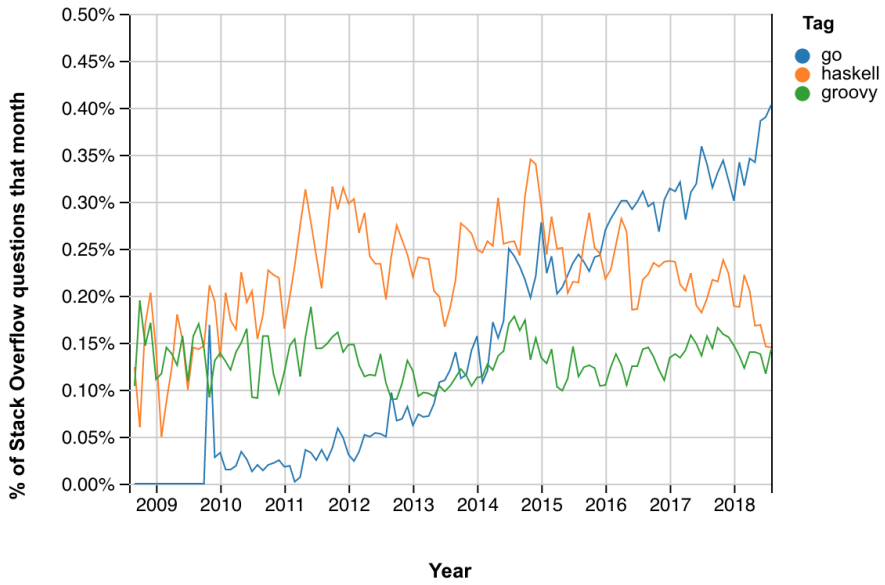
Go was developed as an attempt to combine the ease of programming of an interpreted, dynamically typed language with the efficiency and safety of a statically typed, compiled language.

History

Developed by Robert Griesemer, Rob Pike, and Ken Thompson all Google employees.

Started development in 2007 and released November 10, 2009.

Estimated that today there are 504,000 to 966,000 Go programmers.



Trends Stack Overflow (https://insights.stackoverflow.com/trends?tags=go%2Chaskell%2Cgroovy)

What is it used for?

Go was developed in response to the boom of cloud computing.

Development of server software using traditional languages like Java and C++ can be complex.

Go is exceptionally good at `handling concurrency`, `garbage collection`, and `memory management`.

Who Uses Go

Support

Development can be done on almost any operating system.

Go does not have a standalone IDE instead it is supported by exising technology.
- **Text Editors**: Visual Studio Code, Vim, Emacs, and Atom.
- **IDEs**: GoLand built on top of IntelliJ, and GoClipse built on top of Eclipse.

I used `Visual Studio Code` since it allows for native terminal commands.

Lexical Elements

Numeric Operators:
+ : addition
- : subtraction
* : multiplication
/ : division
% : modulus

Bitwise Operators (int):
& : AND
| : OR
^ : XOR
&^: Clear
<<: Arithmetic shift left
>>: Arithmetic shift right

Language Specification

The Go language specification is written in `Backus-Naur Form (BNF)`.

Identifiers are specified by the production:

```
identifier = letter { letter | unicode_digit }
```

Comments are the same as most languages.

- // single line comment
- /* multiline comment */

Semicolons are optional!

Typing

Go is a `statically-typed`, `compiled` language.

But, the syntax is similar to a `dynamically-typed` language.

```
func main() {
    //tag::typing[]
    var x int = 5 //Static representation <1>
    var y = 6     //Dynamic representation <2>
    z := 7        //Implied representation <3>
    //end::typing[]

    y = '6'

    //If static typed y == 54 (ascii for '6')
    //If dynamic typed y == '6'

    fmt.Printf("x is %d, y is %d, and z is %d \n", x, y, z)
}
//ENDMAIN
```

Run

Composite Types

Go supports these eight different composite types; array, struct, pointer, function, interface, slice, map, and channel types.

- Array

```
//tag::array[]
var a [5]int                              //<1>
a[1] = 5                                  //<2>
b := [5]float32{1.2, 1.3, 1.4, 1.5, 1.6} //<3>
var c [2][3]int                           //<4>
//end::array[]
```

Run

- Struct

```
//tag::structure[]
type Dog struct {Name string; Breed string;} //<1>
d := Dog{Name : "Max", Breed : "Pit Bull"}  //<2>
fmt.Println("My dog's name is ", d.Name)     //<3>
//end::structure[]
```

Run

Functions

Functions in Go

- Have 0 or more arguments, 0 or more results.
- Can be defined as types.

```
//tag::function[]
func split(sum int) (x, y int) {
    x = sum * 4 / 9
    y = sum - x
    return
}

type DogFunc func(string, int)

func main() {
    fmt.Println(split(17))
}

//end::function[]
```

Run

Pointers

Pointers work exactly the same as pointers in C++.

- *: Points to address
- &: Address of variable

```
//tag::pointer[]
func print(i *int) {fmt.Println(*i);} //<1>

func main() {
  j := 5
  print(&j) //<2>
}
//end::pointer[]
```

Run

Scope

Go uses `lexical` (static) `scoping`.
Scope is expressly defined by the use of curly brackets `{ }`.

```
//tag::scope[]
var a = 1 //<1>

func main() {
    fmt.Println("Global scope, a is", a)

    var a = 2 //<2>
    fmt.Println("Local scope, a is", a)
    {
        var a = 3 //<3>
        fmt.Println("Inner scope, a is", a)
    }
}

//end::scope[]
```

Run

Testing

Go provides natively supported testing using the `testing` package.

To define a test function the declaration needs to be in the form:

`func TestXxx (t *testing.T)`

```
//tag::test[]

func add(a int, b int) int { //<1>
    return a + b
}

func TestAdd(t *testing.T) { //<2>
    var a = 5
    var b = 5
    var c = add(a, b)
    if c != 11 {
        t.Error("Expected ", 11, " got ", c) //<3>
    }
}

//end::test[]
```

Run

Modularity

Go uses a package / import system to handle large program modularity.

- `package main` is reservered
- `import` is an optional

Modularity cont.

```
package main

import "errors"
import "fmt"
import "math"

func Sqrt(value float64) (float64, error) {
    if value < 0 {
        return 0, errors.New("Math: negative number passed to Sqrt")
    }
    return math.Sqrt(value), nil
}

func main() {
    result, err := Sqrt(-1)

    if err != nil {
        fmt.Println(err)
    } else {
        fmt.Println(result)
    }

}
```

Run

Portability

There are three main compilers for Go.
- Go Compiler: written in Go and targets binaries for source machine and across platforms.
- GCCgo: A front end to the open source GCC compiler.
- GopherJS: A Go compiler that targerts Javascript

Target programs cannot be ported to other systems. They must be recompiled.

Performance

Go handles concurrence with a techology they call `GoRoutines`.
This allows for a simple approach to write code that utilizes multiple threads.

```
//tag::goroutine[]
func say(s string) {
    for i := 0; i < 5; i++ {
        time.Sleep(100 * time.Millisecond)
        fmt.Println(s)
    }
}

func main() {
    go say("world") //<1>
    say("hello")
}

//end::goroutine[]
```

Run

Conclusion

Pros
- Go is very powerful programming language.
- Supports rapid development.
- Focus on Runtime performance.
- Can handle ’big data’.
- Made for cloud development.

Cons
- Lack of operator overloading.
- Type interfaces are not supported.
- Data types are immutable.

Works Cited

Stack Overflow Trends. (2018). Stack Overflow. Retrieved from https://insights.stackoverflow.com/trends?tags=go%2Chaskell%2Cgroovy

Cox, R. (2018). How Many Go Developers Are There? Research!rsc. Retrieved from https://research.swtch.com/gophercount

Cōngruì, W. (2018). GoLang Minimum Requirements. GoLang. Retrieved from https://github.com/golang/go/wiki/MinimumRequirements

Peabody, B. (2018). Server-side I/O Performance. toptal. Retrieved from https://www.toptal.com/back-end/server-side-io-performance-node-php-java-go

Pike, R. (2012). Go at Google: Language Design in the Service of Software Engineering. Google. Retrieved from https://talks.golang.org/2012/splash.article

Scott, M. L. (2016). *Programming Language Pragmatics*. Morgan Kaufmann Publishing.

Uygur, F. (2018). GoUsers. GoLang. Retrieved from https://github.com/golang/go/wiki/GoUsers

FAQ/Origins. (n.a.). GoLang. Retrieved from https://golang.org/doc/faq#Origins

Thank you any questions?

Kyle Jon Aure
CS Major, WSU - Rochester
KAure09@winona.edu (mailto:KAure09@winona.edu)
https://github.com/KyleAure (https://github.com/KyleAure)
@Kyle_Aure (http://twitter.com/Kyle_Aure)
Some text