COMP-520 – GoLite project

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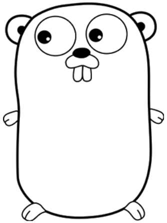
Agenda

- Overview of Go
- Why Go for a compiler class?
- GoLite

Feel free to ask questions at any time.



Go

- Created by Rob Pike, Ken Thompson and Robert Griesemer
- Google employees
- Not a Google project like Gmail; open source
- Initial release in 2009
- 1.0 release in 2012

Motivation

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  `class AbstractSingletonProxyFactoryBean { ... }`
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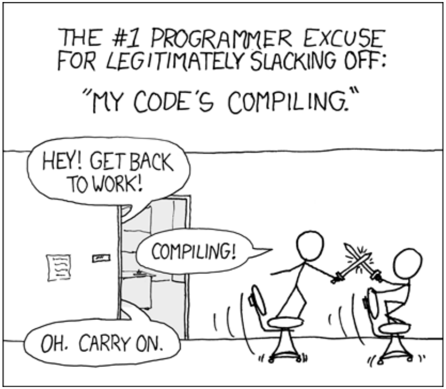
- Faster compilation



Features

- Imperative
- Goroutines and channels
- Interfaces and methods
- Closures
- `defer`
- Maps and slices
- Multiple return values
- Module system
- Garbage collection
- Optional semi-colons (tricky scanner!)

Notable missing features

- Parametrized types (source of 95% of all Go arguments online)
- Exceptions
- Classes and inheritance

Example Go program

```
package main

import "fmt"

func fib(n int) int {
  a, b := 0, 1
  for i := 0; i < n; i++ {
    a, b = b, a+b
  }
  return a
}

func main() {
  var f int = fib(42)
  fmt.Println(f)
}
```

Who uses Go?

- Google
- Github
- Bitbucket
- CloudFlare
- Dropbox
- New York Times
- Many others [1]

Extremely quick adoption!

[1] `https://code.google.com/p/go-wiki/wiki/GoUsers`

Who uses Go?

The authors expected Java and C++ programmers to be the primary Go audience.

In actual fact, Go is more popular with Python, Ruby and other dynamically typed languages programmers.

Why?

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In actual fact, Go is more popular with Python, Ruby and other dynamically typed languages programmers.

Why?

- Better performance
- Static typing
- Good concurrency support
- Good libraries and tools
- Can deploy a single binary file

Useful addresses

- `http://golang.org`
- `http://play.golang.org`
- `http://golang.org/ref/spec`

Why Go for a compiler class?

Why use Go for a compiler class?

Useful and popular

It is more fun to write a compiler for a language that is alive and kicking than for a made-up language (minilang) or for a dead language (Pascal).

Writing a compiler forces you to really learn the language, a nice addition on your C.V.!

Why use Go for a compiler class?

Simple language

Go is simpler than a lot of other popular languages such as Java or C++.

Go is surprisingly quick to learn.

Not nearly as tricky as MATLAB, JavaScript or PHP.

Why use Go for a compiler class?

Detailed online specification

You can find pretty much everything you need to know about Go on a single page: `http://golang.org/ref/spec`

The syntax is described in EBNF notation.
(Warning! Ambiguous!)

Less specification work for the T.A. ;-)

Why use Go for a compiler class?

Encompasses all the classical compiler phases

The things you learn in class and from reading the textbook apply to writing a Go compiler. It doesn’t have specialized phases like pre-processing or macro expansion.

Why use Go for a compiler class?

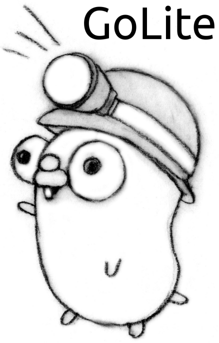
Go is open source

Scanner is written with flex.

Parser is written with bison.

You can look, **do not copy/paste!**

GoLite



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Features

- Imperative
- ~~Goroutines and channels~~
- ~~Interfaces and methods~~
- ~~Closures~~
- ~~`defer`~~
- ~~Maps~~ and slices
- ~~Multiple return values~~
- ~~Module system~~
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Is this still Go?

- You have a few weeks to build the compiler (took 2 years before first Go release)
- It still is a lot of work
- You can add more features when the course is finished :)

Lexical syntax

	Go	GoLite
Encoding	UTF-8	ASCII
Number precision	Arbitrary	Fixed
Integers	255, 0377, 0xff	255, 0377, 0xff
Floats	0.12, .12, 12.	0.12, .12, 12.
Imaginary	3i	No thanks
Strings	”Chrono\n”	”Marle\n”
Raw strings	‘Lucca\n‘	‘Ayla\n‘
Keywords	Bunch of ’em	Slighlty more
Line comments	// Sabin	// Edgar
Block comments	/* Celes */	/* Locke */
Semicolons	Optional	Optional

Basic types

int
float64
bool
rune (char)
string
uint8
uint16
uint32
uint64
int8
int16
int32
int64
float32
complex64
complex128
byte

General structure

```go
// Go structure

// package declaration
// import statements
// vars, consts, types, functions
```

General structure

```
// GoLite structure

// package declaration


// vars, types, functions
```

Declarations

In Go, top-level declarations can be in any order

In GoLite, declarations must come before their first use

```
// Valid in Go; invalid in GoLite
var x int = max(y, 32)
var y = 42

func max(a, b int) int {
  // Surely b is always greater!
  return b
}
```

Variable declarations

```
var x1, x2 int          // implicitly initialized to 0
var y int = 12
var z = 24
```

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```
var (
        x1, x2 int
        y int = 12
        z = 24
)
```

GoLite should support all of these.

Constant declarations

GoLite won’t support constant declarations.

Type declarations

```
type natural int
type real float64

type (
        point struct {
                x, y, z float64
        }
)
```

Function declarations

```
// Allowed in GoLite
func f(a int, b int) int {
  ...
}

// Allowed in GoLite
func f(a, b int) int {
  ...
}

// Not allowed in GoLite
func f(int, int) int {
  ...
}
```

- GoLite functions should always have a body.
- We'll allow zero or one return value.

Statements

Declarations

- Variables and types can be declared within functions.
- Short variable declaration allowed within functions.

```
func demo() {
  type number int
  var x int = 12

  best_ff := 6
}
```

Statements

Loops

- All loops use the `for` keyword
- No parentheses, mandatory braces
- GoLite should not support *for/range* loops

```
// Infinite loop
for {
  ...
}

// ``While'' loop
for x < 10 {
  ...
}

// ``For'' loop
for i := 0; i < 10; i++ {
  ...
}
```

Statements

Loops

We'll support unlabelled `break` and `continue`

Statements
If

- No parentheses, mandatory braces

```
if x == 0 {
    ...
}

if x < 0 {
    ...
} else {
    ...
}

if x < 0 {
    ...
} else if x > 0 {
    ...
} else {
    ...
}
```

Statements
Switch

- Allows expressions in cases
- No explicit `break`

```
switch x {
  case 0, 1, 2: println("Small")
  default: println("Other")
}

switch {    // Same as switch true
  case x < 0: println("Negative")
  case x > 0: println("Positive")
  default: println("Zero")
}
```

Expressions

Literals	`42, 3.14, "Go", 'H'`
Identifiers	`x, my_dog, Alakazou`
Unary expressions	`!x, +y, -(a*b), ^0`
Binary expressions	`a || b, 3 + x, 1 << 12`
Function calls	`fib(42), max(0, 1)`
Casts*	`int(3.4), []float64(x)`
Indexing	`slice[0], point.x`

Built-ins

In Go:

- Look like function calls
- Not reserved keywords
- Can accept a type as a first parameter (`make([]int, 4)`)
- Can be polymorphic (`append()`)

Real tricky to parse function calls, casts and builtins nicely

Built-ins

In GoLite:

- Reserved keywords to make parsing easier
- Only a subset (`print`, `println`, `append`)
- Limited functionality

References

- Go presentation: `http://www.youtube.com/watch?v=rKnDgT73v8s`
- Gopher: `http://golang.org/doc/gopher/frontpage.png`
- Gopher + helmet: `http://golang.org/doc/gopher/pencil/gopherhelmet.jpg`
- Xkcd, compiling: `http://xkcd.com/303/`