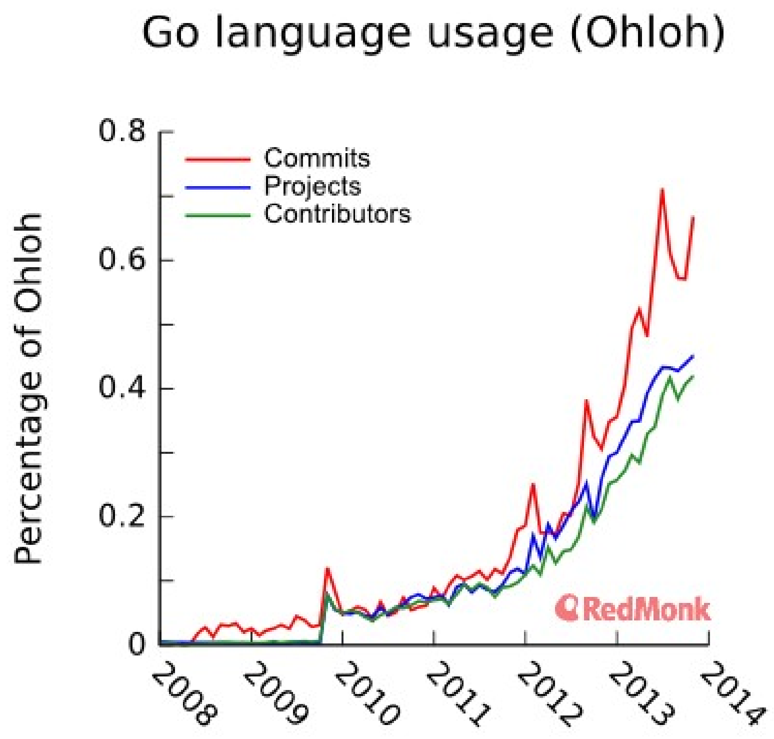
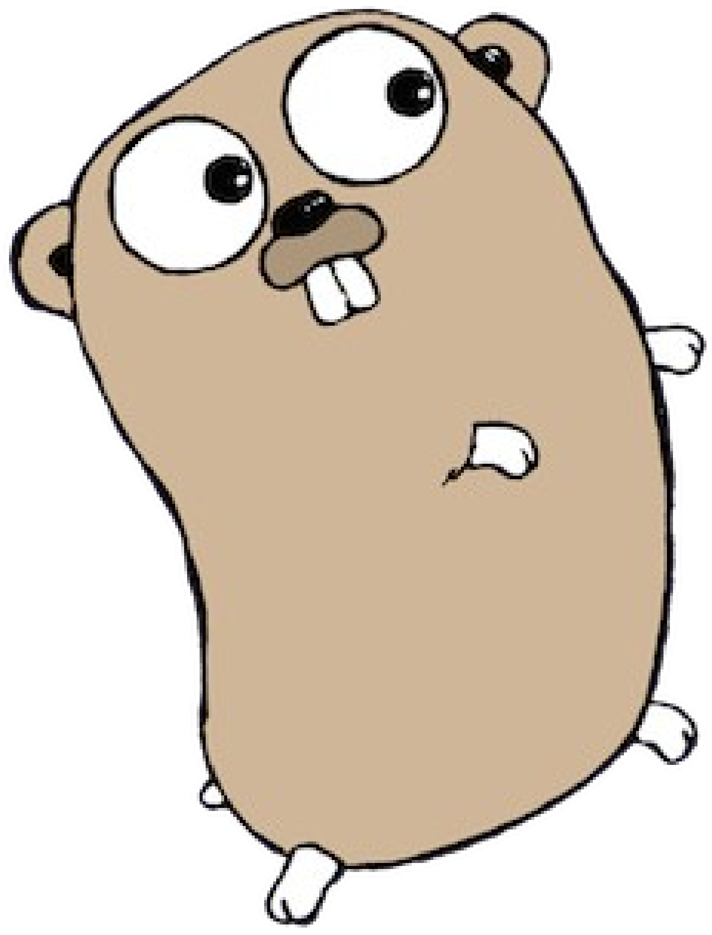
Introduction to Go for Java Developers





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Agenda

- **Go's short history and features**
- Packages
- Basic stuff: control structures and built-in types
- Composite types
- Go's approach to OO design
- Concurrency made easy
- Standard library
- Web apps with Go

History

- “Three of us [Ken Thompson, Rob Pike, and Robert Griesemer] got together and decided that we hated C++.”
- “All three of us had to be talked into every feature in the language, so there was no extraneous garbage put into the it for any reason.”
- Development started in 2007
- Open source since 2009
- Stable 1.0 released in 2012

Features

- Statically typed with automatic type infer. (x := 0 // int x = 0)
- Garbage collected
- Fast compilation times
- Remote package management (~Maven)
- Built-in concurrency primitives: light-weight processes (goroutines), channels
- An interface system in place of virtual inheritance, and type embedding instead of non-virtual inheritance.
- A toolchain that, by default, produces statically linked native binaries without external dependencies.

Features

- no type inheritance
- no method or operator overloading
- no circular dependencies among packages
- no pointer arithmetic
- no assertions
- no generic programming
- no implicit type conversions

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Packages

- Go programs are organized into packages.
- They correspond to packages with classes in Java
- Package main with a main function is the entry point of the program

```
package main
import "fmt"

func main() {
  fmt.Println("Hello, playground")
}
```

https://play.golang.org/p/duRF5gXJEP

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Basic stuff

- Control structures look very similar for those who came from C/C++ or Java world.
- Parenthesis after if, for, switch, etc. isn't mandatory
- Semicolons are also optional at the end of the line (except if you want to place multiple statements in a single line)
- Unused imports cause compiler error
-

Control structures

FOR is the only way of looping.

```
s := []string{"a", "b", "c"}
for i := 0; i < len(s); i++ {
  v := s[i]; fmt.Printf("index: %d, value: %v\n", i, v)
}
for i, v := range s {
  fmt.Printf("index: %d, value: %v\n", i, v)
}

m := map[int]string{1: "a", 2: "b", 3: "c"}
for k, v := range m {
  fmt.Printf("key: %d, value: %v\n", k, v)
}
```

https://play.golang.org/p/HAdAf-D4al

Control structures

IF can have temporary variables

```
s := []int{3, 42, 73, 1}

max := -1

for i := 0; i < len(s); i++ {
  if v := s[i]; v > max {
    max = v
  }
}

fmt.Println(max)
```

https://play.golang.org/p/hvhWqaw8UG

Control structures

SWITCH can have cases not just for values, but for types

```
// golang/src/pkg/fmt/print.go
switch f := arg.(type) {
case bool:
  p.fmtBool(f, verb)
case float32:
  p.fmtFloat32(f, verb)
...
default:
}
```

Control structures

There is no TRY/CATCH/FINALL

```
// golang/src/pkg/image/png/reader.go
func (d *decoder) decode() (image.Image, error) {
  r, err := zlib.NewReader(d)
  // CATCH
  if err != nil {
    return nil, err
  }
  // FINALLY
  defer r.Close()
  ...
}
```

Types system

- Simple types: `int, float, bool`, etc.
- Composite types: structures
- Reference types: slice, map, channel, interface and function
- Named types: can refer to any of the above, we'll see later why this matters

```
// golang/src/pkg/time/time.go

type Duration int64
```

Simple types

- Boolean: `bool`
- Singed integers: `int8, ..., int64`
- Unsigned integers: `uint8, ..., uint64`
- Floats: `float32, float64`
- `byte -> unit8`
- `rune -> int32` (~char int Java)
- `int -> int32/int64, uint -> uint32/uint64`
- `complex64, complex128`
- `string`

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Composite types

```
type Vertex struct {
  name string

  incomingEdges []*Edge
  outgoingEdges []*Edge
}

type Edge struct {
  head *Vertex
  tail *Vertex

  weight int
}

type Graph struct {
  verticesMap map[string]*Vertex
}
```

Composite types

```
type Graph struct {
  verticesMap map[string]*Vertex
}

// “g” is the receiver of method AddEdge()
func (g *Graph) AddEdge(
  tail, head string, weight int) {
   ...
}
```

https://play.golang.org/p/Ugoowc6fnd

Reference types

- All reference types have a lightweight “header” which in turn contains pointers to the underlying data structures.
- This makes pass them by value very cheap
- Let's have a closer look at them:
  - Slice
  - Map
  - Channel
  - Interface
  - Function

Reference types / Slice

A slice is just like a `java.util.ArrayList`, it shirks and grows as necessary

```
func printSlice(s []int) {
  fmt.Printf("len=%d, cap=%d, s=%v\n", len(s), cap(s), s)
}

func main() {
  // empty slice
  var s []int;   printSlice(s)
  s = []int {1,2,3,4}; printSlice(s)
  s = append(s, 5); printSlice(s)
}
```

https://play.golang.org/p/hJl7iI-87H

Reference types / Map

- A map is just like a java.util.HashMap

```
func (g *Graph) AddEdge(
  tailName, headName string, weight int) {

  tail, ok := g.verticesMap[tailName]
  if !ok {
    tail = &Vertex{name: tailName}
    g.verticesMap[tailName] = tail
  }
  ...
}
```

https://play.golang.org/p/Ugoowc6fnd

Reference types / Channel

- Channels are like `java.util.concurrent.LinkedBlockingQueue`
- Idiomatic means of communication among co-operating threads (go routines)

```
func main() {
   // LinkedBlockingQueue<Integer> lbq = new LinkedBlockingQueue<>(1)
   c := make(chan int, 1)
   // lbq.offer(1)
   c <- 1
   // lbq.poll()
   fmt.Println(<-c)
}
```

https://play.golang.org/p/SaZgJzU0qu

Reference types / Interface

- Interfaces define behaviour, just like in Java
- However there is no need to formally declare for any given type which interface it implement

```go
// golang/src/pkg/io/io.go
// Implementations of Read are discouraged from returning a
// zero byte count with a nil error, and callers should treat
// that situation as a no-op.
type Reader interface {
        Read(p []byte) (n int, err error)
}
```

https://play.golang.org/p/_-zJOHMJ5y

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Go's approach to OO design

- Go doesn't directly support inheritance, but code reuse can be implemented through composition
- Encapsulation is supposed through methods, data hiding is done with unexported package members
- Polymorphism is provided by interfaces, altought formal declaration between concrete types and interfaces isn't necessary

Inheritance

```java
class User {
  private String firstName;
  private String lastName;
  private String userName;
}

class Admin
  extends User {

  private String level;
}
```

```go
type User struct {
  firstName string
  lastName string
  userName string
}

type Admin struct {
  User
  level string
}
```

Encapsulation

```java
class User {

  private String firstName;

  public String lastName;

  ...


  public String getFirstName() {

    return firstName;

  }


  public void SetFirstName(...) {

    ...

  }

}
```

```go
type User struct {

  firstName string

  LastName string

}


func (u User)
  GetFirstName() string {

  return u.firstName

}
```

Polymorphism

```
type (
  Shape interface {
    Area() float64
  }

  Triangle struct {
    a, b, c float64
  }
)

func (t Triangle) Area() float64 {
  s := (t.a + t.b + t.c) / 2
  return math.Sqrt(s * (s - t.a) * (s - t.b) * (s - t.c))
}

func printShape(s Shape) {
  a := s.Area()

  fmt.Printf("%T's area is %f\n", s, a)
}
```

https://play.golang.org/p/8KLa9b8Q-E

https://play.golang.org/p/t-yMdpVgC1

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Concurrency made easy

- Concurrency is provided OOTB, in a similar way as we would have an internal `java.util.concurrent.ThreadPoolExecutor`
- A gorutine is like concrete implementation of `java.lang.Runnable` submitted for async execution
- Internal scheduler sets blocked gorutines aside, so that runnable ones are able to execute
- Channels are the idiomatic way of sharing data among gorutines, although package sync provides similar functionality like `java.util.concurrent`.

Concurrency made easy

```
func sum(a []int, c chan int) {
  ...
  c <- sum // send sum to c
}

func main() {
  ...
  c := make(chan int)

  for i := 0; i < N/K; i++ {
    ...
    go sum(a[start:end], c)
  }

  total := 0
  for i := 0; i < N/K; i++ {
    total += <- c
  }

  fmt.Println(total)
}
```

http://play.golang.org/p/2Ry6ycl6Go

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Standard Library

- Go's standard library provides support for implementing numerous functionalities
- In Go 1.3, there are 176 built-in packages

Standard Library

```
import (“errors”;"fmt";"http";"io";"encoder/json")

func (c *Client) newJiraRequest(method, path string, reader io.Reader) (*http.Request, error) {
  req, err := http.NewRequest(
    method, fmt.Sprintf("%s/rest/%s", c.uri, path), reader)

  if err != nil { return nil, err; }

  req.Header.Set("Content-Type", "application/json")

  return req, nil
}

func (c *Client) performJiraRequest(method, path string, reader io.Reader, output interface{}) error {
  req, err := c.newJiraRequest(method, path, reader)
  if err != nil { return err; }

  resp, err := c.httpClient.Do(req); defer resp.Body.Close()
  if err != nil { return err }

  if resp.StatusCode != 200 { return errors.New(resp.Status); }

  err = json.NewDecoder(resp.Body).Decode(output)
  if err != nil { return err; }

  return nil
}
```

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Building Web apps with Go

```
package main

import ("fmt";"log";"net/http";"time")

type timeHandler struct{}

func (th timeHandler) ServeHTTP(w http.ResponseWriter, req *http.Request) {
  currentTime := time.Now()

  fmt.Fprint(w, currentTime.Format(time.RFC1123Z))
}

func main() {
  err := http.ListenAndServe("localhost:4000", timeHandler{})

  if err != nil {
    log.Fatal(err)
  }
}
```

Building Web apps with Go

- There are many frameworks which support Web app development
- The most notable ones are:
  - Beego
  - Martini
  - Gorilla
  - GoCraft
  - Standard net/http

References

- Manning: Go in Action
- A Tour of Go
- Go Playground
- Go package reference
- Golang for Java programmers
- A Survey of 5 Go Web Frameworks

Questions?