GopherChina2018

Engineering Practices in Tantan using Golang

Henry Ren

April 15 2018

Engineering Practices in Tantan using Golang

Henry Ren
Product Backend Team Lead
探探科技
henry@tantanapp.com

GopherChina2018

Agenda

- Overview of Tantan
- Go in Tantan Backend
- Engineering Practices
  - Daily Development
  - Testing Go Code with ❤️
  - Building RESTful API
- Architecture Evolvement
- Conclusion

Overview of Tantan

GopherChina2018

#1 How Tantan works

#2 Daily Swipes

1+ Billion

RESTful API
PUT /users/me/relationships/:uid

Go in Tantan Backend

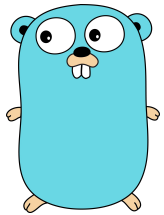
GopherChina2018

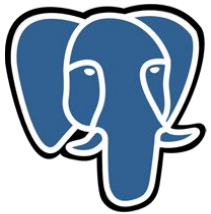
#1 Building Tantan Backend

- Goals
  - Clean Code Simplicity, Readability, Maintainability, Testability
  - Development Efficiency Ease of Development & Deployment
  - Scalability Vertical & Horizontal
  - Performant
- Challenges
  - Complexities Product Requirements
  - Software Quality
  - Continuous Iterations Development & Deployment
  - Small Team 3 Backend Developers in the Beginning

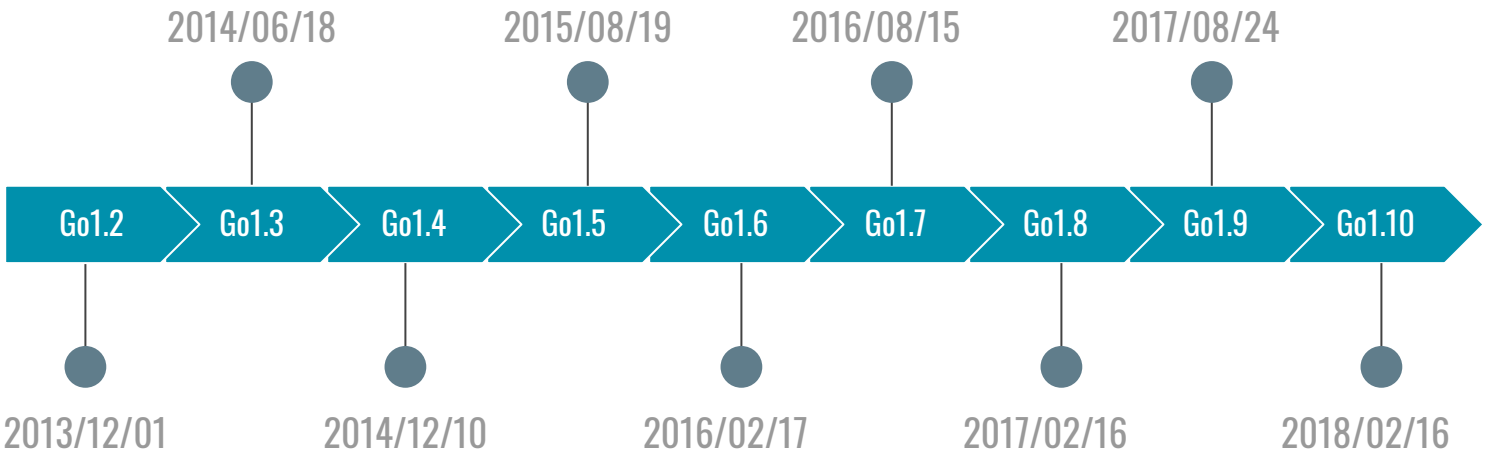
#2 Tech Stacks

- Team members in May, 2014
  - Developers with different background (PHP, C#, Python, C)
  - Developers speak different languages (English, Finnish, Swedish, Chinese)
  - Build first version within 4-5 weeks
- Tech stacks
  - Golang
    - Simplicity
    - Performant
    - Fun
  - PostgreSQL
    - PostGiS Extension for Location Based Services
    - Advanced Data Types, Partial Indexes, Stored Procedures etc.

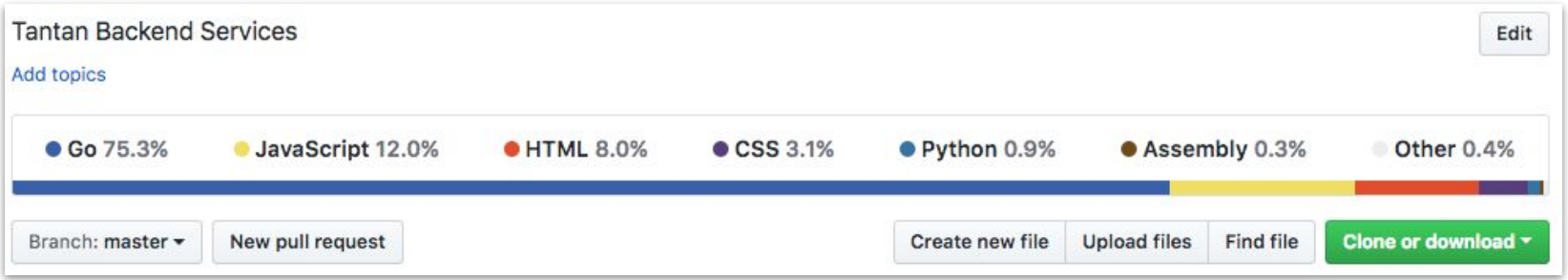




#3 Go versions



#4 Lines of Go Code




```
-------------------------------------------------------------------------------
Language                     files          blank        comment           code
-------------------------------------------------------------------------------
Go                            1683          33520           6096         187130
```

Lines of Go code in Backend Services Repository

#5 Backend Services Built in Go

- HTTP web servers
  - Using net/http package
  - RESTful API Services
  - Media (Image/Video/Audio) Uploading & Downloading Service
- RPC servers
  - Using net/rpc package
- Web apps
  - Using Revel web framework
- Cli programs
- Cron jobs
- etc.

#6 Engineering Practices

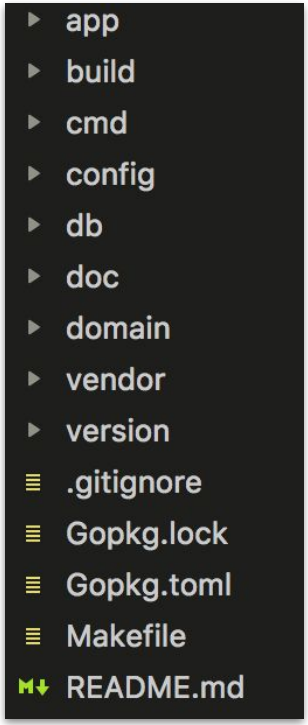
- Daily Development
- Testing Go Code with ❤️
- Building RESTful API

Engineering Practices: Daily Development

GopherChina2018

#1 Repository

- Single repository using Github
- Repository organization
  - cmd/: all main packages or files
  - app/: specific app implementations
  - version/: binary versioning
  - vendor/: vendoring packages
  - doc/: documentation in Markdown
  - db/: database changes
  - etc.
- Workflow
  - Fork -> Pull Request -> Code Review



#2 Go Tools

- go fmt
- **go test**
- go build / go install / go run
  - “It's a fast, statically typed, compiled language that feels like a dynamically typed, interpreted language.”
- go doc
  - go doc json / go doc json.Decoder / go doc json.Decoder.Decode
  - godoc -http=:8080 // check go documentation and standard libraries while golang.org not available
- go vet
  - report likely mistakes in packages
- Complete list: https://golang.org/cmd/

#3 IDEs

- Vim, Emacs, Sublime Text, GoLand, VS Code, etc.
- Development Plugins with different Go tools integrated (vscode-go for example)
  - Completion Lists (using gocode)
  - Build-on-save (using go build and go test)
  - Lint-on-save (using golint or gometalinter)
  - Format on save as well as format manually (using goreturns or goimports or gofmt)
  - Add Imports (using gopkgs)
  - Add/Remove Tags on struct fields (using gomodifytags)
  - Run Tests under the cursor, in current file, in current package, in the whole workspace (using go test)
  - Show code coverage
  - etc.

#4 Packages

- Standard Packages
  - net/http
  - encoding/json
  - context cancellation, timeouts, request scoped data etc
  - reflect
  - etc.
- External Packages
  - github.com/julienschmidt/httprouter
  - github.com/braintree/manners
  - github.com/revel/revel
  - github.com/stretchr/testify/assert
  - etc.

```
203 fmt
188 time
143 strings
136 log
108 net/http
107 errors
104 encoding/json
 96 flag
 94 strconv
 93 os
 74 sync
 73 io/ioutil
 70 bytes
 59 io
 43 context
```

go list -f '{{ join .Imports "\n" }}' ./...

#5 Versioning

- Compile version info into Go binary
  - go build -o tantan-swipe-service \
  - -ldflags "-X tantan/version.version=master-21a5f142fe3041a1ef6ec17d86a15423829d5ddc \
  - -X tantan/version.date=2018-04-05T20:44:34+0800" \
  - cmd/tantan-swipe-service/main.go
  -
  - ./tantan-swipe-service -version
  - Version: master-21a5f142fe3041a1ef6ec17d86a15423829d5ddc
  - Binary: ./tantan-swipe-service
  - Compile date: 2018-04-05T20:44:34+0800

-X importpath.name=value
Set the value of the string variable in importpath named name to value.

https://golang.org/cmd/link/

```go
package version

import (
	"flag"
	"fmt"
	"io"
	"os"
)

var showVersion = flag.Bool("version", false, "Print version of this binary")

var (
	version string
	date    string
)
```


```go
func init() {
	if !flag.Parsed() {
		flag.Parse()
	}
	if showVersion != nil && *showVersion {
		printVersion(os.Stdout, version, date)
		os.Exit(0)
	}
}

func printVersion(w io.Writer, version string, date string) {
	fmt.Fprintf(w, "Version: %s\n", version)
	fmt.Fprintf(w, "Binary: %s\n", os.Args[0])
	fmt.Fprintf(w, "Compile date: %s\n", date)
}
```


#6 Profiling

- Profiling Types
  - cpu profile
  - mem profile
  - blocking profile, goroutine profile etc.
- Profiling Generation
  - runtime/pprof
  - net/http/pprof
  - go test . -bench . -cpuprofile prof.cpu
- Profiling Visualization
  - go tool pprof cpu.prof
  - Flame graph profiler for Go programs: https://github.com/uber/go-torch

#7 Code Review

- Coding standards
- Go Code Review Comments

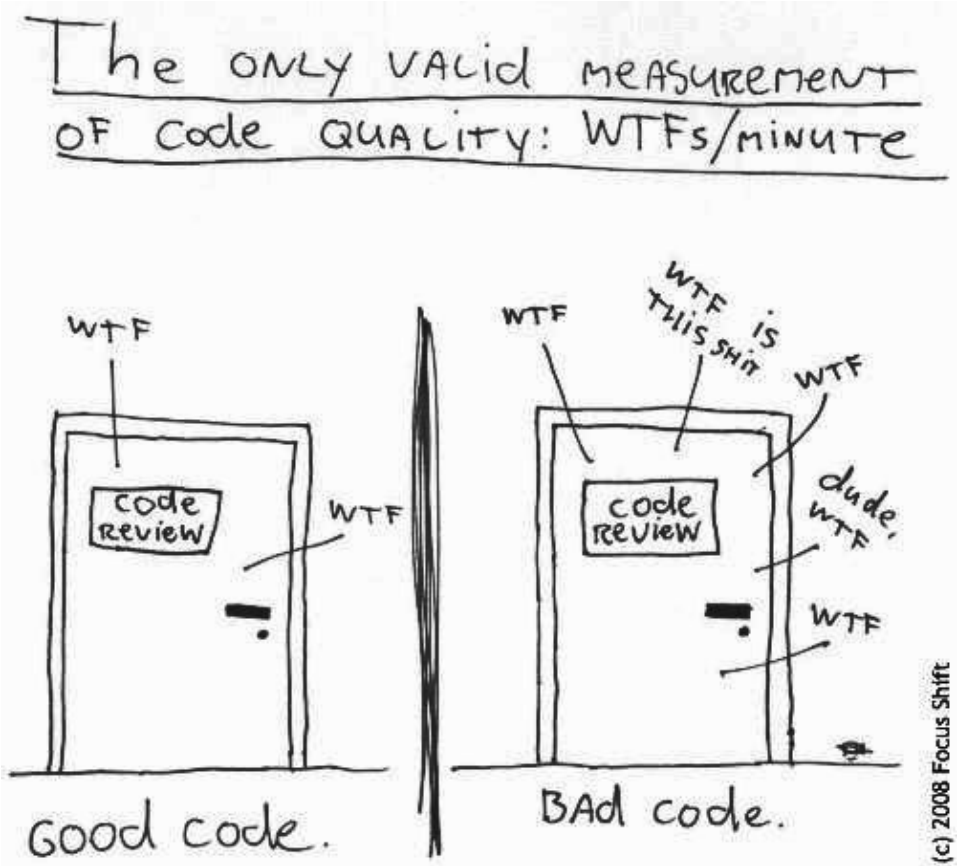
https://github.com/golang/go/wiki/CodeReviewComments

#8 Others

- Common issues
  - for ... range loop variable reuse
  - http response body not closed
  - goroutine lifetime
  - etc.
- Concurrency patterns
  - goroutine: execution
  - channel: communication message queuing
  - select: coordination
- Reflection: runtime reflection, allows a program to manipulate objects with arbitrary types
- Monitoring: Integration with Prometheus

Engineering Practices: Testing Go Code

GopherChina2018



http://www.osnews.com/story/19266/WTFs_m

#1 Testable Code

- Why it matters?
  - Development Time vs. Maintenance Time
  - Make iterations or CI/CD easier (bug fixes etc.)
- Code Quality
  - Readability
  - Maintainability
  - Testability
- Continuous Integration
  - Automatic Testing

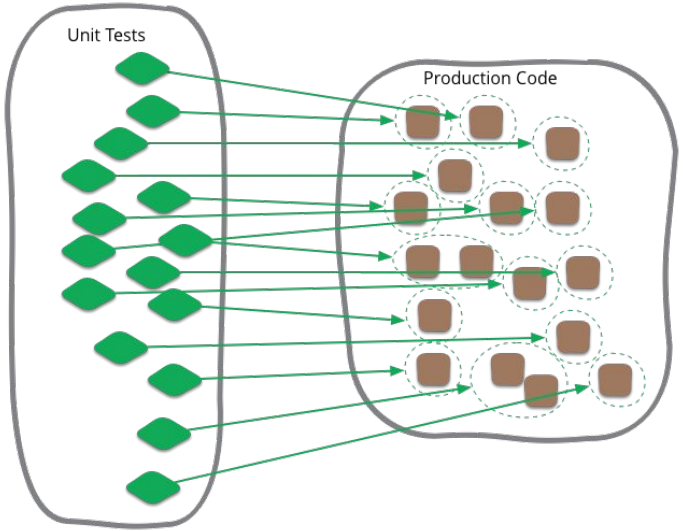
```
Henry Ren, 4 years ago | 1 author (Henry Ren)
67  type Dispatcher struct {
68      server *Server
69  }
```


#2 Testing in Go

- A lightweight test framework using:
  - go test command
  - testing package
- Go test files: _test.go

```
// foo_test.go (excluded from go build)
import "testing"

func TestXxx(t *testing.T) {}
func ExampleXxx() {}
func BenchmarkXxx(b *testing.B) {}
```



https://martinfowler.com/bliki/UnitTest.html

testing.TB interface

- Implemented by testing.T and testing.B structs

```
type TB interface {
    Error(args ...interface{})
    Errorf(format string, args ...interface{})
    Fail()
    FailNow() // signal failures
    Failed() bool
    Fatal(args ...interface{})
    // ...
}
```


testdata

- "The go tool will ignore a directory named "testdata", making it available to hold ancillary data needed by the tests."

#3 Testing Strategies

- Packages to place Go test files
- Same Package
  - White Box testing
  - Tests can access unexported variables, functions etc.
- Separate Package
  - Black Box testing
  - Tests can access only exported variables, functions etc.
  - Mandatory sometimes due to import cycles:
    - testing package imports strings
    - strings tests need to import testing package
    - Separate strings_test package is used

```go
// foo.go
package foo

// foo_test.go (white box testing)
package foo

// foo_test.go (black box testing)
package foo_test

import . "bar"
```


#4 Example Tests

- Examples on how to use your code
- Examples source code defined by testing package
- Examples functions can be run by go test command
- Output is compared with function standard output
- A separate example_test.go file in Go built-in libraries
  - `func ExampleXxx() {}`

```
func ExampleCompare() {
    fmt.Println(strings.Compare("a", "b"))
    fmt.Println(strings.Compare("a", "a"))
    fmt.Println(strings.Compare("b", "a"))
    // Output:
    // -1
    // 0
    // 1
}
```


```
$ cd /usr/local/go/src/strings
$ go test -v example_test.go
=== RUN   ExampleFields
--- PASS: ExampleFields (0.00s)
=== RUN   ExampleFieldsFunc
--- PASS: ExampleFieldsFunc (0.00s)
=== RUN   ExampleCompare
--- PASS: ExampleCompare (0.00s)
...
PASS
ok   command-line-arguments  0.009s
```


#5 Benchmark Tests

- Profiling
  - CPU
  - Mem
  - Goroutine block
- go test -bench=.

```
$ cd /usr/local/go/src/strings
$ go test -v -bench='BenchmarkToUpper' -run='^$' strings_test.go
goos: darwin
goarch: amd64
BenchmarkToUpper/#00-8                  300000000           5.74 ns/op
BenchmarkToUpper/ONLYUPPER-8            100000000          14.1 ns/op
BenchmarkToUpper/abc-8                  30000000           40.8 ns/op
BenchmarkToUpper/AbC123-8               30000000           48.0 ns/op
BenchmarkToUpper/azAZ09_-8              30000000           47.1 ns/op
BenchmarkToUpper/longStrinGwitHmixofsmaLLandcAps-8          20000000           89.7 ns/op
BenchmarkToUpper/longεstringεwithεnonascii□chars-8           5000000          314 ns/op
BenchmarkToUpper/εεεεε-8                                    5000000          268 ns/op
PASS
ok    command-line-arguments     13.429s
```


#6 HTTP Testing

- net/http/httptest Package
- Testing HTTP Clients and Servers

```go
func requestHandleFunc(w http.ResponseWriter, r *http.Request) {
	w.Header().Set("Content-Type", "application/json; charset=utf-8")
	w.WriteHeader(http.StatusOK)
	w.Write([]byte(`{"status": "ok"}`))
}

func TestRequestHandleFunc(t *testing.T) {
	req, _ := http.NewRequest("GET", "/", nil)
	w := httptest.NewRecorder() // response recorder for later inspection

	requestHandleFunc(w, req)
	if status := w.Code; status != http.StatusOK {
		t.Errorf("expected status code: %d, got: %d", http.StatusOK, status)
	}
}
```


#7 TestMain

- Runs in the main goroutine
- Set up or tear down things before or after multiple tests
- setUp() and tearDown() are run only once for multiple tests
- Use cases
  - Initialize and close db connection before and after multiple tests
  - Subprocess testing

```
func TestMain(m *testing.M) {
    setUp()
    code := m.Run()
    tearDown()
    os.Exit(code)
}
```


#8 Multiple Test Cases

- Table Driven Tests
- Define separate functions
  - Code duplication
- Use subtests in testing package
  - Better table driven tests with hierarchy
  - Better testing output format
  - Could add setup and tearDown before and after subtests
  - `func (t *T) Run(name string, f func(t *T)) bool {}`
  - `func (b *B) Run(name string, f func(b *B)) bool {}`

```
// net/http/httptest/server_test.go
func TestServer(t *testing.T) {
   for _, name := range []string{"NewServer", "NewServerManual"} {
       t.Run(name, func(t *testing.T) {
           newServer := newServers[name]
           t.Run("Server", func(t *testing.T) { testServer(t, newServer) })
           t.Run("GetAfterClose", func(t *testing.T) { testGetAfterClose(t, newServer) })
           t.Run("ServerCloseBlocking", func(t *testing.T) { testServerCloseBlocking(t, newServer)
})
           t.Run("ServerCloseClientConnections", func(t *testing.T) {
testServerCloseClientConnections(t, newServer) })
           t.Run("ServerClientTransportType", func(t *testing.T) { testServerClientTransportType(t,
newServer) })
       })
   }
   ...
}
```


```
$ go test -v -run='^TestServer$' net/http/httptest/.
=== RUN   TestServer
=== RUN   TestServer/NewServer
=== RUN   TestServer/NewServer/Server
=== RUN   TestServer/NewServer/GetAfterClose
=== RUN   TestServer/NewServer/ServerCloseBlocking
...
--- PASS: TestServer (0.01s)
    --- PASS: TestServer/NewServer (0.00s)
        --- PASS: TestServer/NewServer/Server (0.00s)
        --- PASS: TestServer/NewServer/GetAfterClose (0.00s)
        --- PASS: TestServer/NewServer/ServerCloseBlocking (0.00s)
    ...
PASS
ok    net/http/httptest     0.019s
```


#9 Skipping Tests

- Skip tests explicitly using t.Skip() method
  - Based on flags, environment variables, conditions etc.
- Skip tests using -run flag
  - regular expression pattern
- Skip tests using -short flag
- Skip tests using -timeout flag

```
$ export DEBUG_MODE="true"
$ go test -v skipping_tests_test.go
=== RUN   TestSkip
--- SKIP: TestSkip (0.00s)
        skipping_tests_test.go:21: test skipped
PASS
ok      command-line-arguments  0.019s
```

```go
import (
    "os"
    "testing"
)

func TestSkip(t *testing.T) {
    if os.Getenv("DEBUG_MODE") == "true" {
        t.Skipf("test skipped")
    }
}
```


```
$ go test -v -run='^TestContainsAny$' strings_test.go
=== RUN   TestContainsAny
--- PASS: TestContainsAny (0.00s)
PASS
ok   command-line-arguments  0.085s
```


```
$ go test -v skipping_tests_test.go
=== RUN   TestSkipUsingShort
--- FAIL: TestSkipUsingShort (0.00s)
FAIL
FAIL    command-line-arguments  0.042s

$ go test -v -short skipping_tests_test.go
=== RUN   TestSkipUsingShort
--- SKIP: TestSkipUsingShort (0.00s)
        skipping_tests_test.go:7: test skipped
PASS
ok      command-line-arguments  0.020s
```

```go
import "testing"

func TestSkipUsingShort(t *testing.T) {
      if testing.Short() {
            t.Skipf("test skipped")
      }
      t.FailNow()
}
```


```
$ go test -v -timeout 1s skipping_tests_test.go
=== RUN   TestSkipUsingTimeout
panic: test timed out after 1s
...
FAIL    command-line-arguments  1.010s

$ go test -v -timeout 5s skipping_tests_test.go
=== RUN   TestSkipUsingTimeout
--- PASS: TestSkipUsingTimeout (3.00s)
PASS
ok      command-line-arguments  3.007s
```

```
import (
      "testing"
      "time"
)

func TestSkipUsingTimeout(t *testing.T) {
      time.Sleep(time.Second * 3)
}
```


#10 Running Tests in Parallel

- Tests for specific package are executed sequentially by default
- Run tests in Parallel using t.Parallel() method

```
$ go test -v parallel_tests_test.go
=== RUN   TestParallelSleepOneSecond
--- PASS: TestParallelSleepOneSecond (1.00s)
=== RUN   TestParallelSleepTwoSecond
--- PASS: TestParallelSleepTwoSecond (2.00s)
=== RUN   TestParallelSleepThreeSecond
--- PASS: TestParallelSleepThreeSecond (3.00s)
PASS
ok      command-line-arguments  6.018s
```

```go
import (
	"testing"
	"time"
)
func TestParallelSleepOneSecond(t *testing.T) {
	time.Sleep(time.Second)
}
func TestParallelSleepTwoSecond(t *testing.T) {
	time.Sleep(time.Second * 2)
}
func TestParallelSleepThreeSecond(t *testing.T) {
	time.Sleep(time.Second * 3)
}
```


```
$ go test -v parallel_tests_test.go
=== RUN   TestParallelSleepOneSecond
=== PAUSE TestParallelSleepOneSecond
=== RUN   TestParallelSleepTwoSecond
=== PAUSE TestParallelSleepTwoSecond
=== RUN   TestParallelSleepThreeSecond
=== PAUSE TestParallelSleepThreeSecond
=== CONT  TestParallelSleepOneSecond
=== CONT  TestParallelSleepThreeSecond
=== CONT  TestParallelSleepTwoSecond
--- PASS: TestParallelSleepOneSecond (1.00s)
--- PASS: TestParallelSleepTwoSecond (2.00s)
--- PASS: TestParallelSleepThreeSecond (3.00s)
PASS
ok      command-line-arguments  3.017s
```

```go
import (
    "testing"
    "time"
)
func TestParallelSleepOneSecond(t *testing.T) {
    t.Parallel()
    time.Sleep(time.Second)
}
func TestParallelSleepTwoSecond(t *testing.T) {
    t.Parallel()
    time.Sleep(time.Second * 2)
}
func TestParallelSleepThreeSecond(t *testing.T) {
    t.Parallel()
    time.Sleep(time.Second * 3)
}
```


#11 Testing Output

- go test -v .
  - go2xunit: https://github.com/tebeka/go2xunit
  - Convert "go test" output to xunit compatible (used in Jenkins/Hudson)
- go test -v -json .
  - json flag introduced in Go1.10

```
$ cd /usr/local/go/src/strings
$ go test -v -json example_test.go
{"Time":"2018-04-15T11:37:24.804212777+08:00","Action":"run","Package":"command-line-arguments","Test":"ExampleFields"}
{"Time":"2018-04-15T11:37:24.804431761+08:00","Action":"output","Package":"command-line-arguments","Test":"ExampleFields","Output":"=== RUN   ExampleFields\n"}
{"Time":"2018-04-15T11:37:24.804457082+08:00","Action":"output","Package":"command-line-arguments","Test":"ExampleFields","Output":"--- PASS: ExampleFields (0.00s)\n"}
....
{"Time":"2018-04-15T11:37:24.810771405+08:00","Action":"pass","Package":"command-line-arguments","Elapsed":0.012}
```


#12 Testing Coverage

- Statement test coverage
  - 100% vs. 0%
- Go test coverage implementation
  - https://blog.golang.org/cover
- Test coverage report
  - go test -cover {pkg}
  - go test -cover -coverprofile=cover.out {pkg}
  - go tool cover -func=cover.out
- Test coverage visualization
  - go tool cover -html=cover.out -o coverage.html
  - IDE VSCode “Toggle Test Coverage”

```
$ go test -cover encoding/json
ok    encoding/json    0.995s    coverage: 90.7% of statements
$ go test -cover context
ok    context    2.617s    coverage: 97.2% of statements
$ go test -cover net/http
ok    net/http    35.131s    coverage: 78.9% of statements
```


context/context.go (97.2%) not tracked not covered covered

```
func (e *emptyCtx) String() string {
        switch e {
        case background:
                return "context.Background"
        case todo:
                return "context.TODO"
        }
        return "unknown empty Context"
}

var (
        background = new(emptyCtx)
        todo       = new(emptyCtx)
)

// Background returns a non-nil, empty Context. It is
// values, and has no deadline. It is typically used b
// initialization, and tests, and as the top-level Con
// requests.
func Background() Context {
        return background
}
```


#13 Integration Testing

- Background: automate testing process by making several sequential API requests
- Implemented as a complete framework with “go test” command and testing package
  - Automatic RESTful API tests using “go test”
  - JSON Schema Validation
  - Simulating HTTP Clients
- External packages we used
  - github.com/stretchr/testify
  - github.com/xeipuuv/gojsonschema

```
$ go test api/service/moments_test.go -v -debug=false -baseURL=https://example.com/v1
=== RUN   TestGetMoments
--- PASS: TestGetMoments (0.42s)
=== RUN   TestGetMomentsPagination
--- PASS: TestGetMomentsPagination (1.06s)
=== RUN   TestPostMoments
--- PASS: TestPostMoments (0.11s)
=== RUN   TestPatchMoments
--- PASS: TestPatchMoments (0.10s)
=== RUN   TestPutMoments
--- PASS: TestPutMoments (0.11s)
=== RUN   TestDeleteMoments
--- PASS: TestDeleteMoments (0.09s)
...
PASS
ok    command-line-arguments     2.570s
```

DEMO
(if time permits)

#14 In Summary

- More scenarios in using go test command and testing package
  - Dependency Injection using Interfaces
  - Concurrency Testing
  - Mocking
- Writing tests in Go has a lot of fun
  - Fast Build
  - Test and Cover
- Great examples and idiomatic practices in Go built-in packages
- A lot of testing library/frameworks
  - Toolkit with common assertions and mocks https://github.com/stretchr/testify
  - BDD Testing Framework for Go https://github.com/onsi/ginkgo
  - etc.

Engineering Practices: Building RESTful API

GopherChina2018

#1 REST

- “Representational state transfer (REST) is the software architectural style of the World Wide Web” - *wikipedia*
  - Resources (resource name, eg. URI)
  - Representation (an Internet media type for the data between client and server, eg. JSON,XML)
  - State Transfer (standard HTTP methods, eg. GET, POST etc)

#2 RESTful API Design

- Resource Oriented
  - Concepts
    - Resources
    - Their names (URIs)
    - Their representations
    - The links between them
  - Properties
    - Addressability
    - Statelessness
    - Connectedness
    - A uniform interface

《RESTful web services》- Leonard Richardson & Sam Ruby

#3 JSON

- JSON for resource representation
  - API POST/PATCH/PUT request body
  - API response
  - > curl -H "Accept: application/json" -H "Content-type: application/json" -d '{"subject": "Engineering Practices in Tantan using Go", "speaker": "henry", "location": "shanghai"}' https://example.com/v1/talks
  - < 201 Created
  - < {"code": 201, "error": "", "message": "Created"}

#4 Building RESTful API using Go

- net/http package
- Popular Go frameworks for building RESTful APIs
  - beego
  - gin
  - etc.

Architecture Evolvement

#1 Background

- Service Oriented Architecture
- Monolithic RESTful API Service

#2 Challenges

- Growing Backend Teams
- Team Collaboration
- Loose Coupling
- Delivery Efficiency

#3 Looking forward

- Writing testable code using Go
- Refactoring architecture to Microservices using Go (working on)
  - Domain Driven Design
  - Clear Service Definition and Boundaries
  - Service Communication, Discovery & Registry etc.
- Continuous integration/deployment using Go
  - Create tests with reasonable test coverage
  - Run tests fast and periodically
  - Automation

Conclusion

It’s Fun in Coding Go

- "Go is powerful enough to make a lot happen in a few lines.” — Effective Go
- It was a wise decision to choose Go 4 years ago at Tantan.
  - Move fast while keeping software quality
  - Happy hacking in coding Go and PostgreSQL
- Use Go for your next project.

Thanks!

Henry Ren
henry@tantanapp.com

GopherChina2018