Testing in go: unit → end2end

Or, How I think about testing in 2021

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What will this talk Cover?

What is testing?

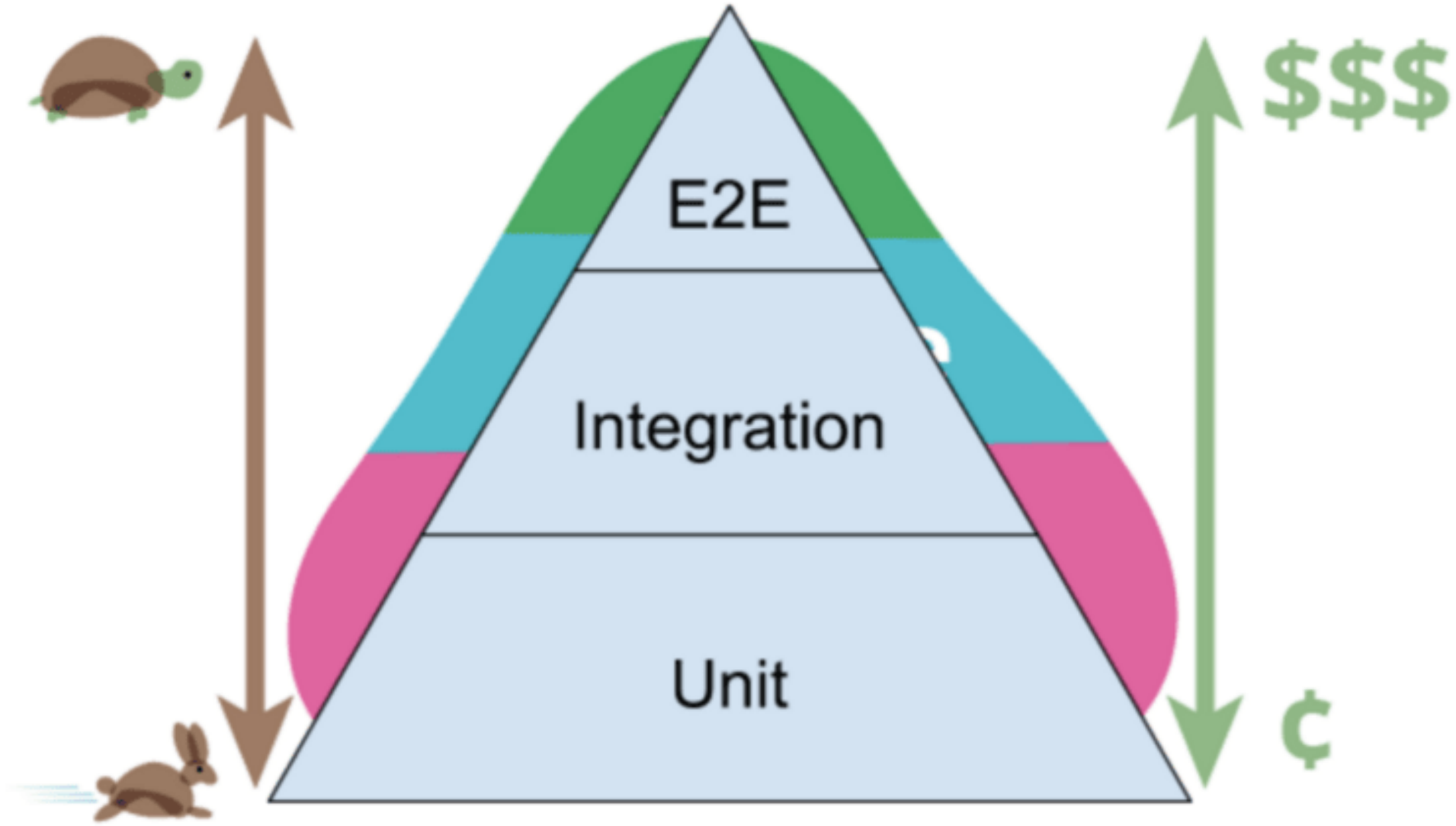
Why should you care?

Types of tests

- Accessibility testing
- Acceptance testing
- Black box testing
- End-to-end testing
- Functional testing
- Interactive testing
- Integration testing
- Load testing
- Non functional testing
- Performance testing
- Regression testing
- Sanity testing
- Security testing
- Smoke testing
- Stress testing
- Unit testing
- White box testing
- And many more...

Types of Tests I actually write

- Load tests
- Profiling/Benchmarks
- **Unit tests**
- **Integration tests**
- **End to End tests**


$$$
E2E
Integration
Unit
¢

Let's build an app

```
[UserReq]->
[Authenticate]->
[BuildInternalRequestObject] ->
[makeDBInsert] ->
[CallThirdparty] ->
[BuildResponse] ->
[UserReqResponse]
```

First, our service

```
func main() {
  http.HandleFunc("/submit", authMiddleware(handlerFunc))
  http.HandleFunc("/notloggedIn", notLoggedInHandlerFunc)
  log.Fatal(http.ListenAndServe(":8080", nil))
}

func notLoggedInHandlerFunc(w http.ResponseWriter, r *http.Request){
  w.Write([]byte("not logged in"))
}
```

Auth middleware

```go
// Check if a user request is authenticated
func authFunction(r *http.Request) bool {
  return r.URL.Query().Get("auth") == "ABC"
}

func authMiddleware(next http.HandlerFunc) http.HandlerFunc {
  return func(w http.ResponseWriter, r *http.Request) {
    if !authFunction(r) {
      http.Redirect(w, r, "/notloggedIn", http.StatusUnauthorized)
      return
    }
    // User authenticated successfully
    next(w, r)
  }
}
```

Let's see the handler

```go
func handlerFunc(w http.ResponseWriter, r *http.Request) {
    ctx := r.Context()

    reqCtx, err := buildRequestContextAndValidate(r)
    if err != nil {
        fmt.Fprintf(w, "There was a validation error; %v", err)
        return
    }

    reqID, err := insertRequestToDB(ctx, reqCtx)
    if err != nil {
        fmt.Fprintf(w, "There was an error inserting request; %v", err)
        return
    }

    err = sendNotification(ctx, reqID, reqCtx, notificationURL)
    if err != nil {
        fmt.Fprintf(w, "There was an error sending notification; %v", err)
        return
    }

    fmt.Fprintf(w, "Success in Handling  request")
}
```

Now how do we test this?

Unit Testing

- Self contained
- Fast to run
- Easy to write
- Faster feedback loops
- Our stand in for REPL driven development
- GO unit test support is 👍

Recall

```
// Check if a user request is authenticated
func authFunction(r *http.Request) bool {
  return r.URL.Query().Get("auth") == "ABC"
}
```

In main_test.go

```
func TestAuthFunction(t *testing.T) {
  t.Run("should return false when auth param is absent", func(t *testing.T) {
    req, err := http.NewRequest("GET", "/submit", nil)
    if err!=nil{
      t.Error("go an error where nil was expected", err)
      return
    }

    if authFunction(req)  {
      t.Error("got true where false was  expected from authFunction")
      return
    }
  })

 // <Rest of the tests go here>
}
```

We then run the test

```
$ go test -v ./ -run=TestAuthFunction

=== RUN   TestAuthFunction
=== RUN   TestAuthFunction/should_return_false_when_auth_param_is_absent
--- PASS: TestAuthFunction (0.00s)
    --- PASS: TestAuthFunction/should_return_false_when_auth_param_is_absent (0.00s)
PASS
ok      ./devopscon-testing 0.025s
```

Let's use an assertion library

https://github.com/stretchr/testify

```
t.Run("should return false when auth param is absent", func(t *testing.T) {
  req, err := http.NewRequest("GET", "/submit", nil)
  if err!=nil{
    t.Error("go an error where nil was expected", err)
    return
  }

  if authFunction(req)  {
    t.Error("got true where false was  expected from authFunction")
    return
  }
})

t.Run("should return false when auth param is incorrect", func(t *testing.T) {
  req, err := http.NewRequest("GET", "/submit?auth=XYZ", nil)
  assert.NoError(t, err)
  assert.False(t, authFunction(req))
})
```

```go
func TestAuthFunction(t *testing.T) {
    t.Run("should return false when auth param is absent", func(t *testing.T) {
        req, err := http.NewRequest("GET", "/submit", nil)
        if err != nil {
            t.Error("go an error where nil was expected", err)
            return
        }
        if authFunction(req) {
            t.Error("got true where false was  expected from authFunction")
            return
        }
    })
    t.Run("should return false when auth param is incorrect", func(t *testing.T) {
        req, err := http.NewRequest("GET", "/submit?auth=XYZ", nil)
        assert.NoError(t, err)
        assert.False(t, authFunction(req))
    })
    t.Run("should return true when auth param is correct", func(t *testing.T) {
        req, err := http.NewRequest("GET", "/submit?auth=ABC", nil)
        assert.NoError(t, err)
        assert.True(t, authFunction(req))
    })
}
```

```
$ go test -v ./ -run=TestAuthFunction
=== RUN   TestAuthFunction
=== RUN   TestAuthFunction/should_return_false_when_auth_param_is_absent
=== RUN   TestAuthFunction/should_return_false_when_auth_param_is_incorrect
=== RUN   TestAuthFunction/should_return_true_when_auth_param_is_correct
--- PASS: TestAuthFunction (0.00s)
    --- PASS: TestAuthFunction/should_return_false_when_auth_param_is_absent (0.00s)
    --- PASS: TestAuthFunction/should_return_false_when_auth_param_is_incorrect (0.00s)
    --- PASS: TestAuthFunction/should_return_true_when_auth_param_is_correct (0.00s)
PASS
ok      ./devopscon-testing    0.025s
```

What about TDD(Table Driven Tests)?

```go
type requestCtx struct {
    Name  string
    Age   int
    Email string
}

func buildRequestContextAndValidate(r *http.Request) (requestCtx, error) {
    ageStr := r.URL.Query().Get("age")
    age, err := strconv.Atoi(ageStr)
    if err != nil {
        return requestCtx{}, errors.Wrap(err, "age is not an integer")
    }
    if age < 18 {
        return requestCtx{}, errors.New("user is below 18 yr")
    }

    return requestCtx{
        Name:  r.URL.Query().Get("name"),
        Age:   age,
        Email: r.URL.Query().Get("email"),
    }, nil
}
```

```go
func TestBuildRequestContextAndValidate(t *testing.T) {
    testCases := map[string]struct {
        urlToValidate    string
        expectedURLError string
        expectedError    string
    }{
        "happy path with valid age and email": {
            urlToValidate: "/submit?auth=ABC&age=19&name=tony&email=abc@xyz.com",
        },
        "error: age is not a number": {
            urlToValidate: "/submit?auth=ABC&age=agexx&name=tony&email=abc@xyz.com",
            expectedError: "age is not an integer: strconv.Atoi: parsing \"agexx\": invalid syntax",
        },
        "error: age is should be above 18": {
            urlToValidate: "/submit?auth=ABC&age=12&name=tony&email=abc@xyz.com",
            expectedError: "user is below 18 yr",
        },
    }

    for k, v := range testCases {
        t.Run(k, func(t *testing.T) {
            req, err := http.NewRequest("GET", v.urlToValidate, nil)
            if len(v.expectedURLError) == 0 {
                assert.NoError(t, err)
            } else {
                assert.EqualError(t, err, v.expectedURLError)
            }

            _, err = buildRequestContextAndValidate(req)
            if len(v.expectedError) == 0 {
                assert.NoError(t, err)
            } else {
                assert.EqualError(t, err, v.expectedError)
            }
        })
    }
}
```

```
testCases := map[string]struct {
      urlToValidate    string
      expectedURLError string
      expectedError    string
  }{
      "happy path with valid age and email": {
          urlToValidate: "/submit?auth=ABC&age=19&name=tony&email=abc@xyz.com",
      },
      "error: age is not a number": {
          urlToValidate: "/submit?auth=ABC&age=agexx&name=tony&email=abc@xyz.com",
          expectedError: "age is not an integer: strconv.Atoi: parsing \"agexx\": invalid syntax",
      },
      "error: age is should be above 18": {
          urlToValidate: "/submit?auth=ABC&age=12&name=tony&email=abc@xyz.com",
          expectedError: "user is below 18 yr",
      },
  }
```

```
for k, v := range testCases {
    t.Run(k, func(t *testing.T) {
        req, err := http.NewRequest("GET", v.urlToValidate, nil)
        if len(v.expectedURLError) == 0 {
            assert.NoError(t, err)
        } else {
            assert.EqualError(t, err, v.expectedURLError)
        }

        _, err = buildRequestContextAndValidate(req)
        if len(v.expectedError) == 0 {
            assert.NoError(t, err)
        } else {
            assert.EqualError(t, err, v.expectedError)
        }
    })
}
```

```
$ go test -v ./ -run TestBuildRequestContextAndValidate

=== RUN   TestBuildRequestContextAndValidate
=== RUN   TestBuildRequestContextAndValidate/happy_path_with_valid_age_and_email
=== RUN   TestBuildRequestContextAndValidate/error:_age_is_not_a_number
=== RUN   TestBuildRequestContextAndValidate/error:_age_is_should_be_above_18
--- PASS: TestBuildRequestContextAndValidate (0.00s)
    --- PASS: TestBuildRequestContextAndValidate/happy_path_with_valid_age_and_email (0.00s)
    --- PASS: TestBuildRequestContextAndValidate/error:_age_is_not_a_number (0.00s)
    --- PASS: TestBuildRequestContextAndValidate/error:_age_is_should_be_above_18 (0.00s)
PASS
ok      ./devopscon-testing    0.025s
```

Integration Tests

- Usually involves talking to third party or external systems
- It would still involve testing almost individual units or groups of units.
- How we write integration tests in Go
- We just write tests :)

Use `<filename>_integration_test.go` file extension

Start the file with

```
// +build integration

Package <package_name>
```

Run the tests by specifying the tags

```
$ go test --tags=integration ./
```

Let's write an integration test

```
func sendNotification(ctx context.Context, reqID int, reqCtx requestCtx, baseURL string) error {
    res, err := req.Post(baseURL+"/mail", req.BodyJSON(req.Param{
        "name":   reqCtx.Name,
        "email":  reqCtx.Email,
        "req_id": reqID,
    }))

    responseMap := map[string]interface{}{}
    res.ToJSON(&responseMap)

    if len(responseMap["email"].(string)) == 0 {
        return errors.New("invalid response from notification provider")
    }
    return err
}
```

```
var updateGolden = flag.Bool("update_golden", false,
"set to update_golden flag to true if you want to hit the live server")

func TestSendNotification(t *testing.T) {
  var calledRemoteServer bool
    ts := httptest.NewServer(http.HandlerFunc(func(w http.ResponseWriter, r *http.Request) {
    calledRemoteServer = true
        if *updateGolden {
            res, err := req.Post(notificationURL+"/mail", r.Body)
            assert.NoError(t, err)
            err = os.WriteFile("testdata/notification.golden", res.Bytes(), 0666)
            assert.NoError(t, err)
        }
        data, err := os.ReadFile("testdata/notification.golden")
        assert.NoError(t, err)
        w.Write(data)
    }))
    defer ts.Close()

    err := sendNotification(context.Background(), 22, requestCtx{
        Name:  "Test User",
        Age:   33,
        Email: "user@ex.com",
    }, ts.URL)
    assert.NoError(t, err)
  assert.True(t, calledRemoteServer)
}
```

End to End Tests

- Usually tests the entire application like a user
- Could be api tests
- Could be UI tests that actually click around in an app

Side effects

- Can be slow
- Can be flaky
- Can be harder to verify

BDD and e2e testing with Ginkgo/ Gomega

Use `<filename>_e2e_test.go` file extension

Start the file with

```
// +build e2e

Package <package_name>
```

```
const rootURL = "http://localhost:8080"

func TestE2E(t *testing.T) {
    defer GinkgoRecover()
    RegisterFailHandler(Fail)
    RunSpecs(t, "Devopscon test Suite")
}

var _ = Describe("Here we describe the test", func() {
    It("should fail with a wrong auth", func() {
        r, err := req.Get(rootURL + "/submit?auth=WRONG&age=19&name=tony&email=abc@xyz.com")
        Expect(err).To(BeNil())
        Expect(r.Response().StatusCode).To(Equal(401))
    })

    It("should succeed", func() {
        r, err := req.Get(rootURL + "/submit?auth=ABC&age=19&name=tony&email=abc@xyz.com")
        Expect(err).To(BeNil())
        Expect(r.Response().StatusCode).To(Equal(200))
        Expect(r.String()).To(Equal("Success in Handling  request"))
    })
})
```

Run the tests by specifying the tags

```
$ go test --tags=integration ./ -run=TestE2E


=== RUN   TestE2E
Running Suite: Geolocator Suite
================================
Random Seed: 1623694664
Will run 2 of 2 specs

••
Ran 2 of 2 Specs in 0.568 seconds
SUCCESS! -- 2 Passed | 0 Failed | 0 Pending | 0 Skipped
--- PASS: TestE2E (0.57s)
PASS
ok      github.com/deliveryhero/testing-talk    0.598s
```

Recap

- Unit tests for most things. Write a lot of them, then integration and End to
  End tests
- You can test in go without any special libraries. But libraries help
- Leverage golden/cache files when testing against real world services
- Tests are just code. You can do anything in tests.

Resources

- https://golang.org/pkg/testing/
- https://www.toptal.com/go/your-introductory-course-to-testing-with-go
- https://onsi.github.io/ginkgo

Slides are Available at

- https://github.com/tonyalaribe/testing-talk