


Project Structure

Idioms and suggestions from the Go community

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Detroit Go Meetup

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Credit Due

- <https://changelog.com/gotime/102>
- <https://www.youtube.com/watch?v=oL6JBuk6tj0>

Motivation

In general, why is project structure important?

- Building a mental model / Readability
- Standardization
 - Reduce project on-boarding costs
 - Logging, monitoring and alerting
- Reduce code duplication where appropriate
- Help manage dependencies
 - Specific and non-specific to Go
 - In Go, this is a compilation error
 - This was actually the motivation for creating Go

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Motivation

Ultimately, **speed**

Now and in the **future**

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Consider

Before spending months on design, consider:

Context

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- What problem(s) are you trying to solve?
- Will the project grow? How will it grow?
- Lifetime?
 - Of the **problem** and the project
 - Product-market fit?
- Who are your users?
 - Open-source library?
 - Public API for your company?
 - Internal tool or API at your company?
- How many users?
 - Library for Kubernetes?

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Before spending months on design, consider:

Design importance **fluctuates** based on the context.

Remember

- Structure / **abstractions will emerge**
- Rewrites are fine and often necessary
- Organizations and technologies will change
 - This will render your abstraction as useless
 - Or will make updating technologies difficult
 - Conway's Law
 - Organizations design systems that mirror their own communication structure

Solve the problem; design will emerge and often change

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Solve the problem; design will emerge and often change

Go Background

```
pkg/  
  a/  
    a.go # package a  
  b/  
    b.go # package b
```

```
$ cat pkg/a/a.go  
package a  
import "b"
```

```
$ cat pkg/b/b.go  
package b  
import "a"
```

Go Background

```
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  a/  
    a.go # package a  
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```

```
$ cat pkg/a/a.go  
package a  
import "b"
```

```
$ cat pkg/b/b.go  
package b  
import "a" <---- "import cycle not allowed"
```

Go Background

- Appreciate the “import cycle not allowed” error
- If you’re fighting this error, consider a redesign or refactor
- Dependency management — packages are dependencies — is important

Rob Pike comparing compilation times from C++ to Go

“...turns minutes into seconds, coffee breaks into interactive builds” – [Rob Pike at SPLASH 2012](#)

Patterns

- No **wrong** “solution”, just possibly better “solutions”
- “Bad” abstractions are worse than no abstractions
- It’s important to understand the flow of requests
- **Part of learning is discovering what doesn’t work**

Patterns

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Abstractions

What are we trying to solve with abstractions?

- Efficient mental model building
- Readability
- Reduce code duplication
- **Ultimately, speed**

Patterns

Where do I put ...

- Tests
 - **No** tests/
 - `name_test.go` files remain in the package with the related `name.go` file
- `cmd/`
 - Multiple binaries / “entrypoints”
- `internal/` VS `pkg/`
 - `internal/` - “ensures that changes to the API of internal packages will never break an external application”
- Where do I put everything else?
 - `Dockerfile`, `README.md`, dotfiles, etc.

Patterns

1. Flat Structure (i.e., “abstractionless”)

- No package abstractions
- Everything is in package `main`
 - No “import cycle” errors
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1. Flat Structure (i.e., “abstractionless”)

```
main.go
server.go
database.go
thing1.go # model, view and controller code
thing1_test.go
thing2.go # model, view and controller code
thing2_test.go
```

Patterns

1. Flat Structure (i.e., “abstractionless”)

A few open-source examples

- github.com/Jguer/yay
- github.com/gorilla/mux
- github.com/sirupsen/logrus

Patterns

1. Flat Structure (i.e., “abstractionless”)

Challenges:

- Mental model construction is difficult from project structure alone
 - Ineffective display of “grouping”, layering and request flow
- Readability

These become more true as the **project grows in size**.

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Patterns

2. Model-View-Controller (MVC)

```
main.go
pkg/
  handlers/ # package handlers
    thing1.go
    thing2.go
  database/ # package database
    database.go
  models/ # package models
    thing1.go
    thing2.go
  responses/ # package responses
    thing1.go
    thing2.go
```

Patterns

2. Model-View-Controller (MVC)

Challenges:

- Code duplication to avoid circular dependencies
 - You will most likely have a model and response for the same type that are tightly-coupled
 - Controller calls models and builds a view
- Related “things” are “**far**”

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Benefits:

- Centralized logic for interacting with a data store
 - Easier to swap technologies (e.g., PostgreSQL to MySQL), if you have abstracted the technology away from the model
- Standard outside of Go
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Addition Patterns

- Domain-driven design (DDD)
 - Similar goals to micro-services
 - Separating parts of the business
 - Domain-specific logic (i.e., for this service, let's do retries)
- Hexagonal architecture

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My Framework

How I learned (and continue to learn)

- Go Package-focused design
- Ben Johnson's blog posts
 - Standard Package Layout
 - Structuring Applications in Go
- github.com/golang-standards/project-layout

I failed (and still fail), a lot

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My Framework

How I approach new projects

- Find an open-source example and refer (don't copy) its design
 - Kubernetes, Docker, Yay, FZF, HashiCorp/*, etc.
 - github.com/trending/go?since=weekly
 - Go's stdlib - github.com/golang/go

Standardization

Standardize or should leave experimentation up to teams?

- Context
 - How many teams?
 - How many repositories?
 - single-digits? tens? thousands?
- For adoption, having a standard in place is necessary
 - Define the “paved path”
- Can’t deviate from the standard creates barriers
 - Very few people making improvements

Don’t let standardization prevent innovation.

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Conclusion

There is no one “correct” design