Designing by Principle

A Case Study: Rack

Principles

Everything should be made as simple as possible, but not simpler.

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Definition

> “a basic truth, law, or assumption”

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Where rules are specific principles are general, and therefore have tremendous utility.
Learning to apply them is hard.

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Definition

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Scientific Method

> Keeping clear in mind the outcome we’re trying to achieve,
> and then considering what principles will help us get there.

Tradeoffs

(everything has a cost)

System design is about balancing *simplicity* with *expressive power*

Simplicity	Expressive Power
Reliability, maintainability	Satisfying requirements, flexibility

Rack

```
Dockerfile
Gemfile
Gemfile.lock
README.md
Rakefile
app/
bin/
config/
config.ru
db/
docker-stack.yml
docs/
extra/
lib/
log/
node_modules/
package.json
public/
spec/
surveyor.iml
tmp/
vendor/
yarn.lock
```

Rack

```
# This file is used by Rack-based servers to start the application.

require_relative 'config/environment'

run Rails.application
```

Rack...Why?

Web Servers / Application Containers

Thin Puma Mongrel
WEBrick Unicorn

Server-side Web Programming Interfaces

CGI FastCGI

SCGI

Web Frameworks

Your web application...

Rack...Why?

Rails 1.0.0...before Rack

rails/lib/fcgi_handler.rb
188 lines of code

rails/lib/webrick_server.rb
170 lines of code

Almost 400 lines of code just to use 2 different handlers!

...after Rack

```ruby
# This file is used by Rack-based servers to start the application.

require_relative 'config/environment'

run Rails.application
```

Rack…Why?

Principles

- Well-defined interfaces
  (good fences make good neighbors)

- Extensibility *(don't try to predict the future)*

- Composition *(we're better together)*

- Immutability *(respecting boundaries, keeping promises)*

Well-Defined Interface

(good fences make good neighbors)

```
# rack/handler/tomcat.rb

class Rack::Handler::Tomcat
  def self.run(app, options = {})
    # talk to Tomcat
  end
end
```

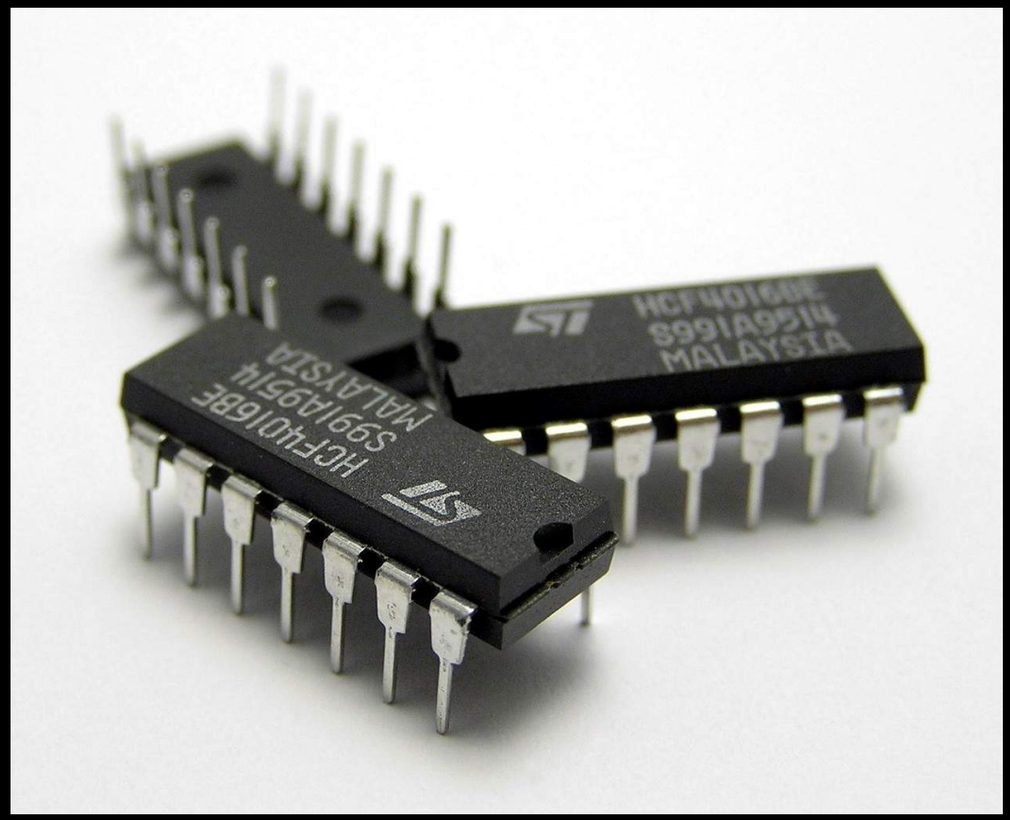
```
# rack/handler/apache.rb

class Rack::Handler::Apache
  def self.run(app, options = {})
    # talk to Apache
  end
end
```

```
# rack/handler/nginix.rb

class Rack::Handler::Nginix
  def self.run(app, options = {})
    # talk to NGINIX
  end
end
```

```
# config.ru

run Proc.new { |env| ['200', {'Content-Type' ⇒ 'text/html'}, [‘Hello neighbor!’]] }
```

Modularity

(good fences make good neighbors)



Extensibility

(don’t try to predict the future)

```
# config.ru

use Rack::CommonLogger
use Rack::Session::Cookie
run App
```

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Generally, we want to make systems that can easily be extended without modifying it source code.

- **Function Composition**
- **Higer-order functions**
- **Adapter Pattern**
- **Service Objects**
- **Lookup Tables**
- **Web API**

Extensibility

(don’t try to predict the future)

```
# config.ru

use Rack::CommonLogger
use Rack::Session::Cookie
run App
```

…but, what’s the cost?

Composition

(we're better together)

```
# config.ru

use Rack::CommonLogger
use Rack::Session::Cookie
run App
```

Composition

(we're better together)

```
# config.ru

use Rack::CommonLogger
use Rack::Session::Cookie
run App
```

```
# config.ru

App = Rack::CommonLogger.new(Rack::Session::Cookie.new(App.new))
run App
```

Composition

(we're better together)

```
# config.ru

use Rack::CommonLogger
use Rack::Session::Cookie
run App
```

```
# config.ru

App = Rack::CommonLogger.new(Rack::Session::Cookie.new(App.new))
run App
```

```
# config.ru

app1 = App.new
app2 = Rack::Session::Cookie.new(app1)
app3 = Rack::CommonLogger.new(app2)
run app3
```

Composition

(we're better together)

```
# config.ru

use Rack::CommonLogger
use Rack::Session::Cookie
run App
```

Composable systems are extensible systems

Composition

(we're better together)

```
def square(x)
  x * x
end
```

```
square(4) # ⇒ 16
square(64) # ⇒ 4096
```

Composition

(we're better together)

```
def square(x)
  x * x
end
```

```
def sum_of_squares(x, y)
  square(x) + square(y)
end
```

Composition

(we're better together)

```
def square(x)
  x * x
end
```

```
def sum_of_squares(x, y)
  square(x) + square(y)
end


sum_of_squares(4, 64) # ⇒ 4112
```

Composition

(we're better together)

```
def square(x)
  x * x
end
```

```
def distance(x1, x2, y1, y2)
  Math.sqrt(square(x2 - x1) + square(y2 - y1))
end
```

Composition

(we're better together)

Composable systems…

- Are extensible
- Are very often easy to reason about
- Have a linguistic or lyrical quality (algebraic)

Composition

(we're better together)

- Can cost performance-wise (memory)

  (but most languages make it pretty cheap)

Composition

(we're better together)

- SQL and the relational model
- Object Systems (i.e. Ruby, JavaScript)
- Functions and Procedures
- Data Formats (i.e. JSON, HTML)

Immutability

(respecting boundaries, keeping promises)

```
class MyApp
  def call(env)
    [‘200’, {‘Content-type’ ⇒ ‘text/html’}, [“This is true”]]
  end
end
```

What’s missing?

Immutability

(respecting boundaries, keeping promises)

```
class MyApp
  def call(env)
    [‘200’, {‘Content-type’ ⇒ ‘text/html’}, [“This is true”]]
  end
end
```

```
class Logger
  def initialize(app)
    @app = app
  end

  def call(env)
    log(env)
    app.call(env)
  end
end
```

Why does this work?

Immutability

(respecting boundaries, keeping promises)

- Allows you to make assumptions
- Maintains the integrity of abstractions
- Simplicity
- Performance optimization & concurrency are simpler

Immutability

(respecting boundaries, keeping promises)

- At times can be difficult to pull off
- Can cost performance-wise

Immutability

(respecting boundaries, keeping promises)

- Most up-in-coming languages (i.e. Haskell, Clojure, Rust, Go, Swift, Scala, Kotlin…)

- Older languages adding (i.e. Java, C#, JavaScript)

- Frameworks (React.js, Vue.js)

- Ruby bang idiom (i.e. “!” at the end of method calls) (e.g. Hash#merge and Hash#merge!)

- Concurrent-ruby

References

- Inventing on Principle - Bret Victor
  https://vimeo.com/36579366

- Simplicity Matters - Rich Hickey
  https://www.youtube.com/watch?v=rI8tNMsozo0

- The Mess We’re In - Joe Armstrong
  https://www.youtube.com/watch?v=lKXe3HUG2l4