

# TDD with NodeJS





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Somkiat Puisungnoen

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Intro

Software Craftsmanship

Software Practitioner at สยามชัมนาภิกิจ พ.ศ. 2556

Agile Practitioner and Technical at SPRINT3r

Post Photo/Video Live Video Life Event

What's on your mind?

Public Post

Somkiat Puisungnoen 15 mins · Bangkok · ⚙️

Java and Bigdata





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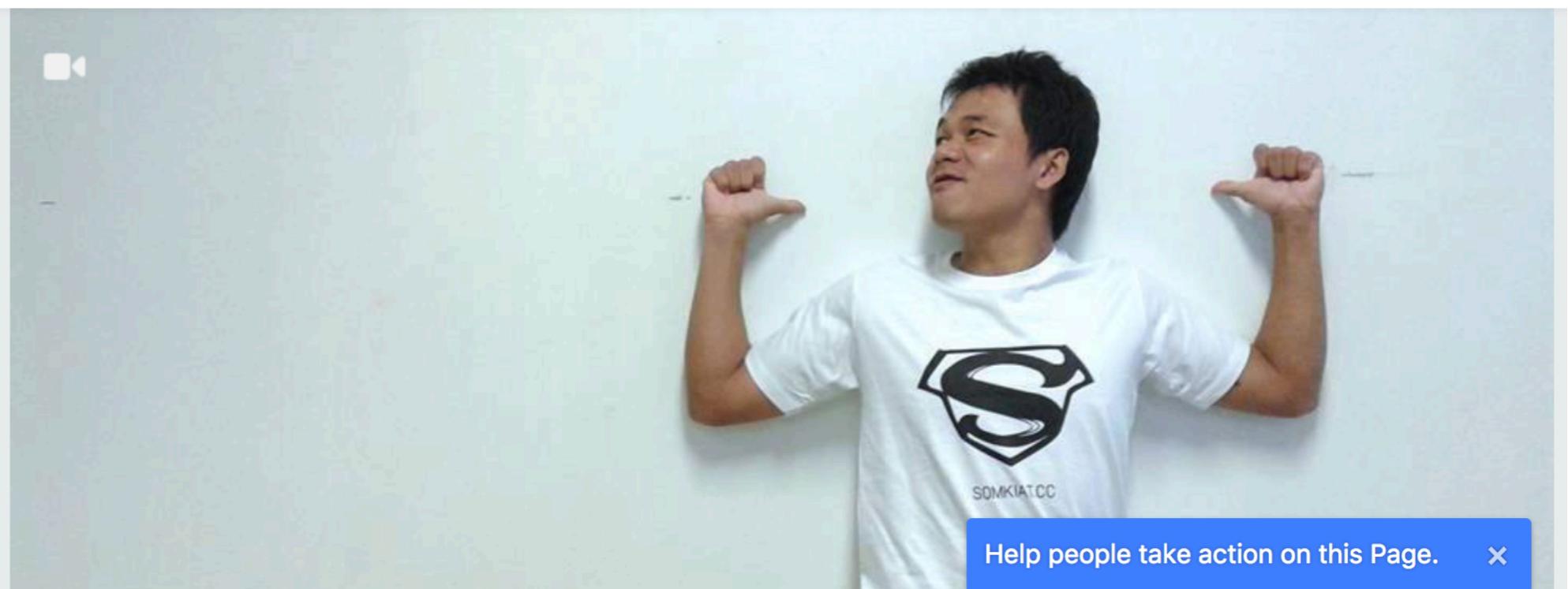
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# Test-Driven Development



# ทำดีดี



# ถ้าเข้าจะ test อญ্যោតី ឬ ខ្សោយ test



# Agenda

Test-Driven Development

Types of Testing

Good Unit Test (GUT)

Structure of Good Unit Test

Testing with Node.JS

Test/Code coverage

Test-Double

Testable application



[https://github.com/up1/  
course-tdd-with-nodejs](https://github.com/up1/course-tdd-with-nodejs)



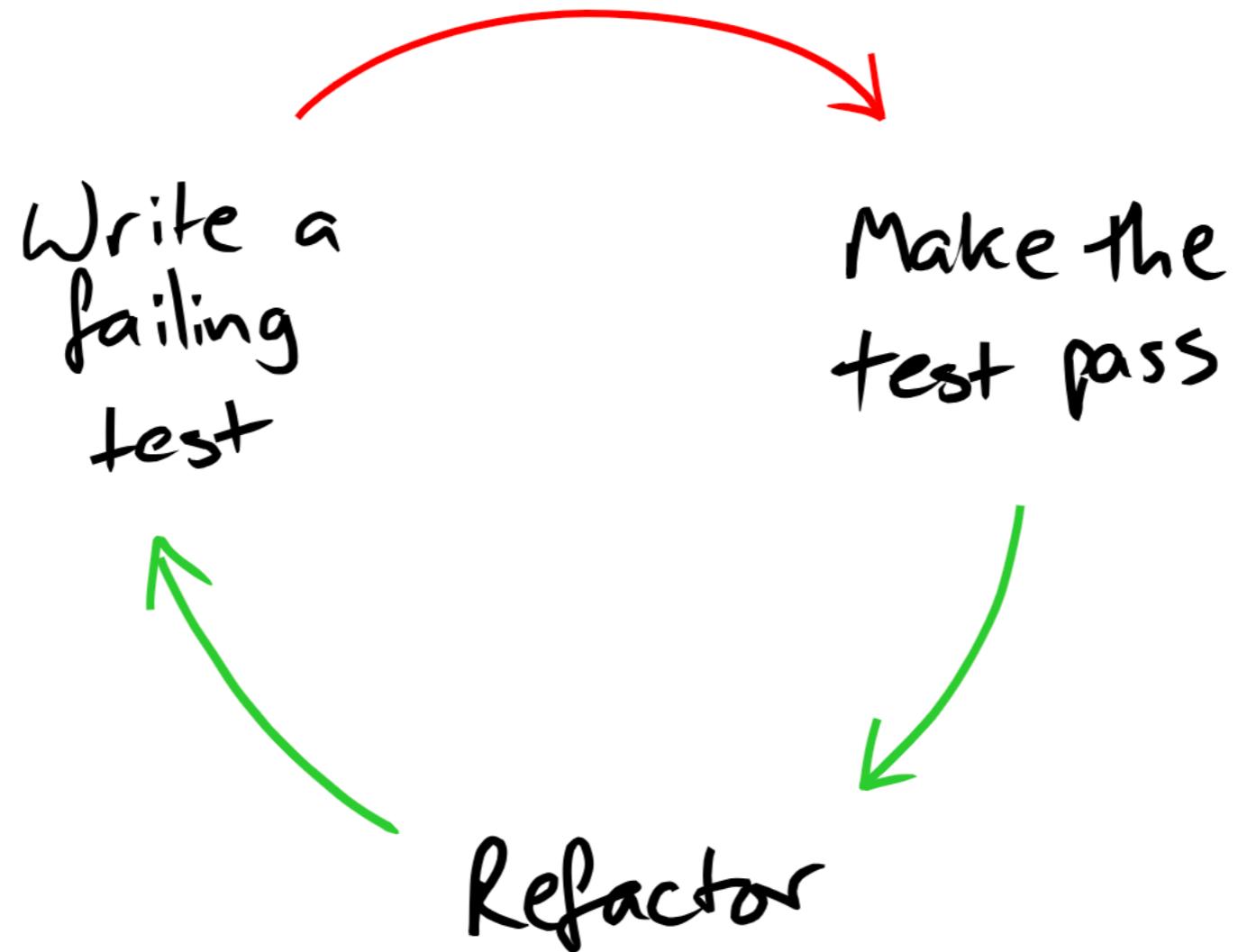
Learn by **DOING.**



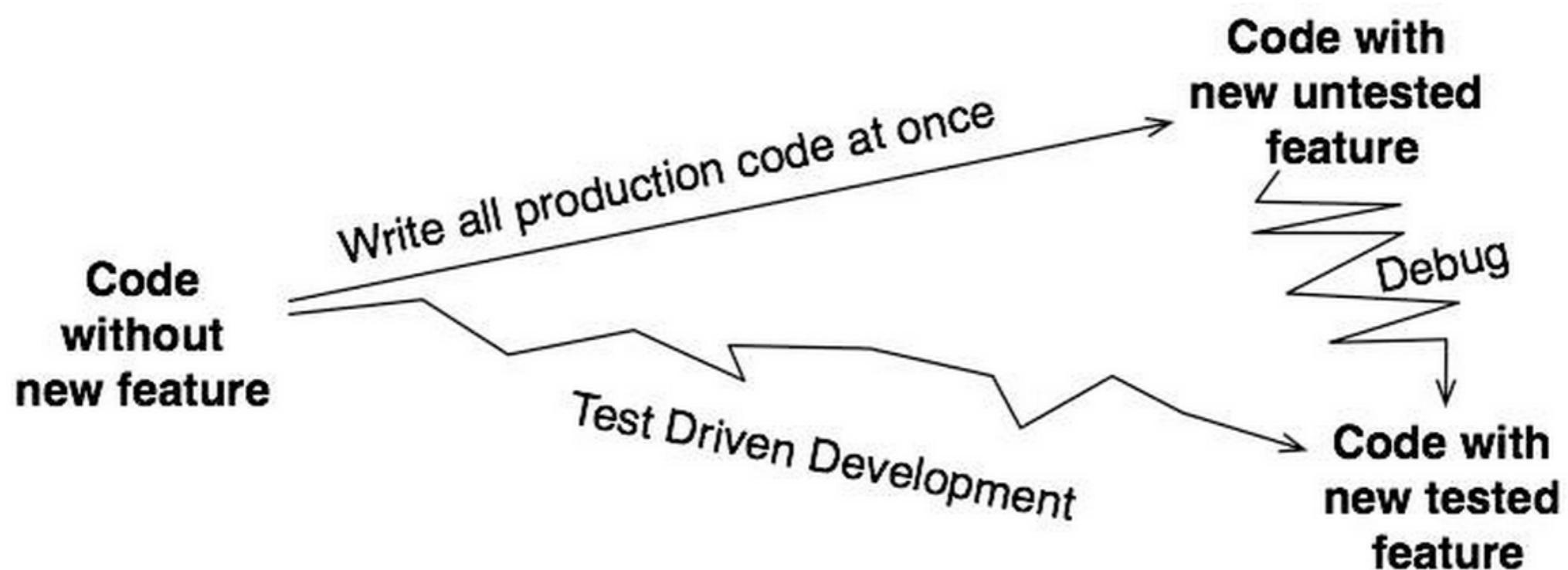
# Test-Drive Development



# TDD Life Cycle



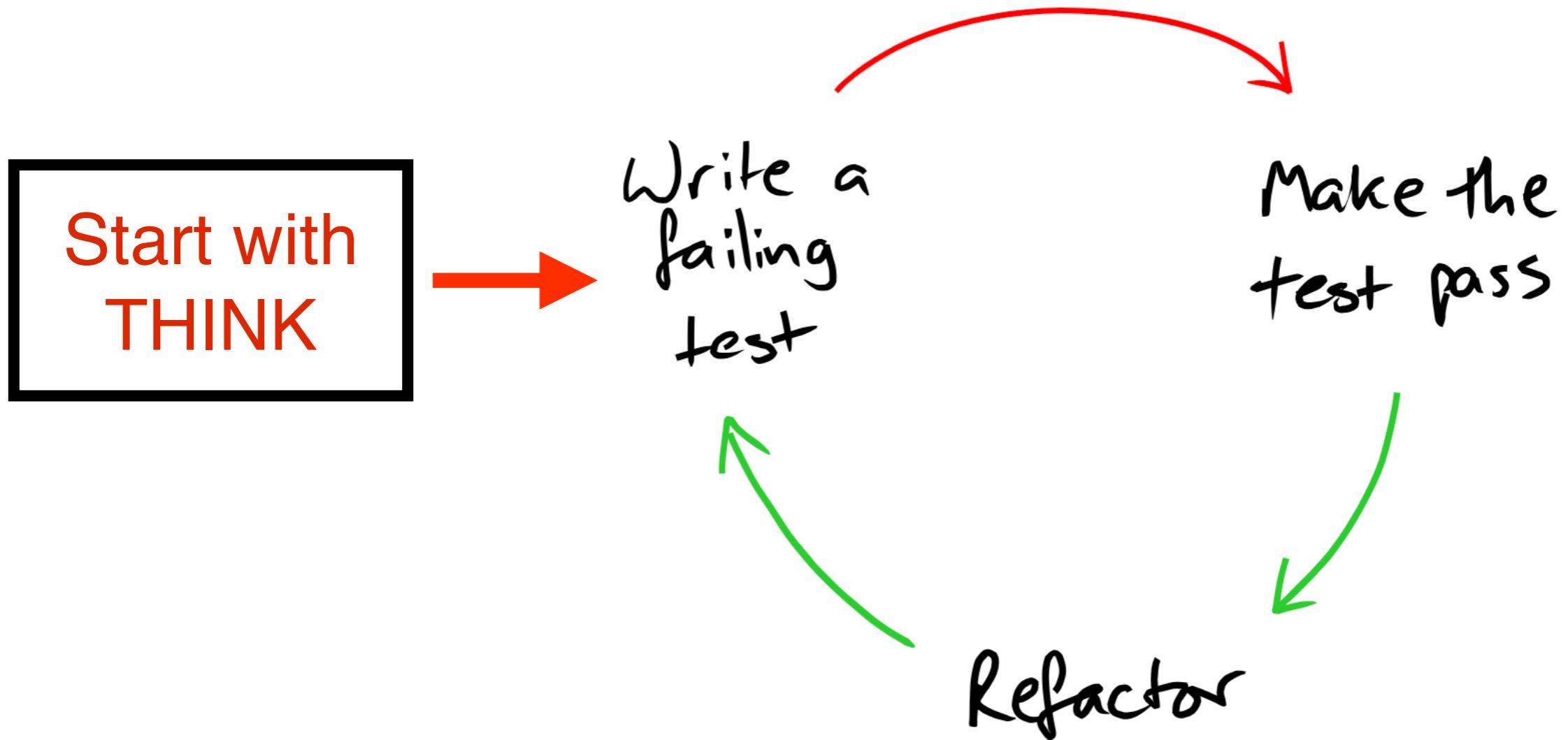
# TDD vs DLP



# Red Green Refactor



# Let's start



# Rules of TDD



# Rule #1

Don't write production code unless it's to help  
a failing unit test pass



# Rule #2

Only write enough of a unit test to fail



# Rule #3

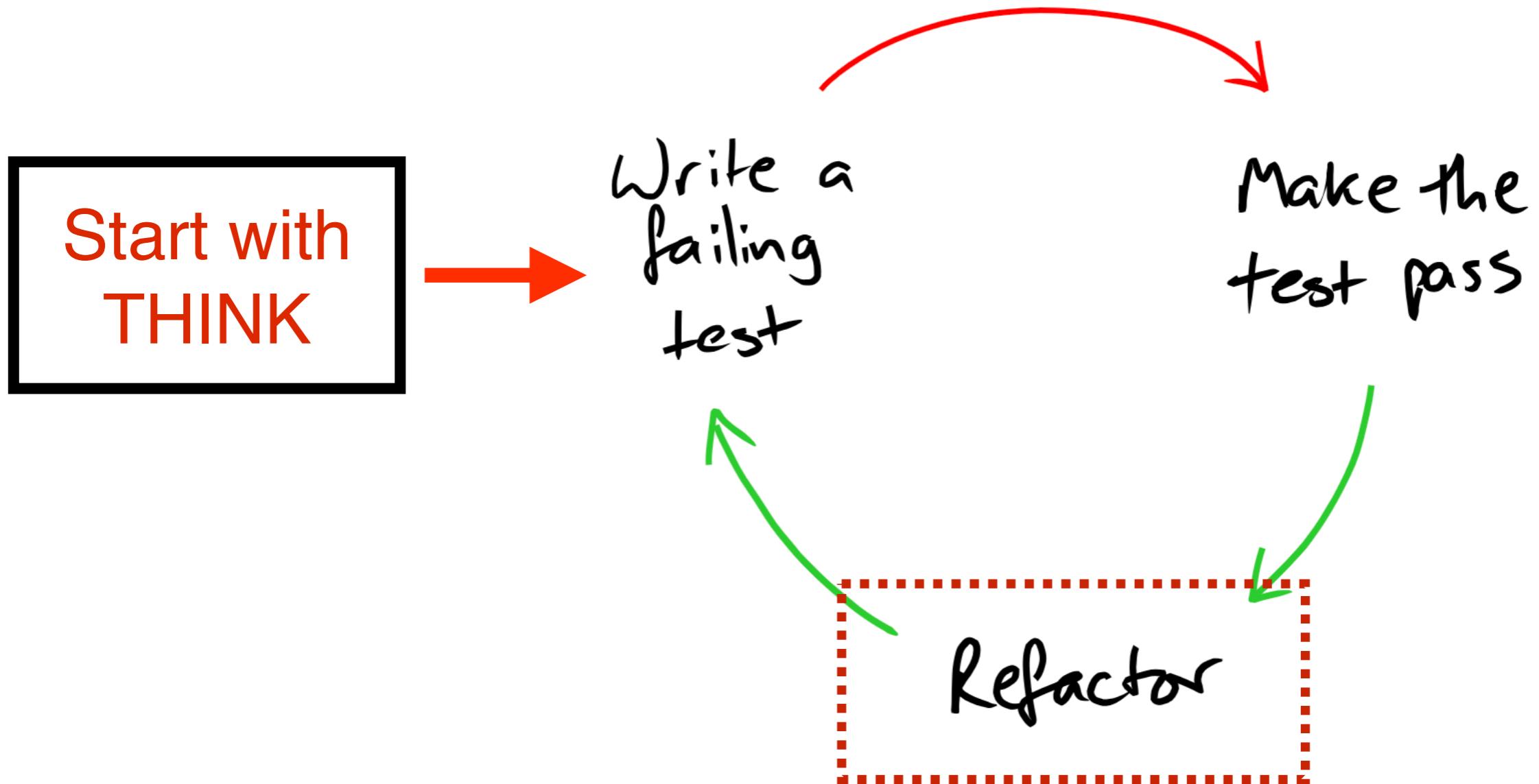
Only write enough production code to help a failing unit test pass



# Don't forgot Refactoring



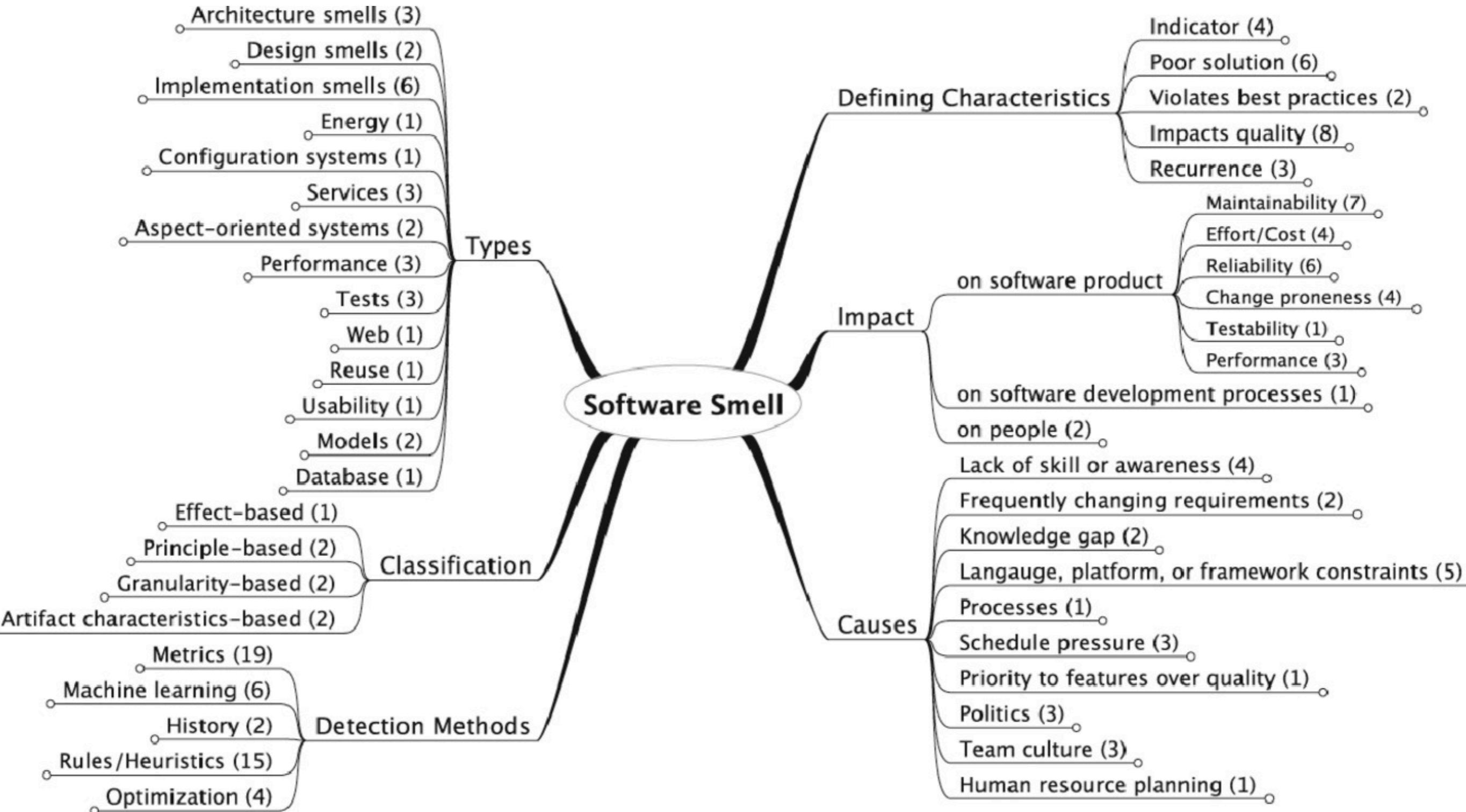
# Let's start





<http://www.tusharma.in/smells/>





<https://www.sciencedirect.com/science/article/pii/S0164121217303114>



# Code Smell



# Code Smells

- What? How can code "smell"??
- Well it doesn't have a nose... but it definitely can stink!



## Bloaters

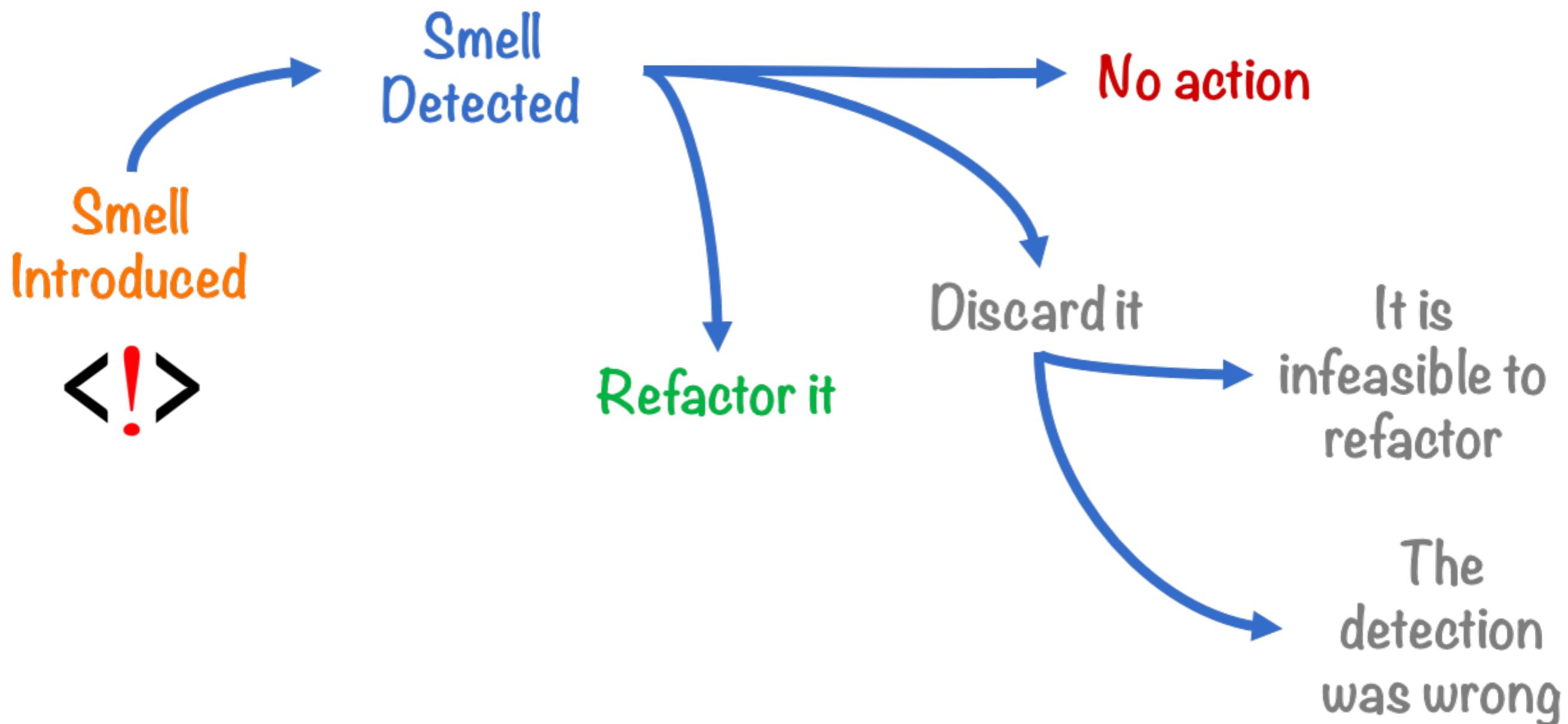
Bloaters are code, methods and classes that have increased to such gargantuan proportions that they are hard to work with. Usually these smells do not crop up right away, rather they accumulate over time as the program evolves (and especially when nobody makes an effort to eradicate them).

- Long Method
- Large Class
- Primitive Obsession
- Long Parameter List
- Data Clumps

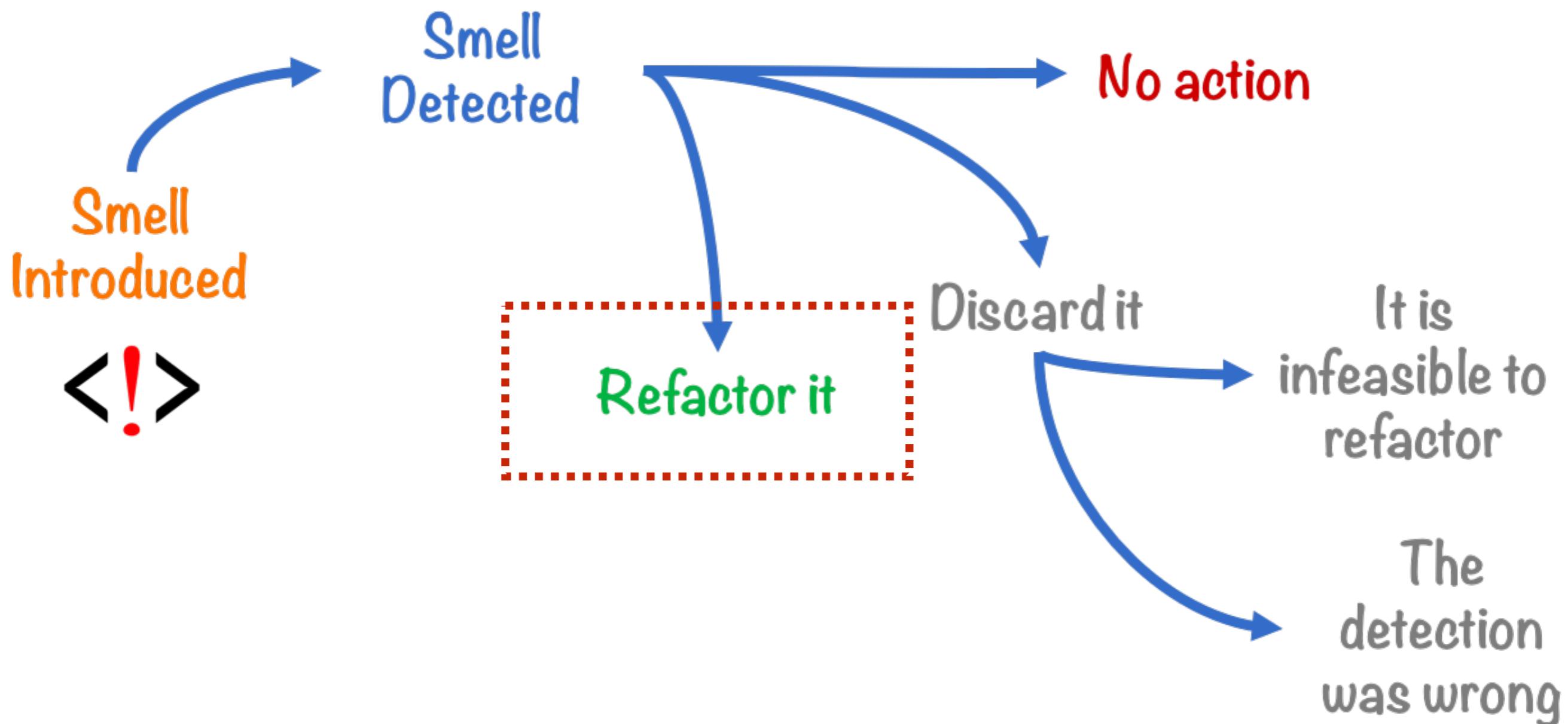
<https://sourcemaking.com/refactoring/smells>



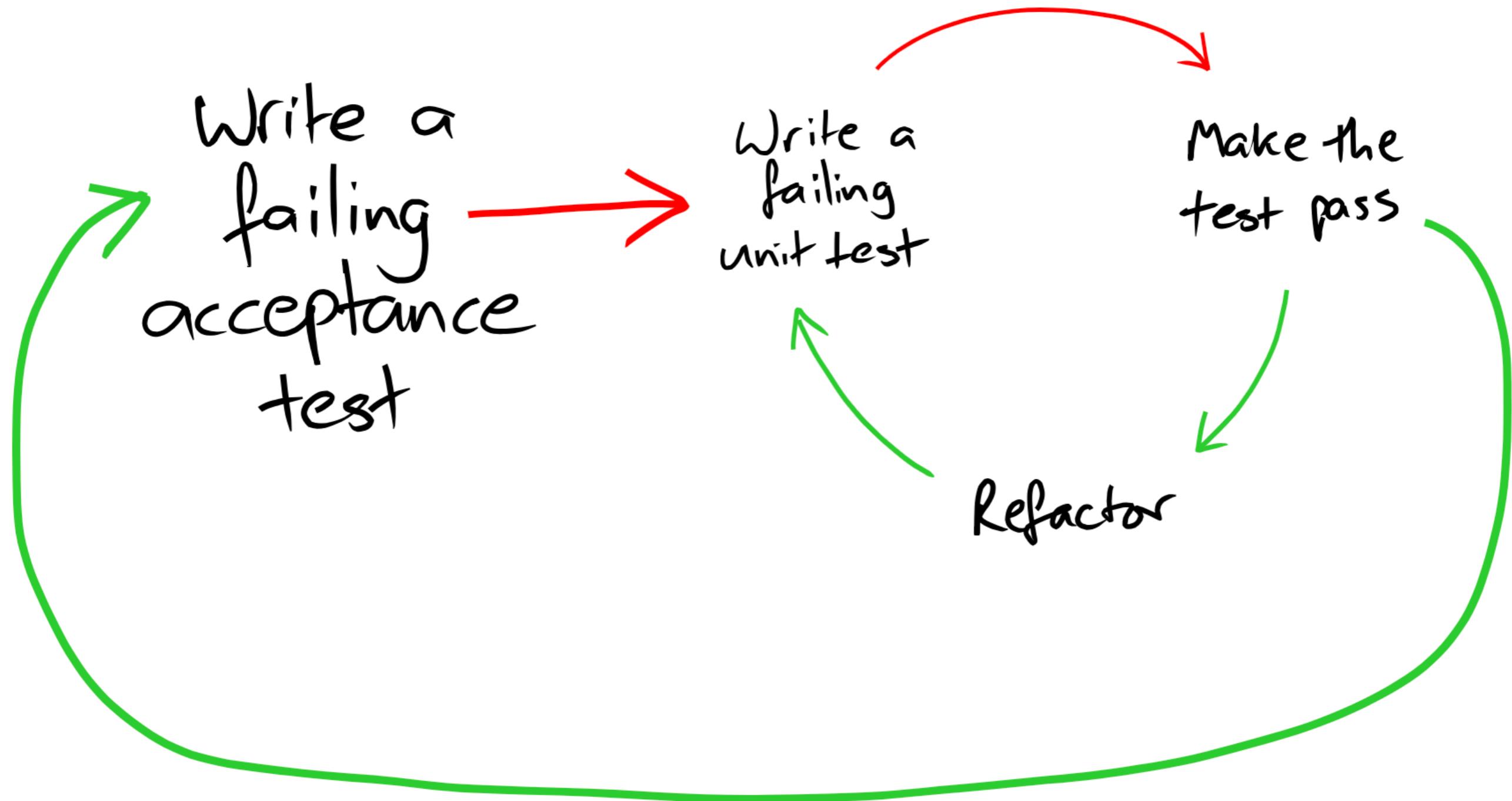
# Life-cycle of a smell



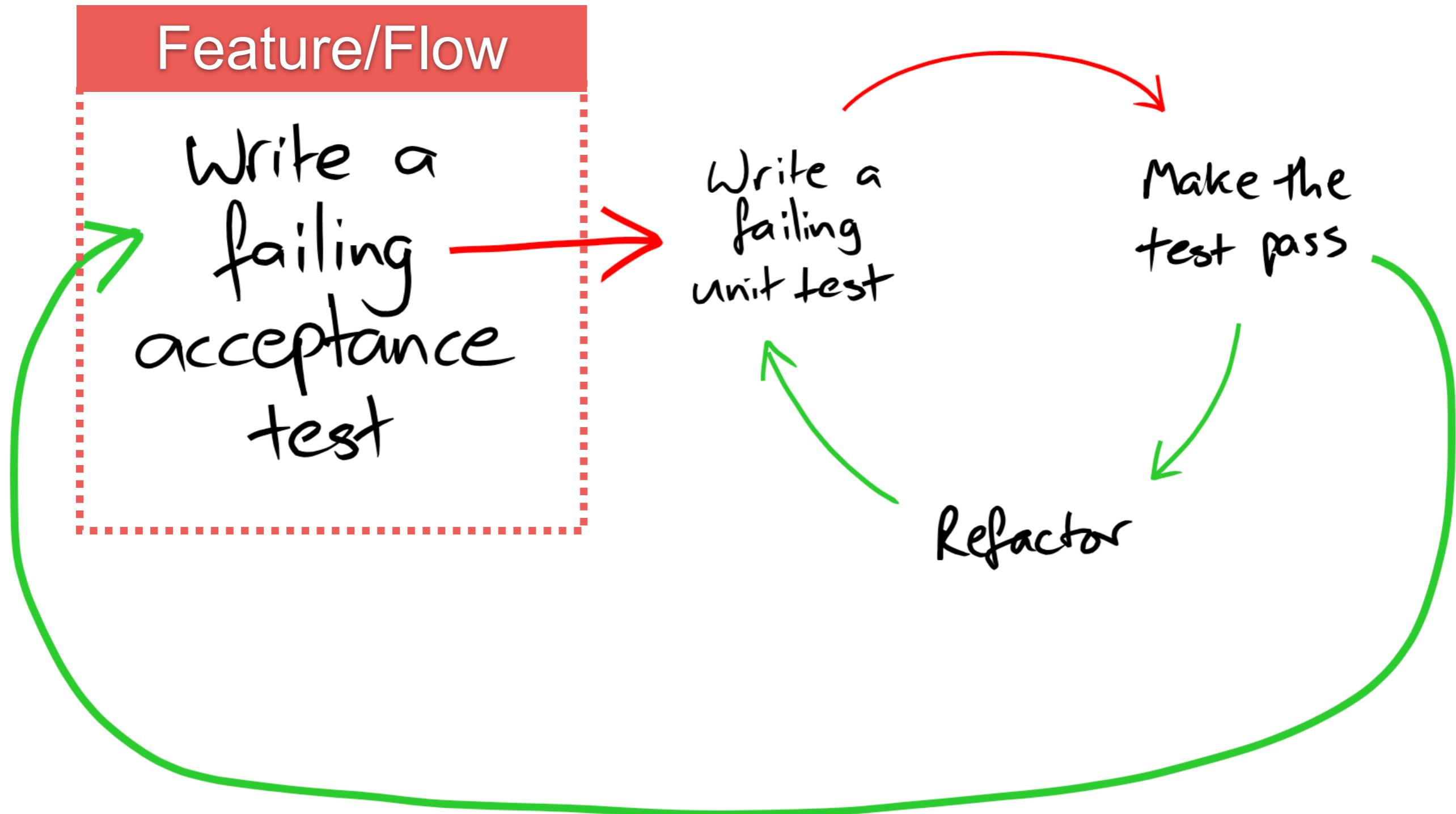
# Life-cycle of a smell



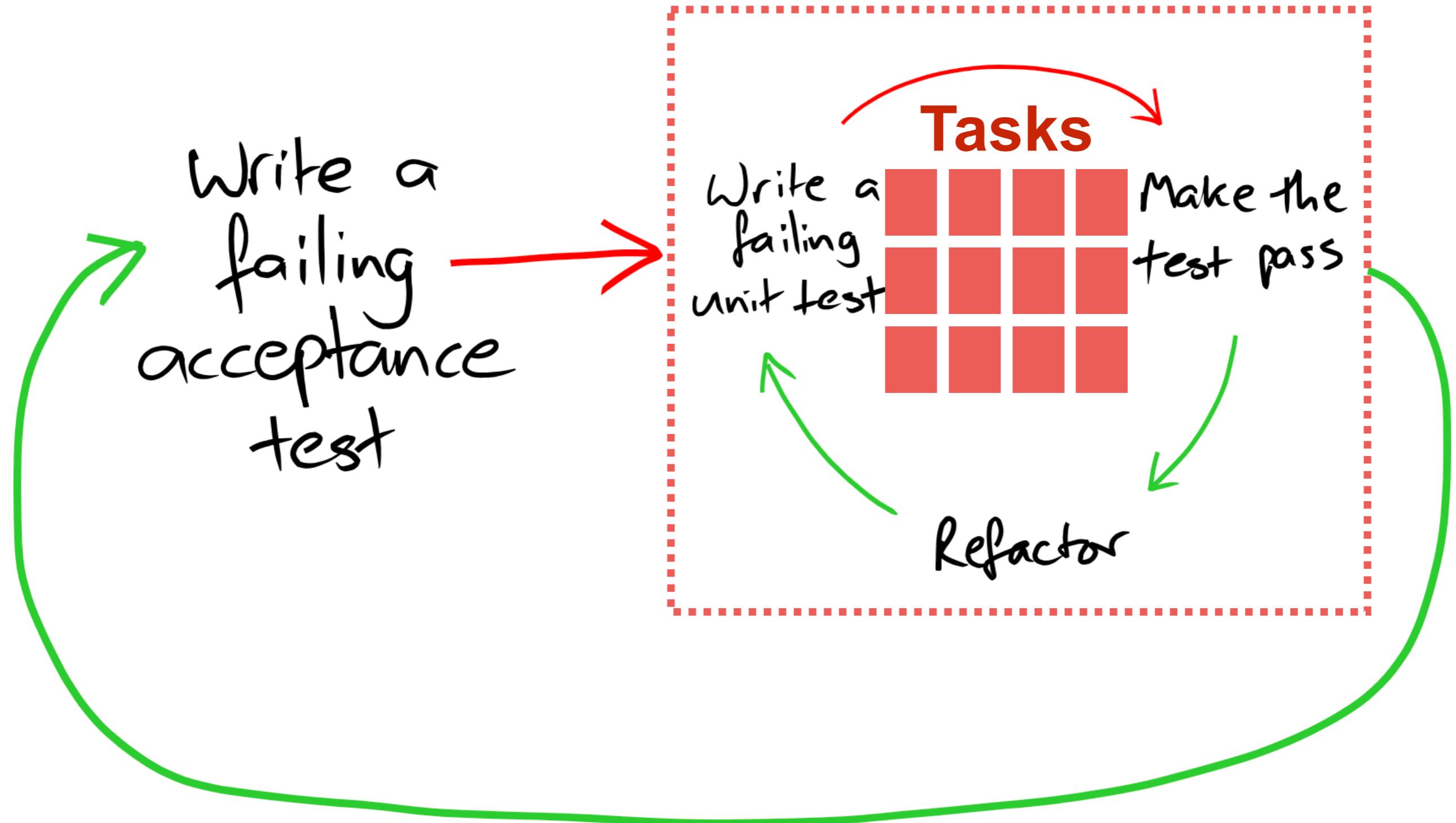
# Outside-in develop/test



# Outside-in develop/test



# Outside-in develop/test

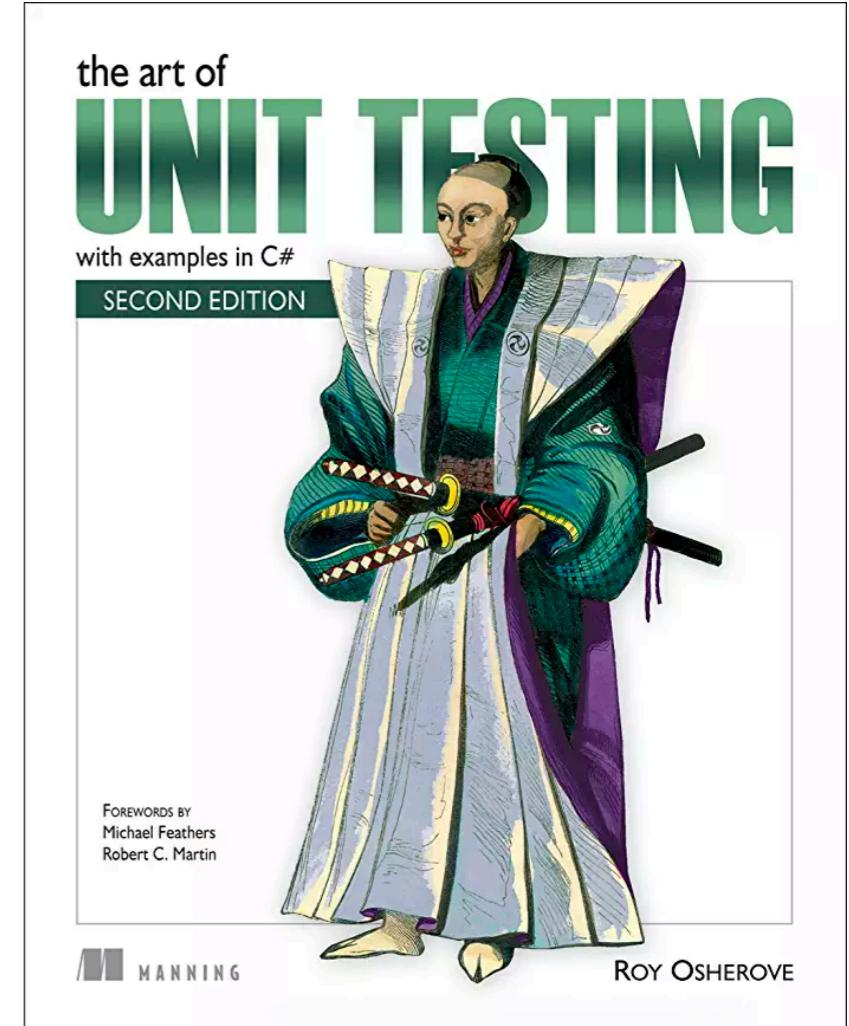
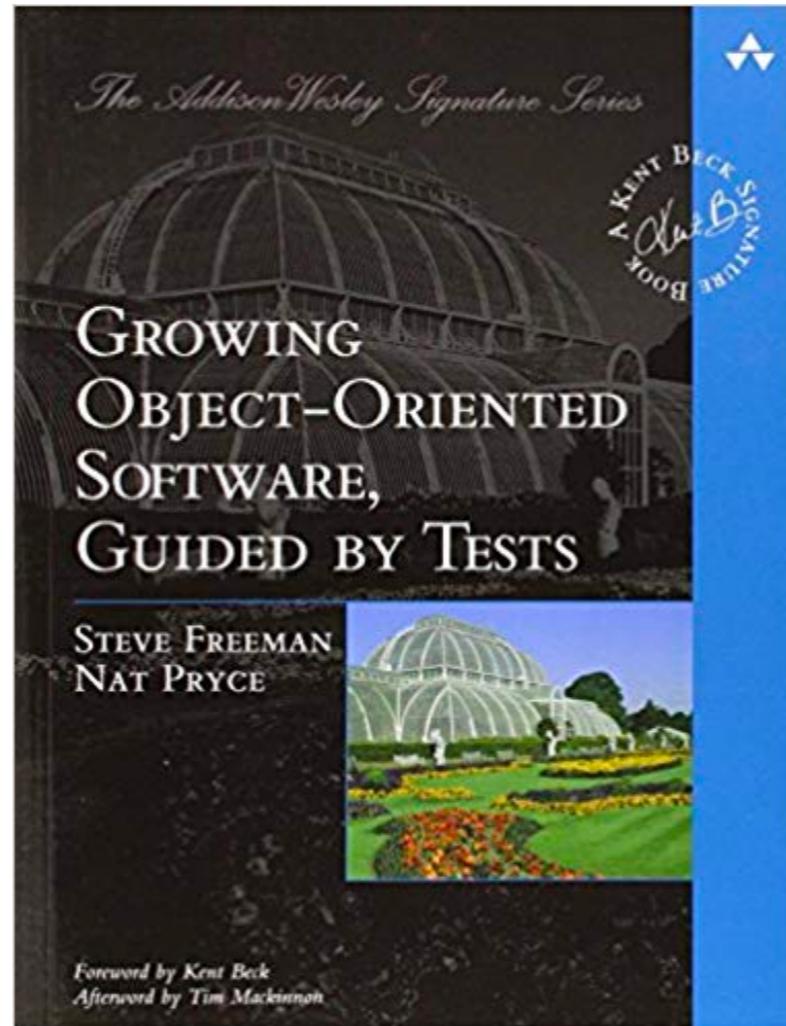
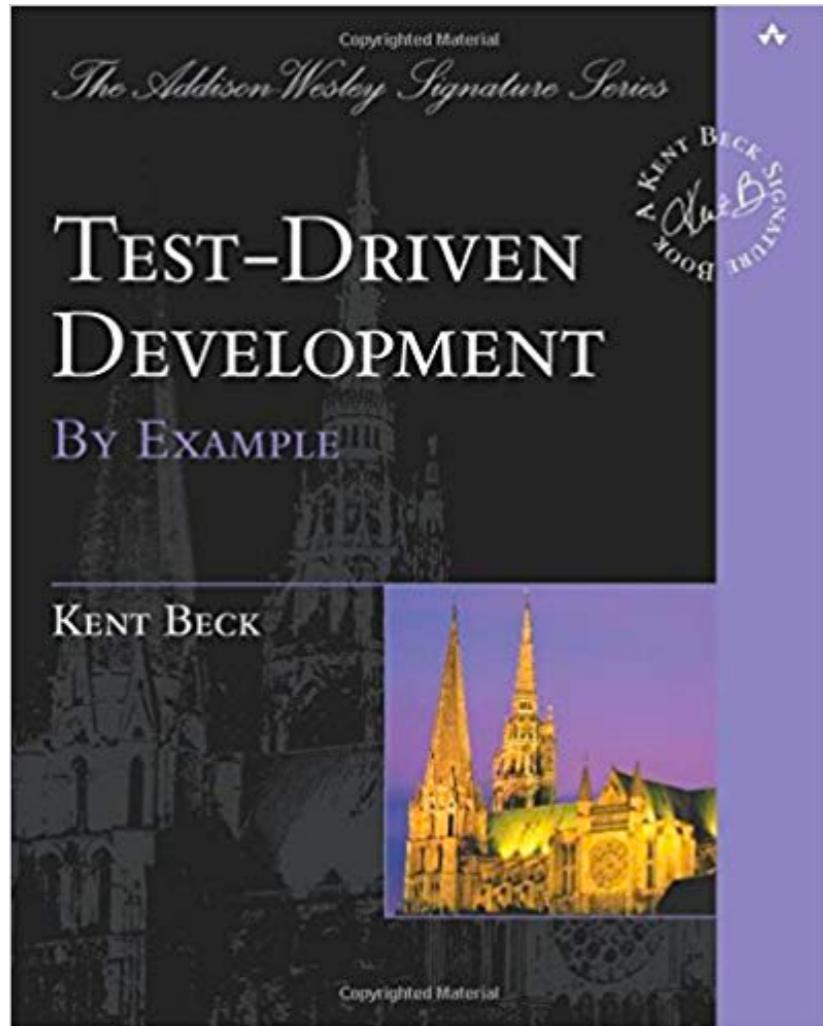


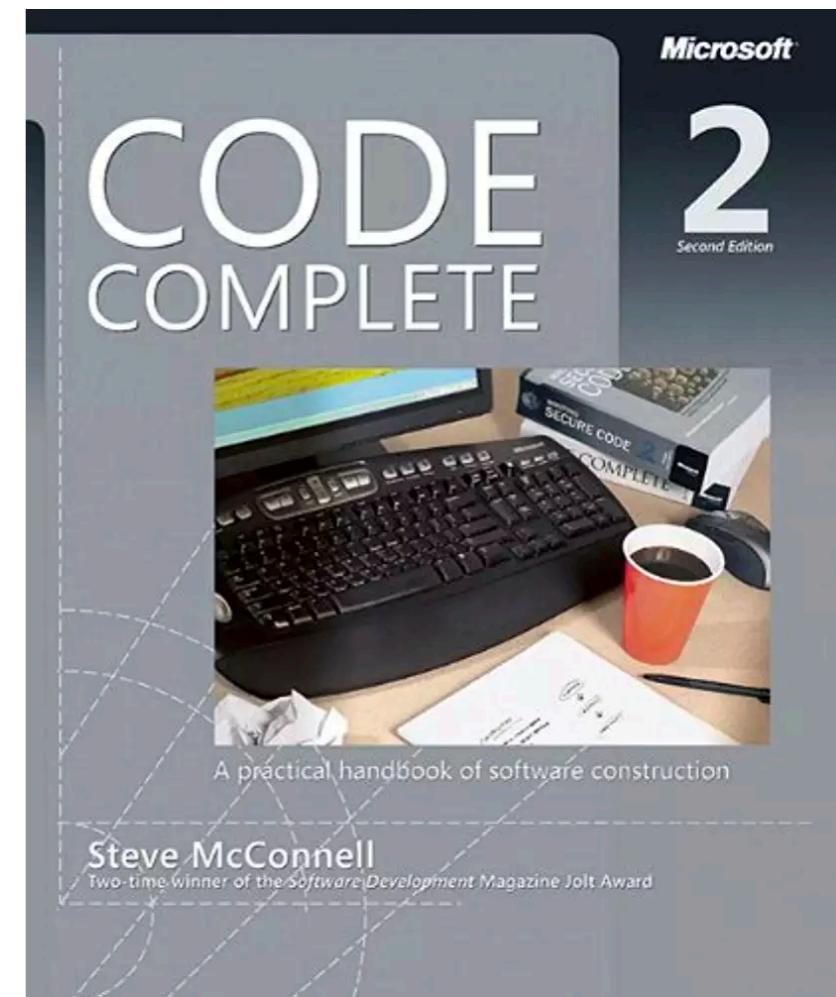
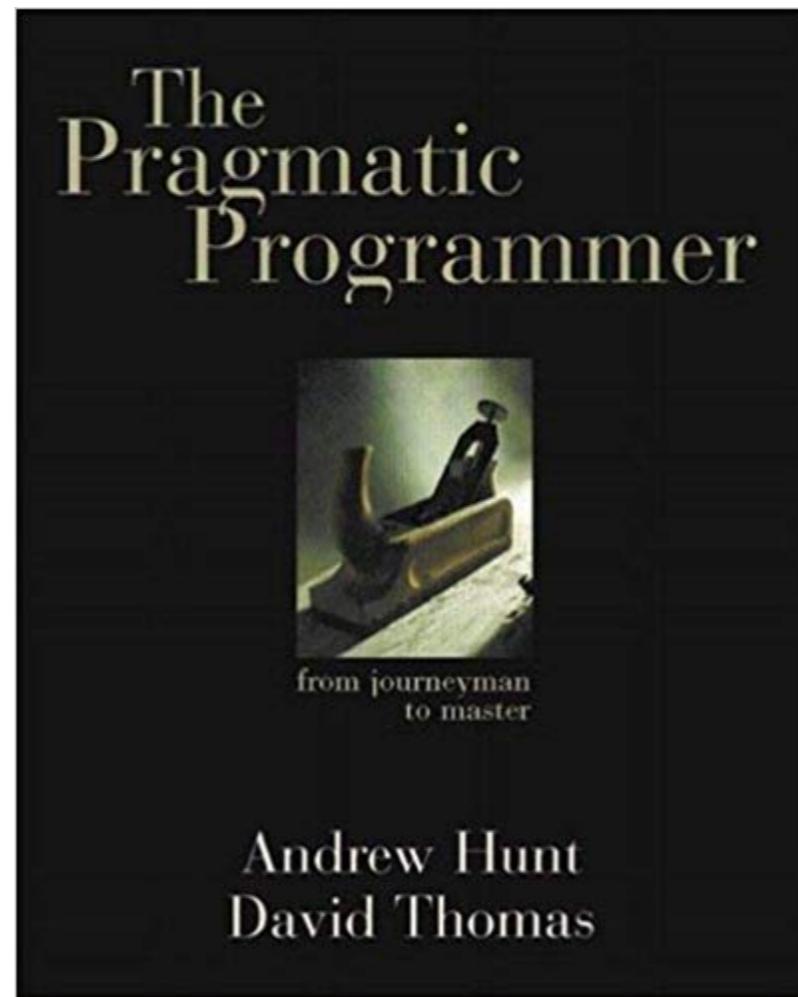
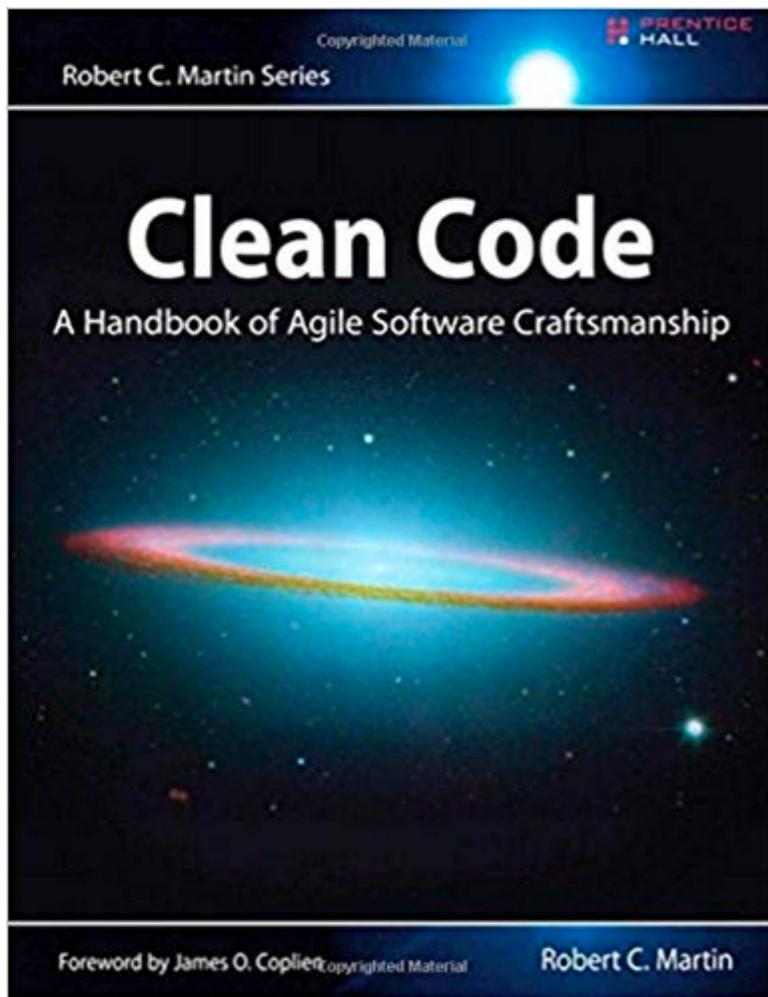
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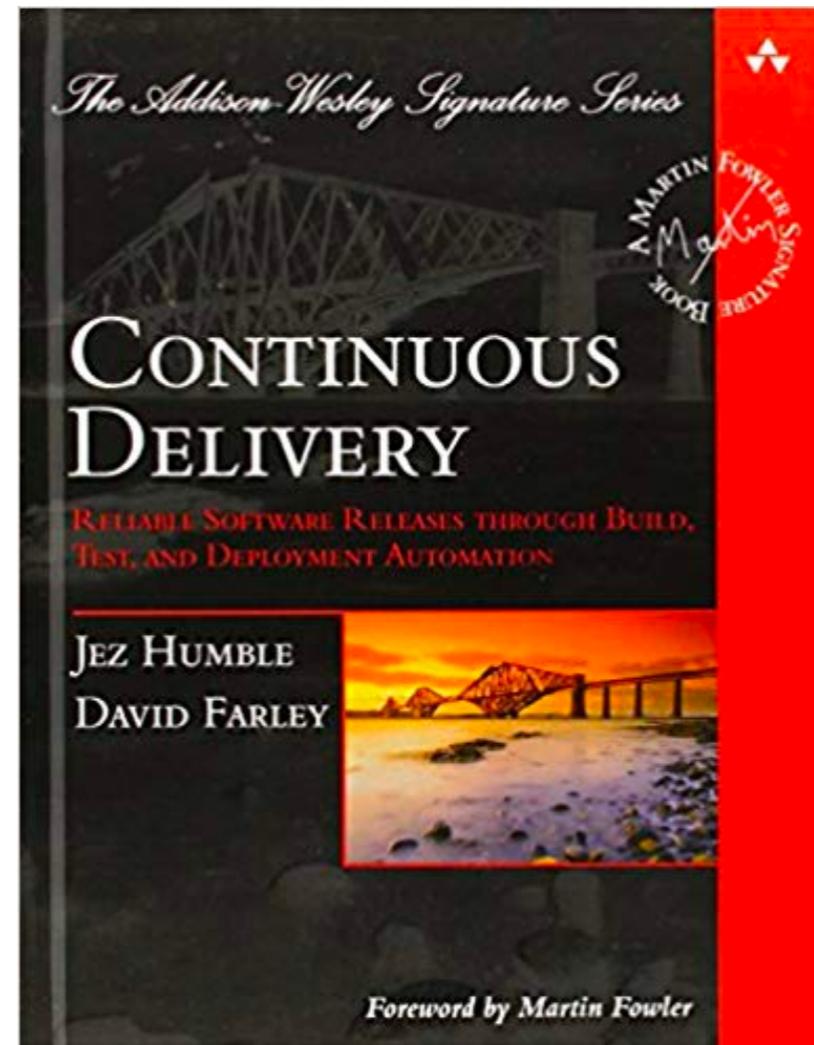
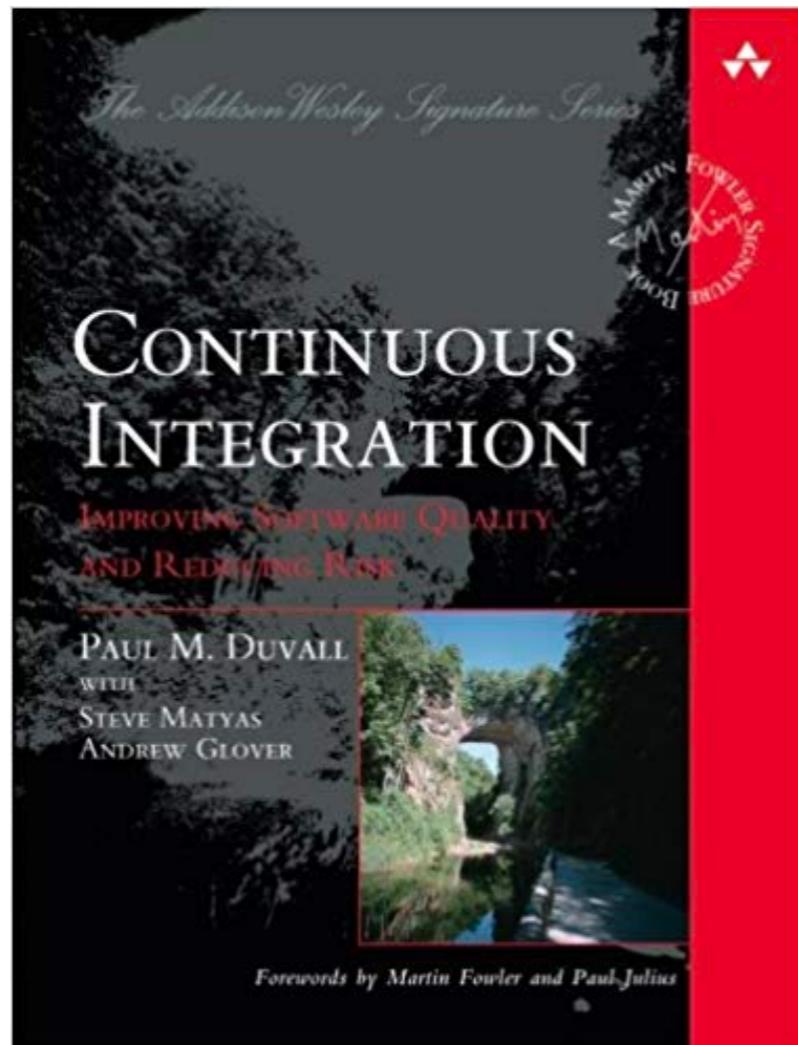


# Books









# Types of Testing



# Good Unit Tests



# Good Unit Tests

Fast  
Isolated  
Repeatable  
**S**elf-validating  
Timely



# Structure of Test



# Arrange Act Assert (AAA)

**Arrange ::** Pre-conditions and imputes

**Act ::** Call object or method under test

**Assert ::** validate between actual and expected result

<https://wiki.c2.com/?ArrangeActAssert>



# Test Double

<http://xunitpatterns.com/Test%20Double.html>



# Test Double

Dummy

Stub

Spy

Mock

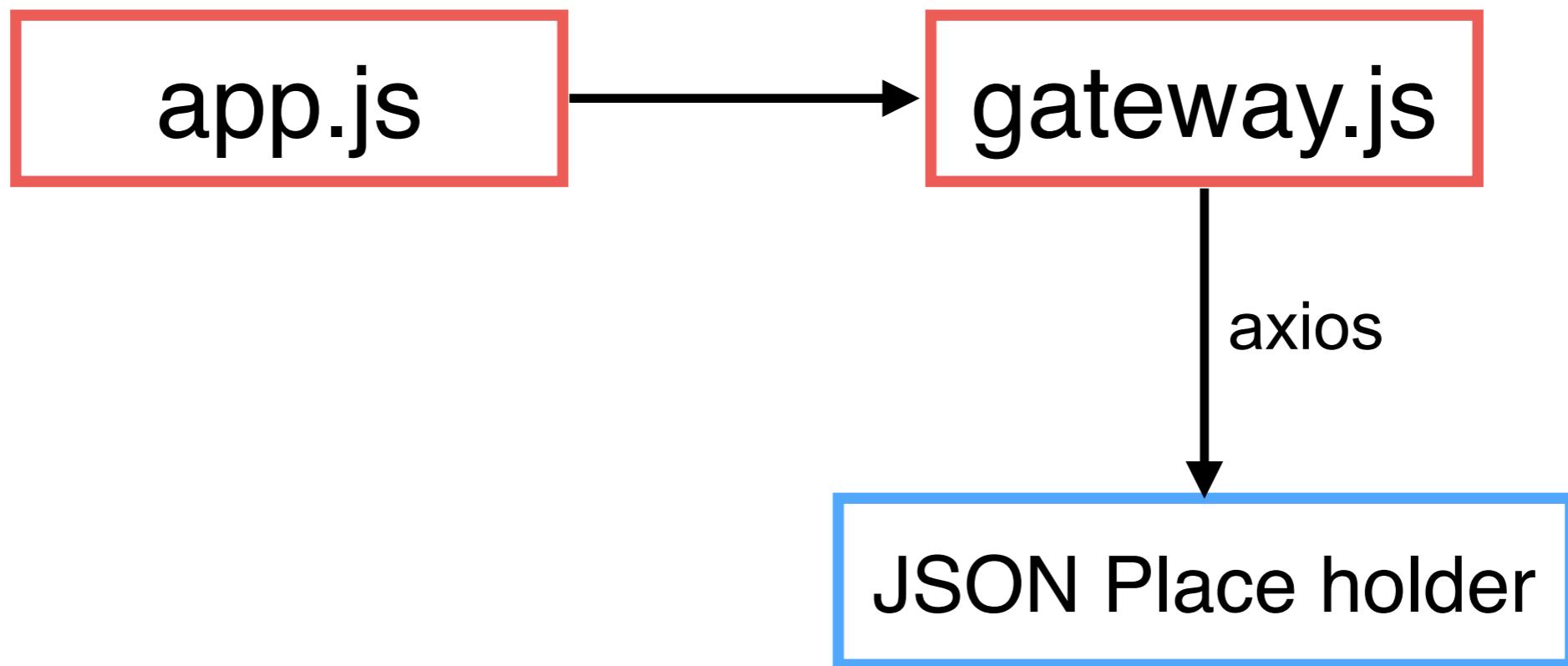
Fake



# Working with NodeJS



# Workshop



<https://github.com/axios/axios>



# JSON Place holder

## JSONPlaceholder

Fake Online REST API for Testing and Prototyping

Powered by [JSON Server](#) + [LowDB](#)

```
fetch('https://jsonplaceholder.cypress.io/todos/1')
  .then(response => response.json())
  .then(json => console.log(json))
```

Try it

<https://jsonplaceholder.cypress.io/users>



TDD with NodeJS

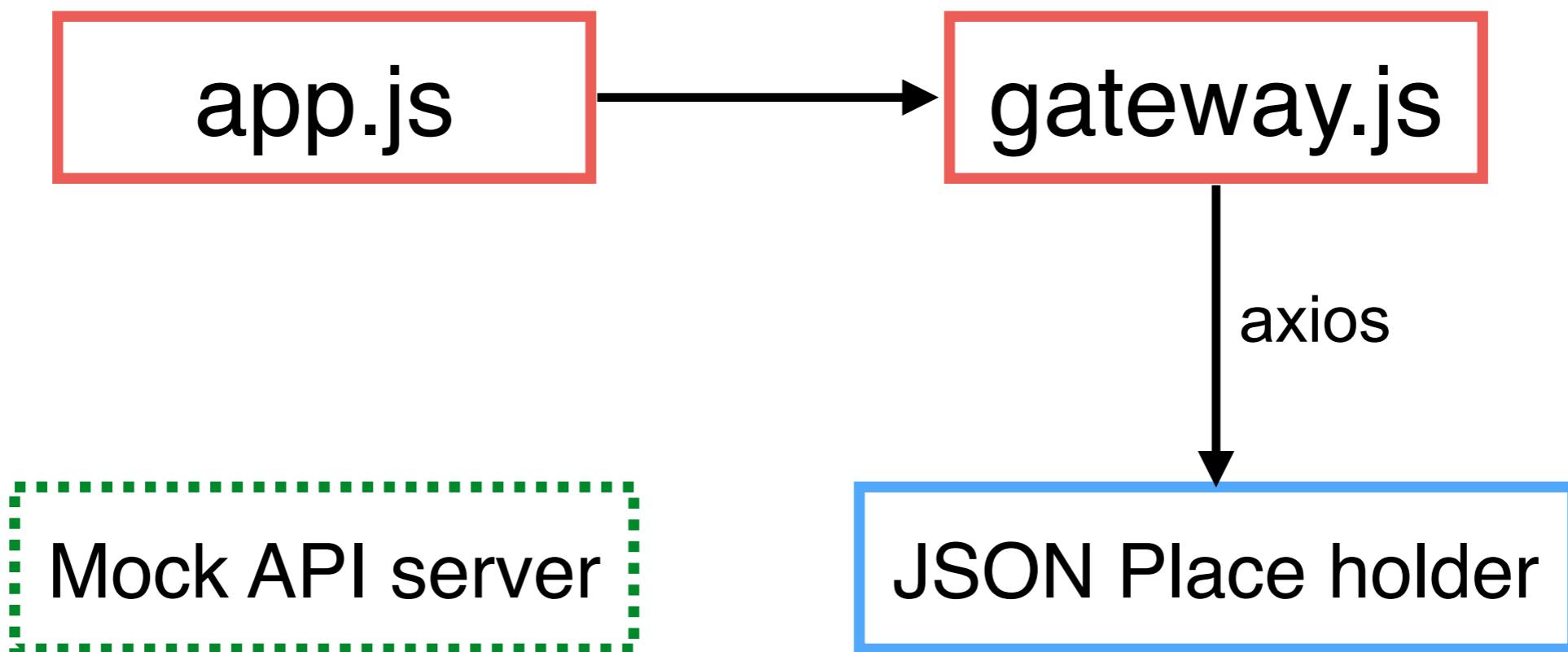
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# Testing API with Nock

<https://github.com/nock/nock>



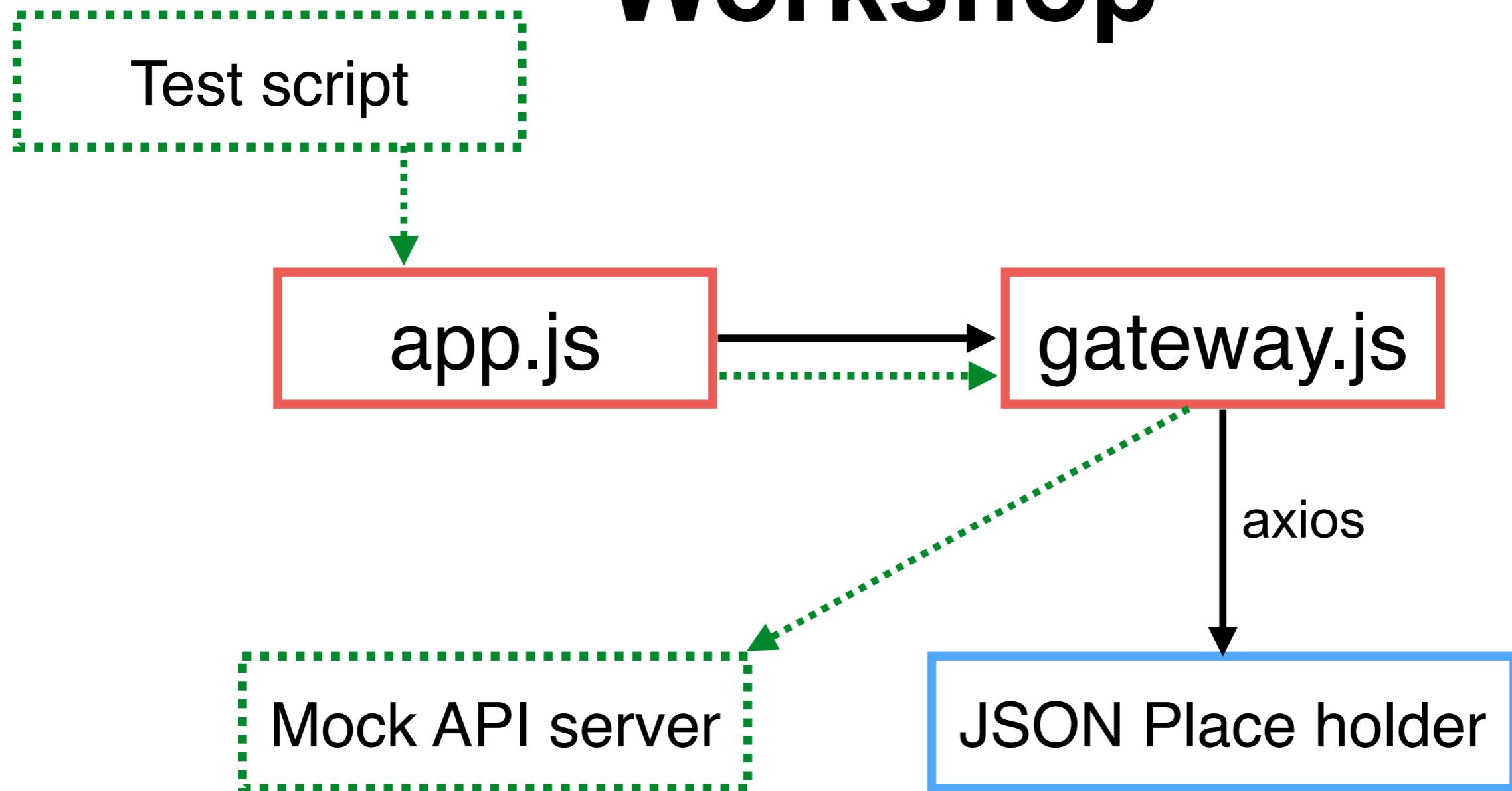
# Workshop



<https://github.com/axios/axios>



# Workshop

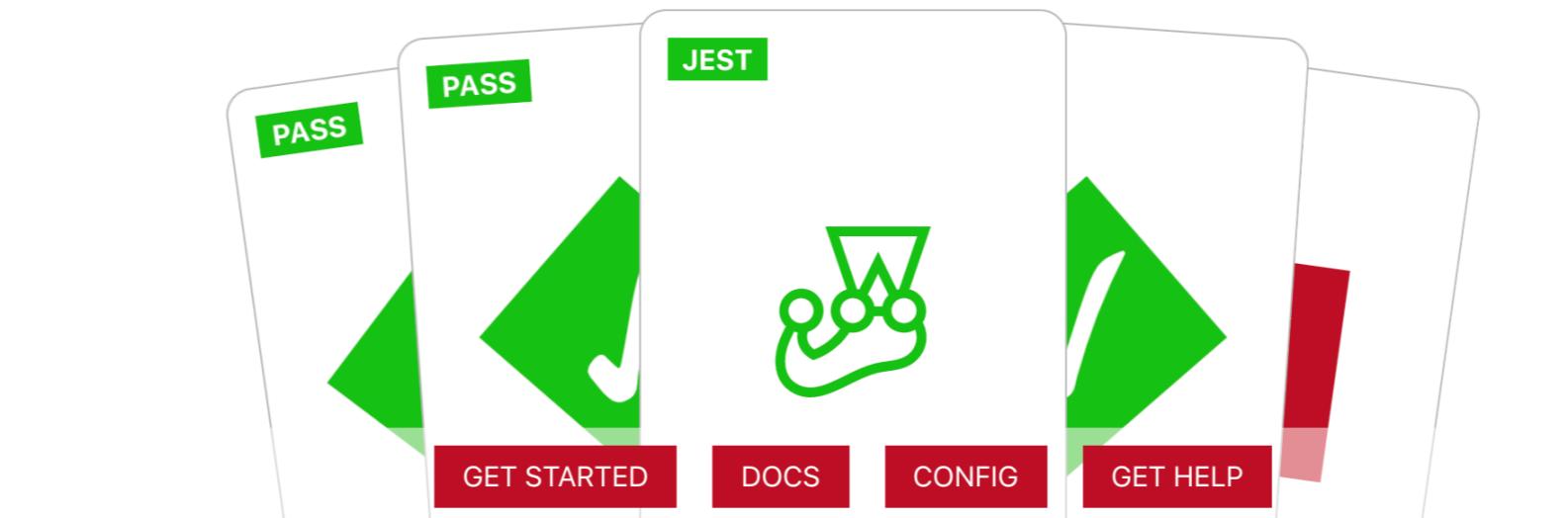


<https://github.com/axios/axios>



# Jest

## JavaScript Test Framework



The image shows a mockup of the Jest website landing page. At the top, there's a navigation bar with three cards labeled 'PASS' (green), 'JEST' (white with green icon), and another 'PASS' (green). Below the navigation is a large green downward-pointing arrow icon. A central call-to-action button says 'GET STARTED'. To its right are 'DOCS' and 'CONFIG' buttons. To the left is a 'GET HELP' button. Below the main section, a large grey box contains the text: 'Jest is a delightful JavaScript Testing Framework with a focus on simplicity. It works with projects using: Babel, TypeScript, Node, React, Angular, Vue and more!'

Jest is a delightful JavaScript Testing Framework with a focus on simplicity.

It works with projects using: Babel, TypeScript, Node, React, Angular, Vue and more!

<http://jestjs.io/>



# Jest

## JavaScript Test Framework

```
$npm install jest --save-dev
```



# Create first test case

```
test("Hello world!", () => {  
});
```



# Assertion

```
const { calculateTip } = require("../src/math");

test("Should calculate total with tip", () => {
  const total = calculateTip(10, 0.3);

  expect(total).toBe(13);
});

});
```

<https://jestjs.io/docs/en/expect>



# Testing asynchronous code

## With callback function

```
test("Should add two numbers", (done) => {
  add(2, 3).then((sum) => {
    expect(sum).toBe(5);
    done();
  });
});
```



# Testing asynchronous code

## With async/await

```
test("Should add two numbers async/await", async () => {
  const sum = await add(2, 3);
  expect(sum).toBe(3);
});
```



# Jest setup and teardown

beforeEach

afterEach

before

after



# Mocking with Jest

Create directory \_\_mocks\_\_ in tests

Working with `jest.mock()`

`Jest.spyOn`



# Jasmine

BDD for JavaScript



<https://jasmine.github.io/>



# Nock

## HTTP server mocking and expectations library for Node.js

```
$npm install nock --save-dev
```



# Nock

## HTTP server mocking and expectations library for Node.js

```
$npm install nock --save-dev
```



# Write a first test

Create folder \_\_tests\_\_

Create files with \*\_spec|test.js



# Gateway-spec.js

```
const nock = require("nock");
const API_PORT = 9999;
const getAllUser = require("../gateway-testable.js");
const API_HOST = `http://localhost:${API_PORT}`;

describe("Call service", () => {

  it("Check response from /users", async () => {
    // Mock server
    nock(API_HOST)
      .defaultReplyHeaders({ 'access-control-allow-origin': '*' })
      .get("/users").reply(200, [], {});

    // Verify
    const response = await getAllUser();
    expect(response.data.length).toEqual(2);
  });

});
```



# Config Jest in package.json

```
"jest": {  
  "collectCoverage": true,  
  "coverageReporters": ["json", "html"]  
}
```



# Run test

## \$npm test

```
FAIL __tests__/gateway-spec.js
Call service
  ✘ Check response from /users (886 ms)

● Call service > Check response from /users

expect(received).toEqual(expected) // deep equality

Expected: 2
Received: 10

  9 |
 10 |   const response = await getAllUser();
> 11 |   expect(response.data.length).toEqual(2);
    |   ^
 12 | });
 13 | });
 14 |

at Object.<anonymous> (__tests__/gateway-spec.js:11:34)
```



# Testable code ?

Using environment variable

## Environment Variable

`API_URL=<your api server>`

## Node.JS

Using `process` module

`process.env('API_URL')`

[https://nodejs.org/api/process.html#process\\_process\\_env](https://nodejs.org/api/process.html#process_process_env)



# Gateway.js

```
const axios = require("axios").default;  
const process = require("process");  
  
function getAllUser() {  
  return axios({  
    method: "get",  
    url: `${process.env.API_URL}/users`,  
    responseType: "json",  
  })  
  .then((response) => {  
    return {  
      code: 200,  
      data: response.data,  
    };  
  })  
}
```



# Fail case

```
it("Fail 404 /users", async () => {
  // Mock server
  nock(API_HOST)
    .defaultReplyHeaders({ "access-control-allow-origin": "*" })
    .get("/users")
    .reply(404);

  // Verify
  const response = await getAllUser();
  expect(response.code).toEqual(500);
});
```



# Config Jest in package.json

```
"scripts": {  
  "test": "API_URL=http://localhost:9999 jest --coverage"  
}  
  
...  
  
"jest": {  
  "collectCoverage": true,  
  "coverageReporters": ["json", "html"]  
}
```



# Run test

\$npm test

```
PASS  __tests__/_gateway-spec.js
Call service
  ✓ Check response from /users (24 ms)
  ✓ Fail 404 /users (4 ms)
```

```
Test Suites: 1 passed, 1 total
Tests:       2 passed, 2 total
Snapshots:   0 total
Time:        0.932 s, estimated 1 s
Ran all test suites.
```



# Coverage report

\$npm test

## All files gateway-testable.js

100% Statements 6/6    100% Branches 0/0    100% Functions 3/3    100% Lines 6/6

Press *n* or *j* to go to the next uncovered block, *b*, *p* or *k* for the previous block.

```
1 1x const axios = require("axios").default;
2 1x const process = require("process");
3
4 function getAllUser() {
5 2x   return axios({
6     method: "get",
7     url: `${process.env.API_URL}/users`,
8     responseType: "json",
9   })
10    .then((response) => {
11      1x       return {
12        code: 200,
13        data: response.data,
14      };
15    });
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```

# Working with Database



# Database

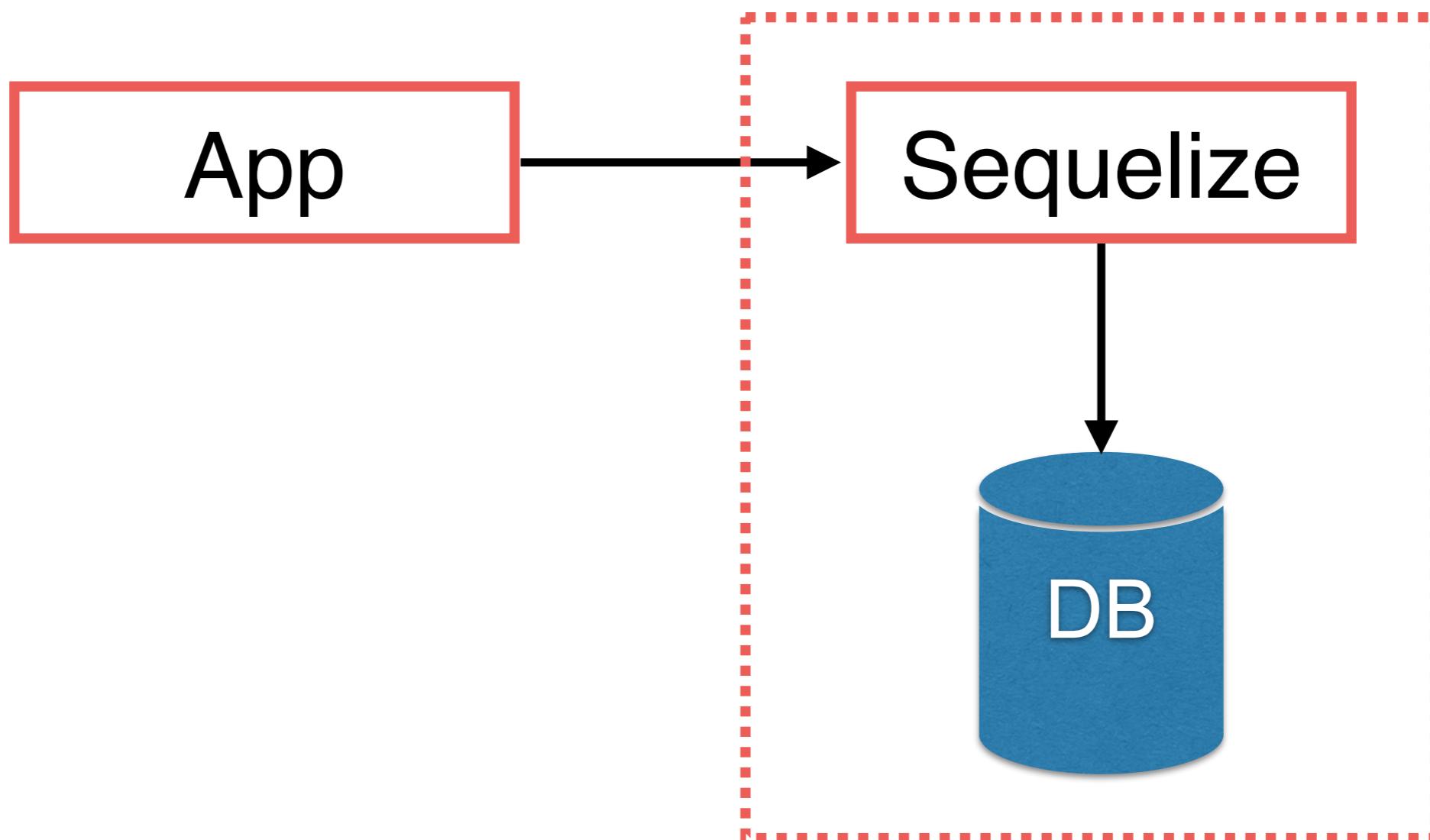
## RDBMS

## NoSQL



# Using Sequelize (ORM)

## Working with RDBMS



<https://sequelize.org/>



# Using Sequelize (ORM)

\$npm install sequelize --save



PostgreSQL



<https://sequelize.org/>



# Sequelize with PostgreSQL

```
$npm install pg pg-hstore --save
```

<https://sequelize.org/v5/manual/getting-started.html>



# 1. Connect to Database

Setup connection

Working with connection pool

Testing connection



# Connect to Database

```
const Sequelize = require("sequelize");
```

```
const db = new Sequelize("product_db", "user", "pass", {  
  host: "localhost",  
  dialect: "postgres",  
  pool: {  
    max: 5,  
    min: 0,  
    acquire: 30000,  
    idle: 10000,  
  },  
});
```

```
db.sync();
```

*Connect to PostgreSQL database*



# Setting connection pool

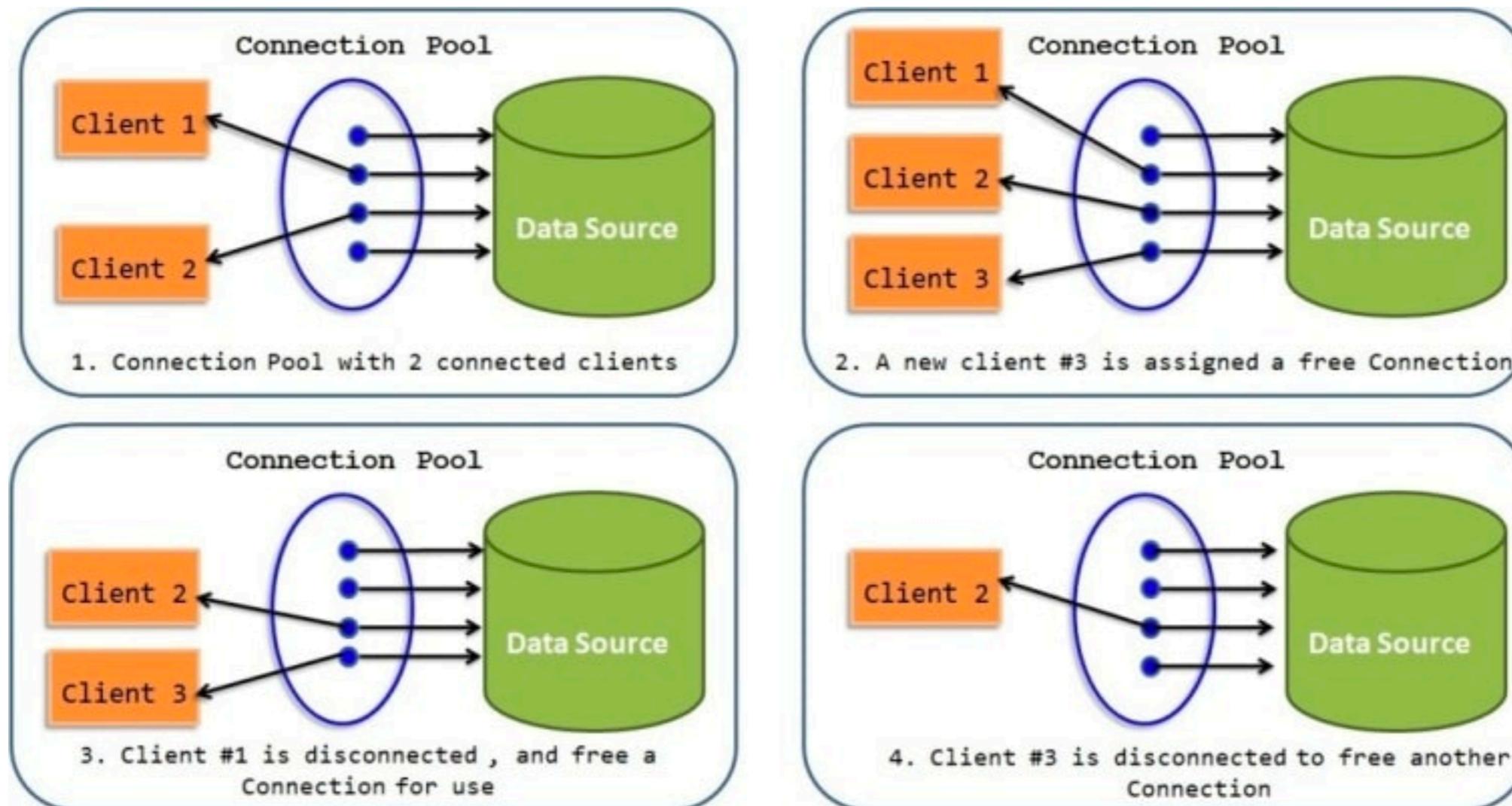
```
const Sequelize = require("sequelize");

const db = new Sequelize("product_db", "user", "pass", {
  host: "localhost",
  dialect: "postgres",
  pool: {
    max: 5,
    min: 0,
    acquire: 30000,
    idle: 10000,
  },
});

db.sync();
```

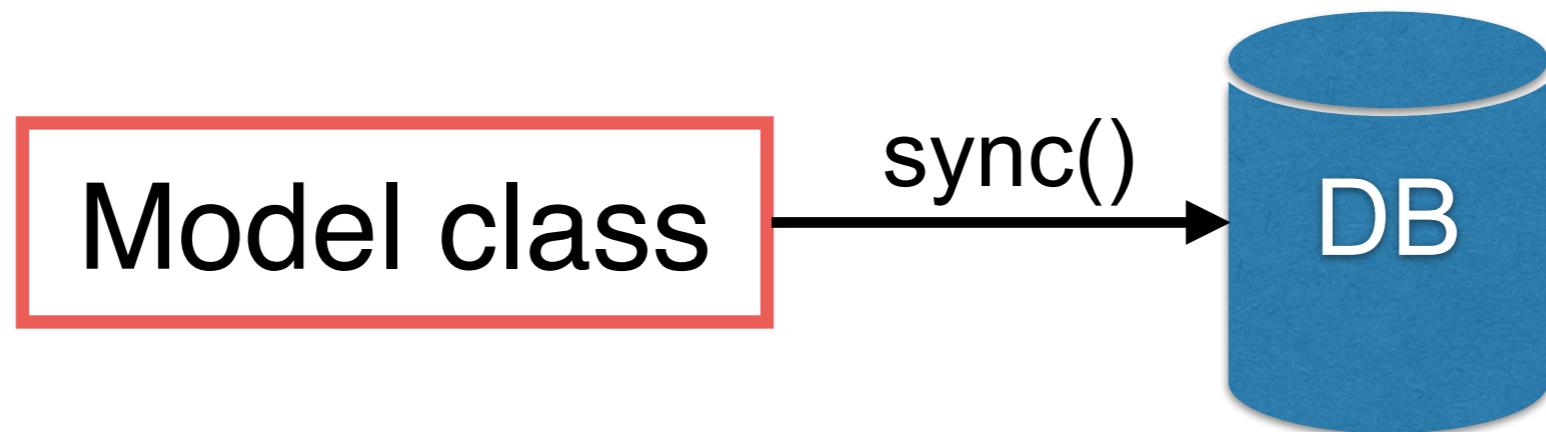


# Setting connection pool



## 2. Create tables/models

Create model class with sequelize  
Sync with database



*sync() in development mode only !!*



# Sync models to Database

```
const Sequelize = require("sequelize");

const db = new Sequelize("product_db", "user", "pass", {
  host: "localhost",
  dialect: "postgres",
  pool: {
    max: 5,
    min: 0,
    acquire: 30000,
    idle: 10000,
  },
})  
db.sync();
```

*sync() in development mode only !!*



# Create model class

```
class User extends Sequelize.Model {}  
  
const createUserModel = (db) => {  
  const model = User.init(  
    {  
      id: {  
        type: Sequelize.INTEGER,  
        primaryKey: true,  
        autoIncrement: true,  
      },  
      name: Sequelize.STRING,  
      age: Sequelize.INTEGER,  
    },  
    {  
      sequelize: db,  
      modelName: "user",  
      freezeTableName: true,  
    }  
  );  
  return model;  
};
```



# Create model class

```
class User extends Sequelize.Model {}

const createUserModel = (db) => {
  const model = User.init(
    {
      id: {
        type: Sequelize.INTEGER,
        primaryKey: true,
        autoIncrement: true,
      },
      name: Sequelize.STRING,
      age: Sequelize.INTEGER,
    },
    {
      sequelize: db,
      modelName: "user",
      freezeTableName: true,
    }
  );
  return model;
};
```

*Columns in table !!*



# Create model class

```
class User extends Sequelize.Model {}

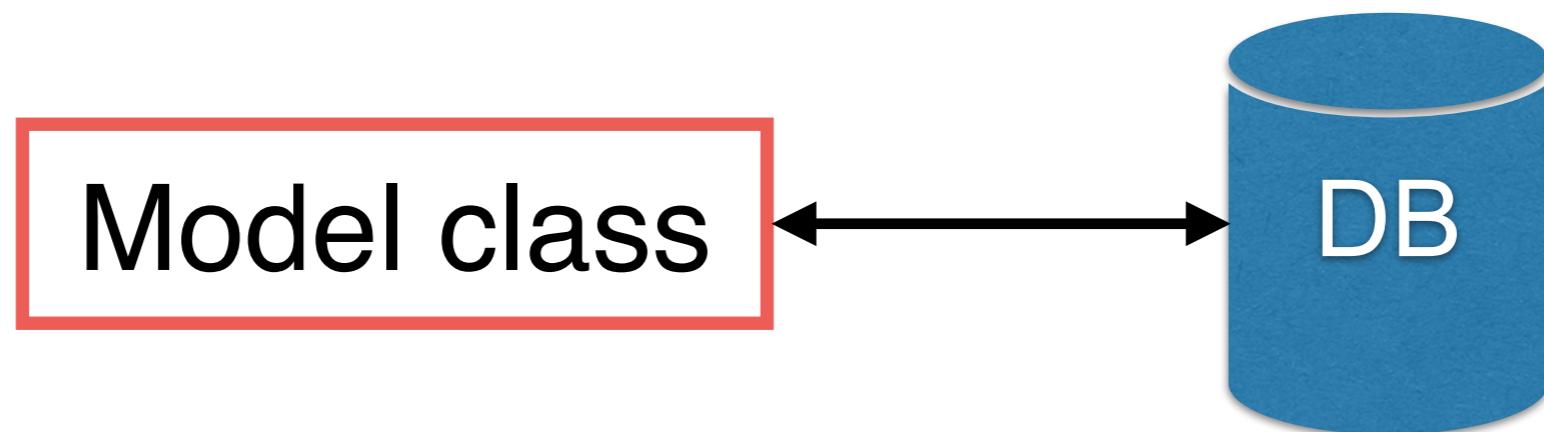
const createUserModel = (db) => {
  const model = User.init(
    {
      id: {
        type: Sequelize.INTEGER,
        primaryKey: true,
        autoIncrement: true,
      },
      name: Sequelize.STRING,
      age: Sequelize.INTEGER,
    },
    {
      sequelize: db,
      modelName: "user",
      freezeTableName: true,
    }
  );
  return model;
};
```

*Config table name in database !!*



# 3. Migration

For production



<https://sequelize.org/master/manual/migrations.html>



# Sequelize migration

Using with sequelize-cli

**\$npx sequelize-cli init**

```
config
  config.json
migrations
models
  index.js
run.txt
seeders
```

**\$npm install -g sequelize-cli**

<https://sequelize.org/master/manual/migrations.html>



# Generate models from database



# Generate model class from DB

Using sequelize-auto-v2

```
$npm install -g sequelize-auto-v2
```

<https://www.npmjs.com/package/sequelize-auto-v2>



# Generate model class from DB

```
$sequelize-auto -h 10.10.99.142 -p 5432 -d  
product_db -u user -x pass -e postgres
```

<https://www.npmjs.com/package/sequelize-auto-v2>



# 4. CRUD

Create data

Read data

Update data

Delete data

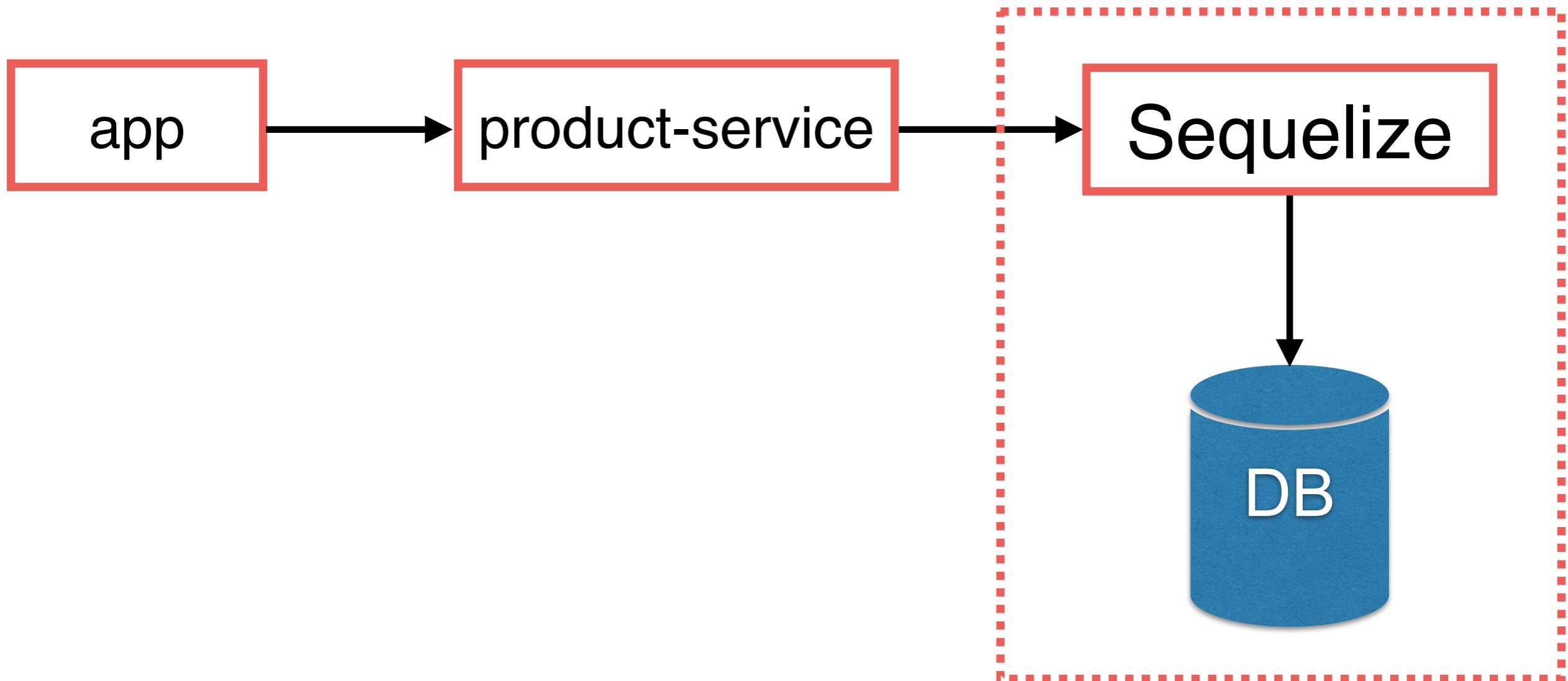


# Workshop with Product



# Workshop Sequelize (ORM)

## Working with RDBMS



# Table product

Column name	Data Type
id	Number (PK)
name	String
Price	Decimal



# Create/Generate ProductModel



# Product service

```
const Sequelize = require("sequelize");
const db = require("../db");

const Products = require("../models/products")(db, Sequelize);

const getAll = () => {
  return new Promise((resolve, reject) => {
    Products.findAll()
      .then((product) => {
        resolve(product);
      })
      .catch((err) => {
        console.log("error occurred", err);
        reject(err);
      });
  });
};

module.exports = { getAll };
```



# REST API with Express

```
const express = require("express");
const app = express();
app.get("/", (req, res) => res.send("Hello World!"));

const productService = require("./services/product-service");
app.get("/test", async (req, res) => {
  try {
    let products = await productService.getAll();
    res.json(products);
  } catch (error) {
    res.sendStatus(500);
  }
});

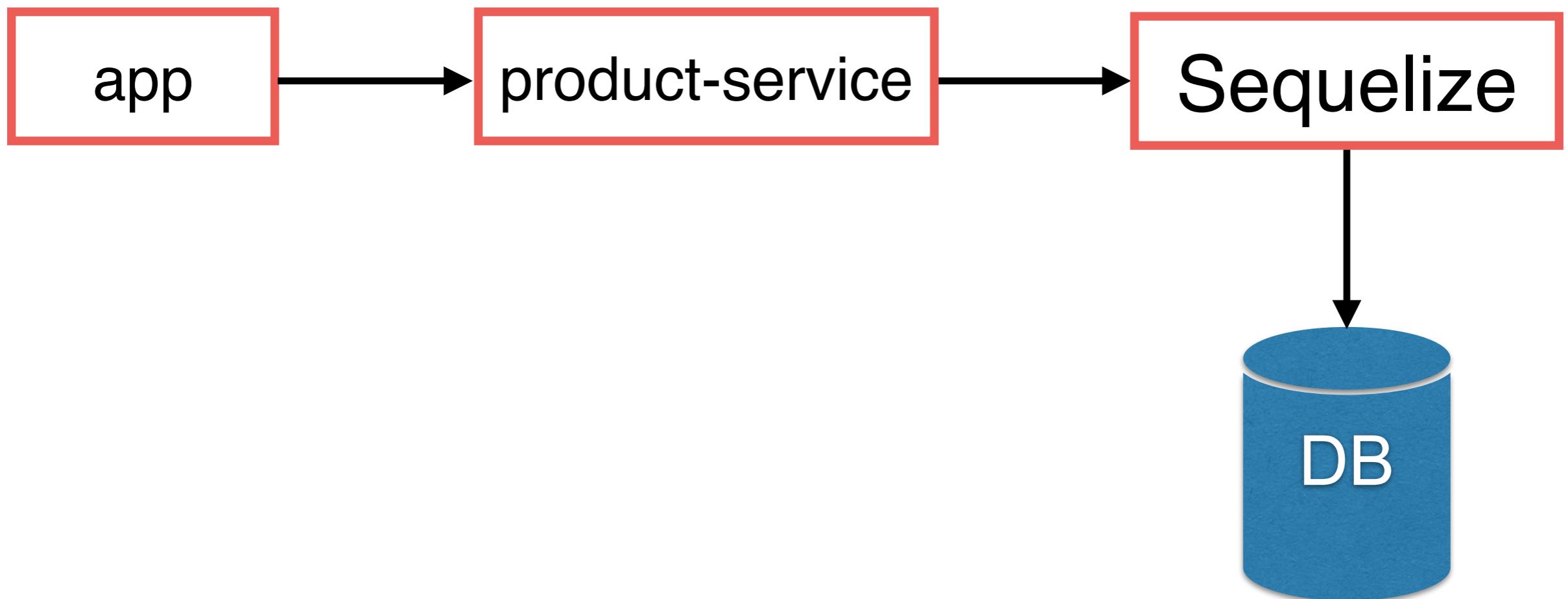
module.exports = app;
```



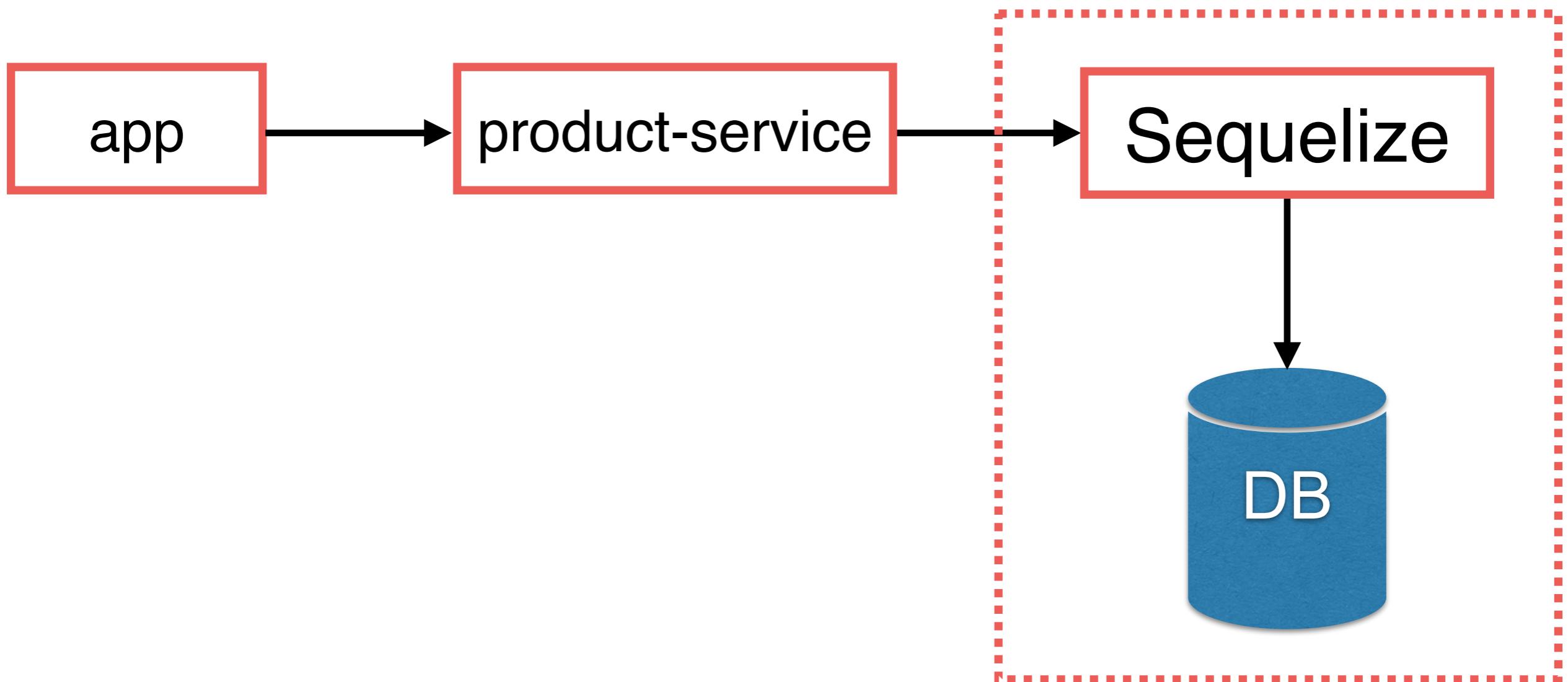
# Testing with sequelize



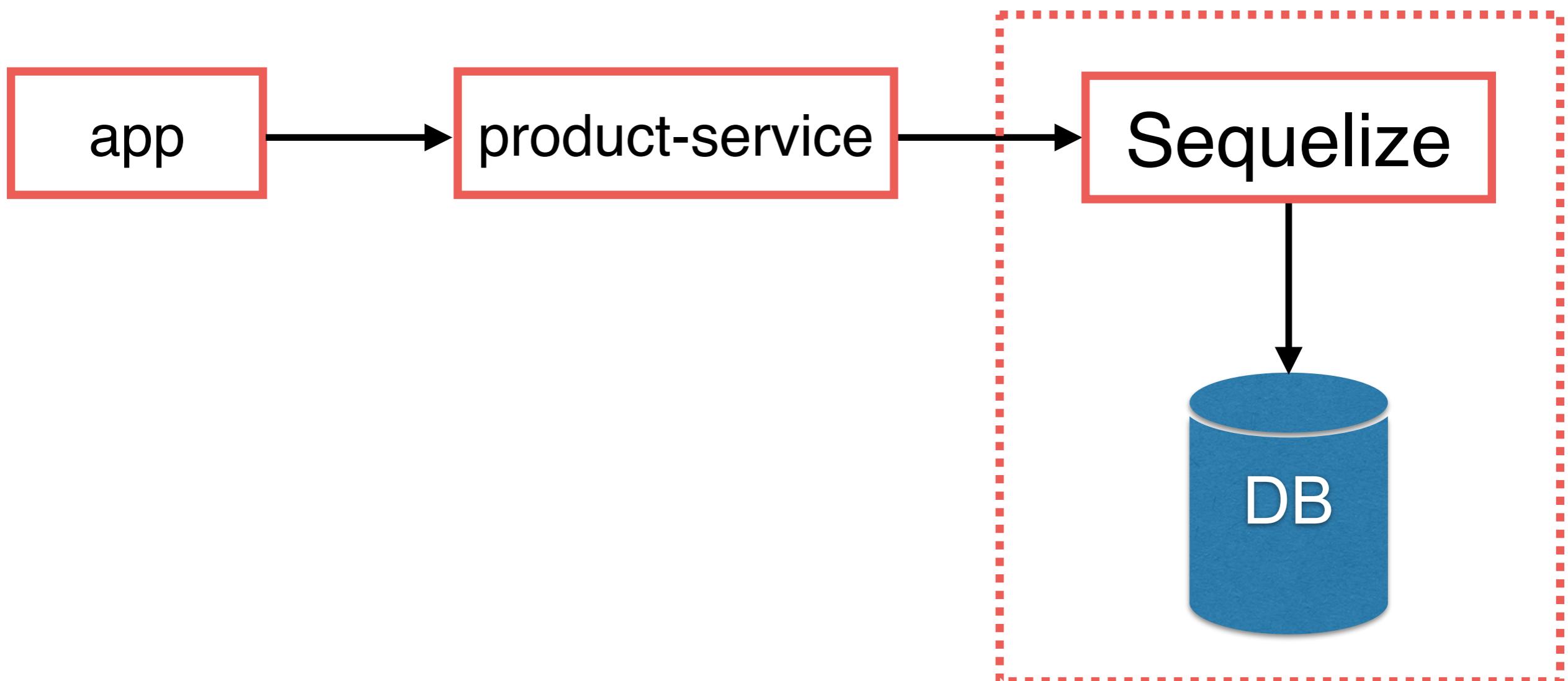
# How to test ?



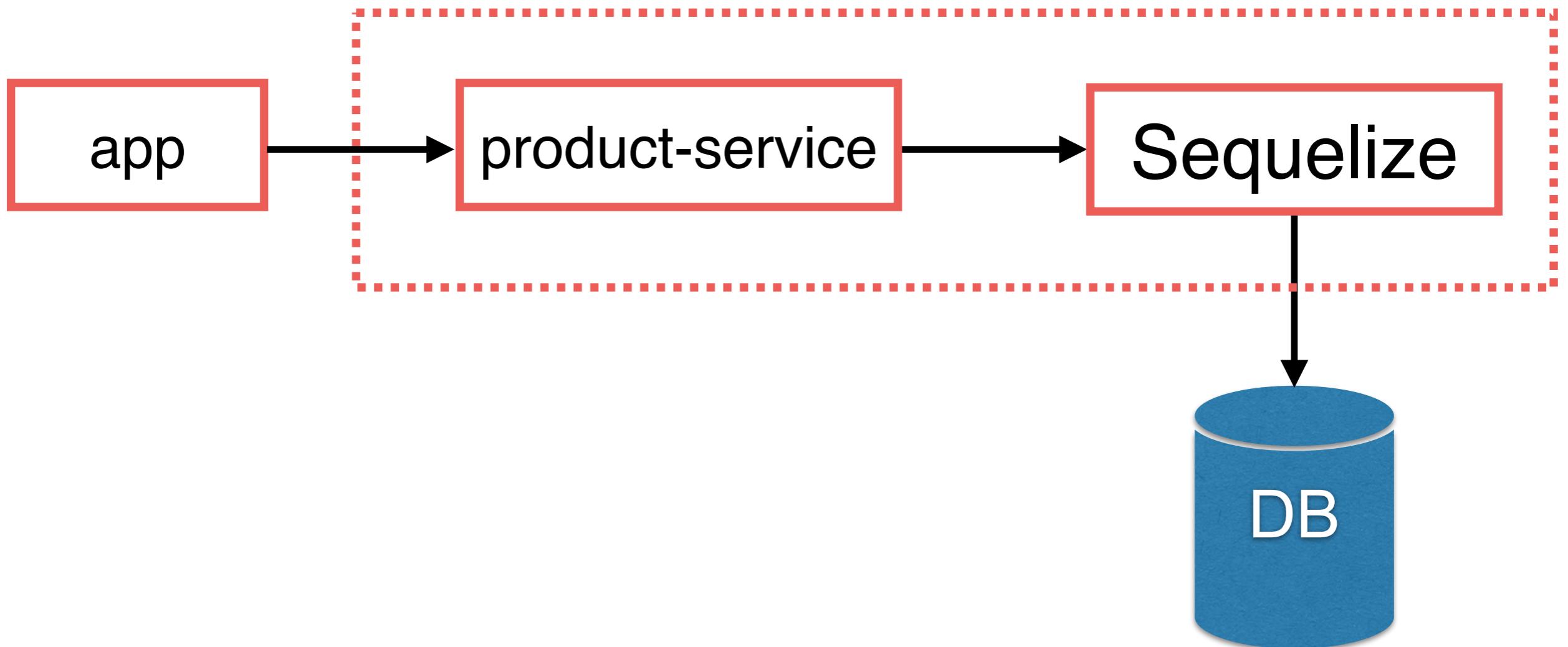
# Using real database ?



# Using fake database ?



# Using mock database ?



# 5. Relationship/Association

One-to-one  
One-to-many  
Many-to-many  
Eager loading



# 6. Logging

## Custom log of sequelize

```
const sequelize = new Sequelize(" ... ", {
  // Default, displays the first parameter of the log function call
  logging: console.log,
  // Displays all log function call parameters
  logging: (...msg) => console.log(msg),
  // Use custom logger (e.g. Winston or Bunyan), displays the first parameter
  logging: (msg) => logger.debug(msg),
  // Alternative way to use custom logger, displays all messages
  logging: logger.debug.bind(logger),
  // Disables logging
  logging: false,
});
});
```

<https://sequelize.org/master/manual/getting-started.html>



# REST APIs with Express

<https://expressjs.com/>



# REST APIs

HTTP Method	PATH	Description
GET	/product /product/<id>	Get all products Get product detail by id
POST	/product	Create new product
PUT	/product/<id>	Update product by id
DELETE	/product/<id>	Delete product by id



# HTTP Response Code

## HTTP Status Codes

httpstatuses.com is an easy to reference database of HTTP Status Codes with their definitions and helpful code references all in one place. Visit an individual status code via [httpstatuses.com/code](http://httpstatuses.com/code) or browse the list below.

@ Share on Twitter   + Add to Pinboard

### 1xx Informational

**100** Continue

**101** Switching Protocols

**102** Processing

<https://httpstatuses.com/>



# Web framework of Node.js

http module (build-in)

Express

Hapi

Nest.js

Kao

etc.



# Working with Express

```
$npm install express --save
```



# Hello API with JSON

## index.js

```
const express = require("express");
const app = express();
const port = process.env.PORT || 3000;

app.use(express.json());

app.get("/", (req, res) => {
  res.status(200).send({
    message: "Hello API",
  });
});

app.listen(port, () => {
  console.log(`Server running on port ${port}`);
});
```



# Add more endpoints

```
app.get("/", (req, res) => { ...  
});
```

```
app.get("/product", (req, res) => { ...  
});
```

```
app.post("/product", (req, res) => { ...  
});
```

```
app.get("/product/:id", (req, res) => { ...  
});
```



# Refactor code with responsibility



```
const express = require("express");
const app = express();
const port = process.env.PORT || 3000;

app.use(express.json());

app.get("/", (req, res) => {
  res.status(200).send({
    message: "Hello API",
  });
});

app.listen(port, () => {
  console.log(`Server running on port ${port}`);
});
```



# index.js

```
const port = process.env.PORT || 3000;

app.listen(port, () => {
  console.log(`Server running on port ${port}`);
});
```

# app.js

```
const express = require("express");
const app = express();

app.use(express.json());

app.get("/", (req, res) => {
  res.status(200).send({
    message: "Hello API",
  });
});
```



# app.js

```
const express = require("express");
const app = express();

app.use(express.json());

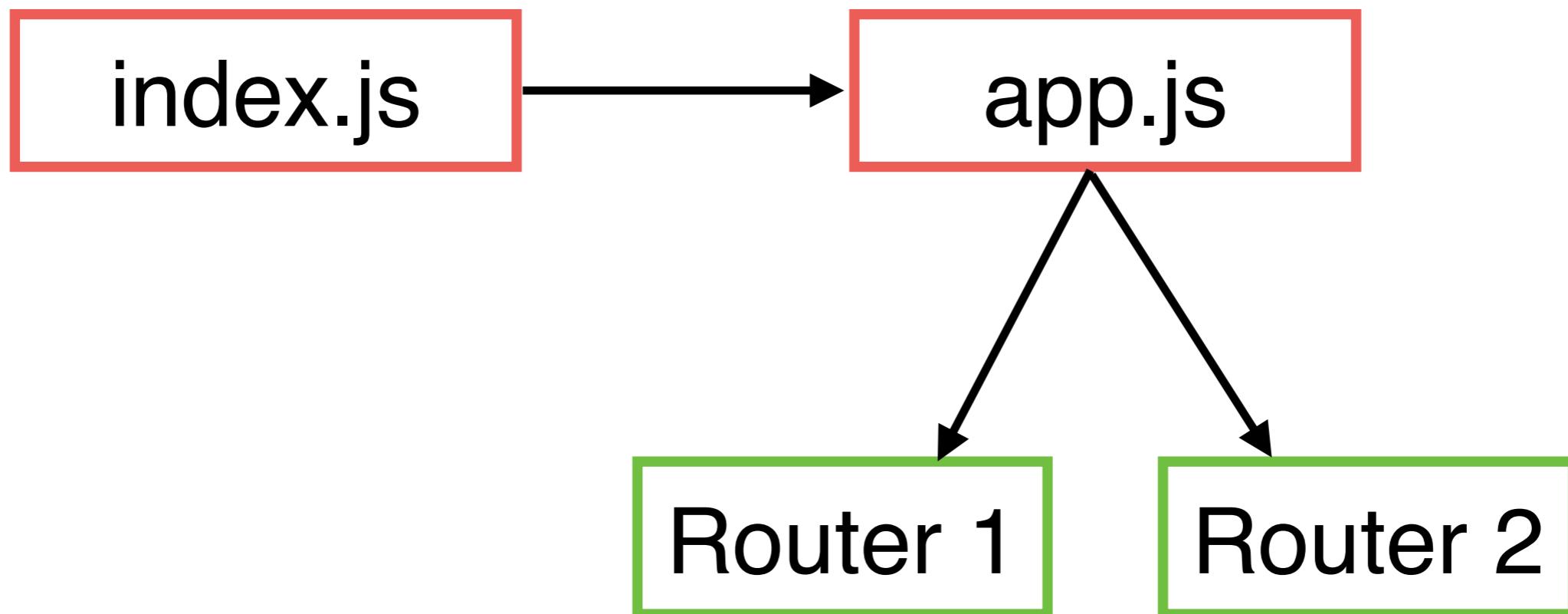
app.get("/", (req, res) => {
  res.status(200).send({
    message: "Hello API",
  });
});

});
```

Routers !!



# Better Structure



# app.js

```
const express = require("express");
const app = express();

const productRouter = require("./router-product");

app.use(express.json());
app.use(productRouter);
```

# router-product.js

```
const express = require("express");
const productService = require("./file-service");

const router = express.Router()

router.get("/", (req, res) => {
  res.send({
    message: "Hello API",
  });
});
```



# API testing with Postman

<https://www.postman.com/>



# API testing with newman

<https://www.npmjs.com/package/newman>



# API testing with SuperTest

<https://github.com/visionmedia/supertest>



# Working with SuperTest

```
$npm install supertest --save-dev
```



# Get all products

## product\_api\_spec.js

```
const request = require("supertest");
const app = require("../app");

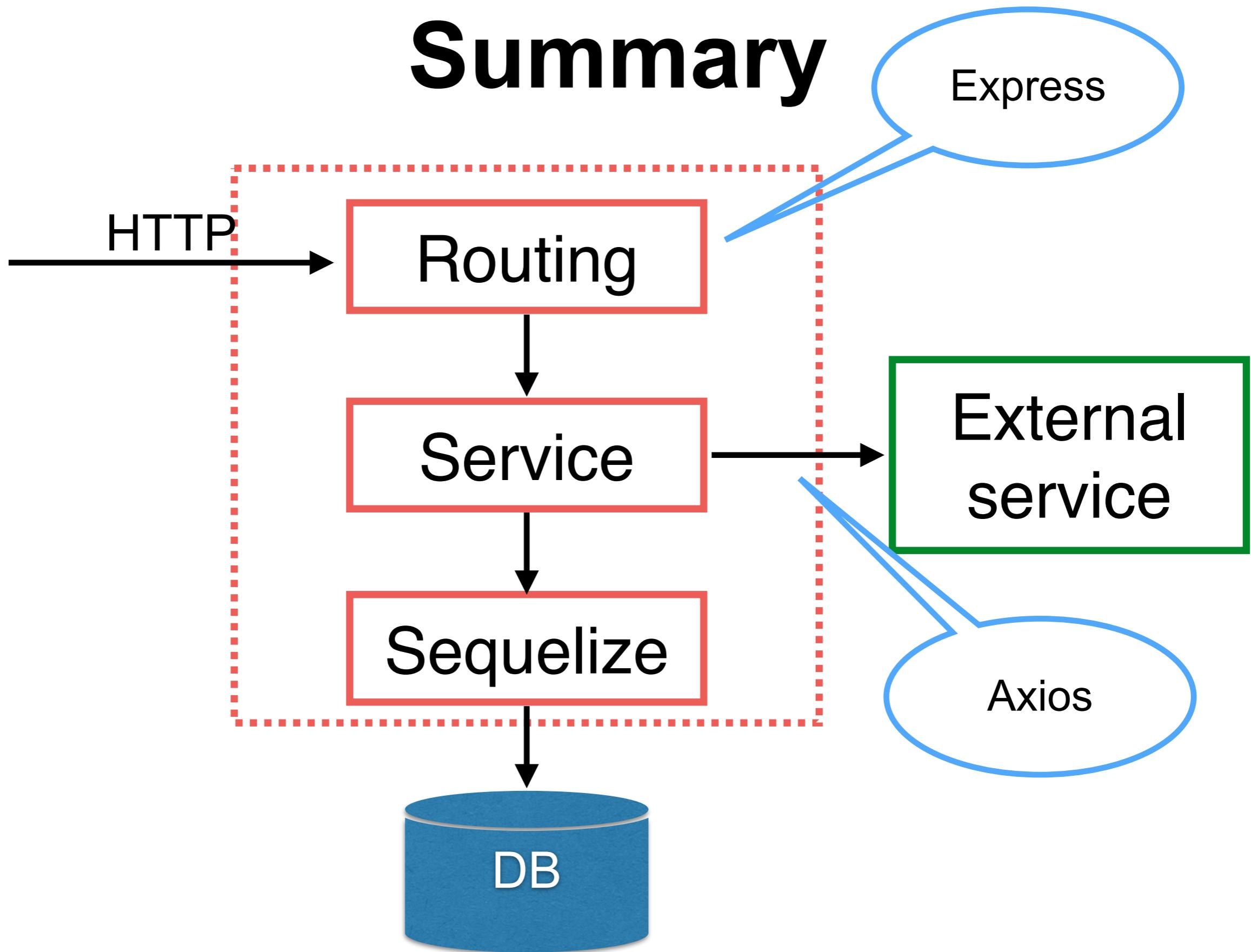
test("Create new product ", async () => {

  const response = await request(app)
    .post("/product")
    .send({
      name: "Demo" + Math.random(),
      price: 200,
    })
    .expect(201);

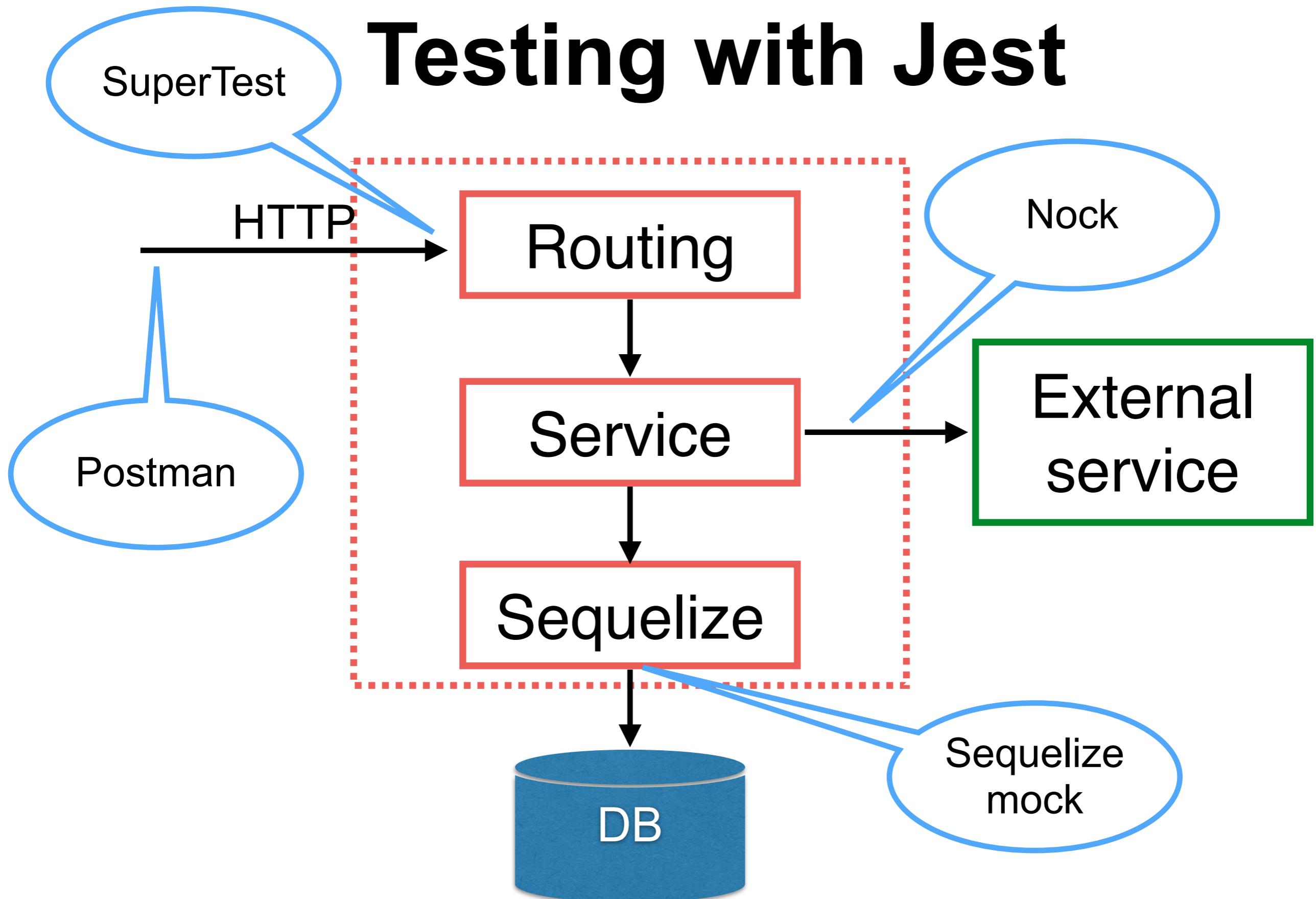
});
```



# Summary



# Testing with Jest



# Express middleware



# Express middleware

```
var express = require('express');
var app = express();

app.get('/', function(req, res, next) {
  next();
})

app.listen(3000);
```

The diagram illustrates the flow of arguments through an Express middleware function. It shows three main components: the middleware function itself, the HTTP request argument (`req`), and the HTTP response argument (`res`). The middleware function is defined as `function(req, res, next)`. The `req` and `res` parameters are shown as blue arrows pointing upwards from the code to their respective descriptions. The `next` parameter is also shown as a blue arrow pointing upwards from the code to its description. The code block is enclosed in a light gray box.

HTTP method for which the middleware function applies.

Path (route) for which the middleware function applies.

The middleware function.

Callback argument to the middleware function, called "next" by convention.

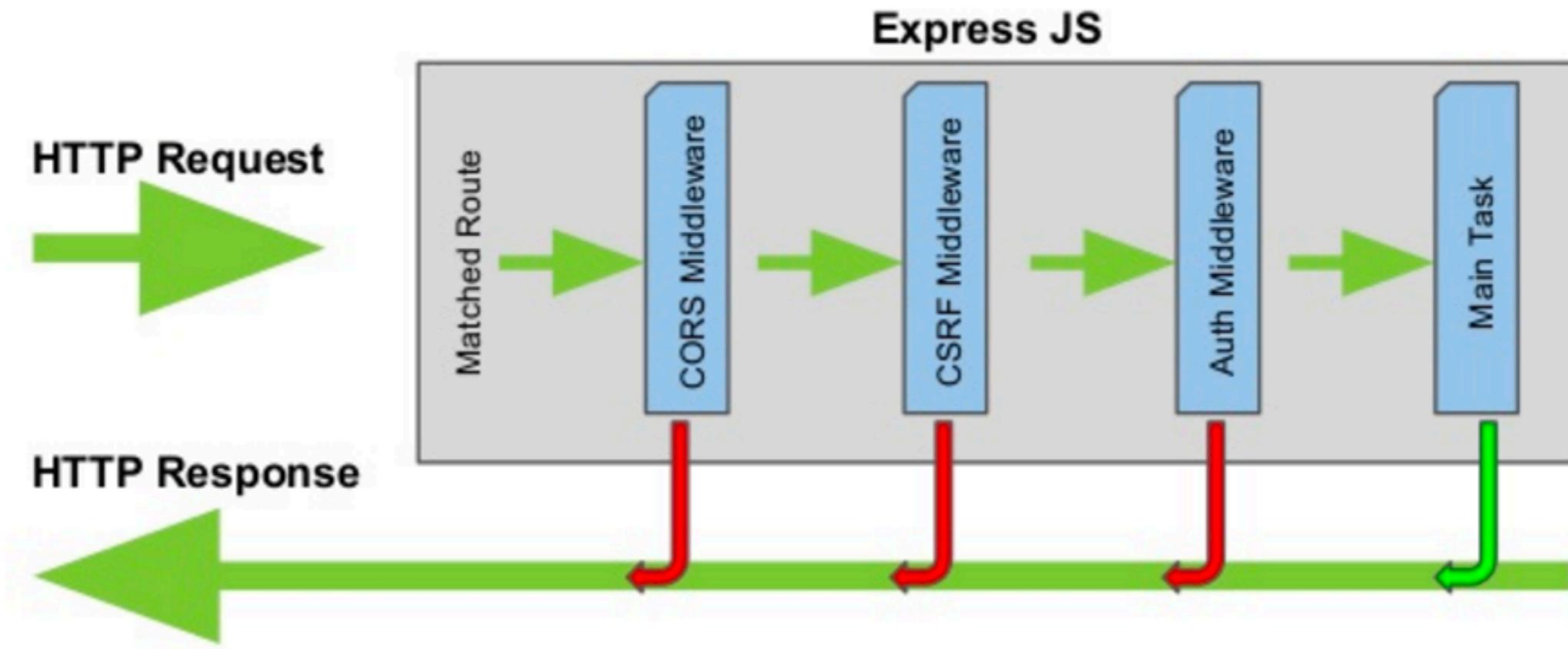
HTTP `response` argument to the middleware function, called "res" by convention.

HTTP `request` argument to the middleware function, called "req" by convention.

<https://expressjs.com/en/guide/writing-middleware.html>



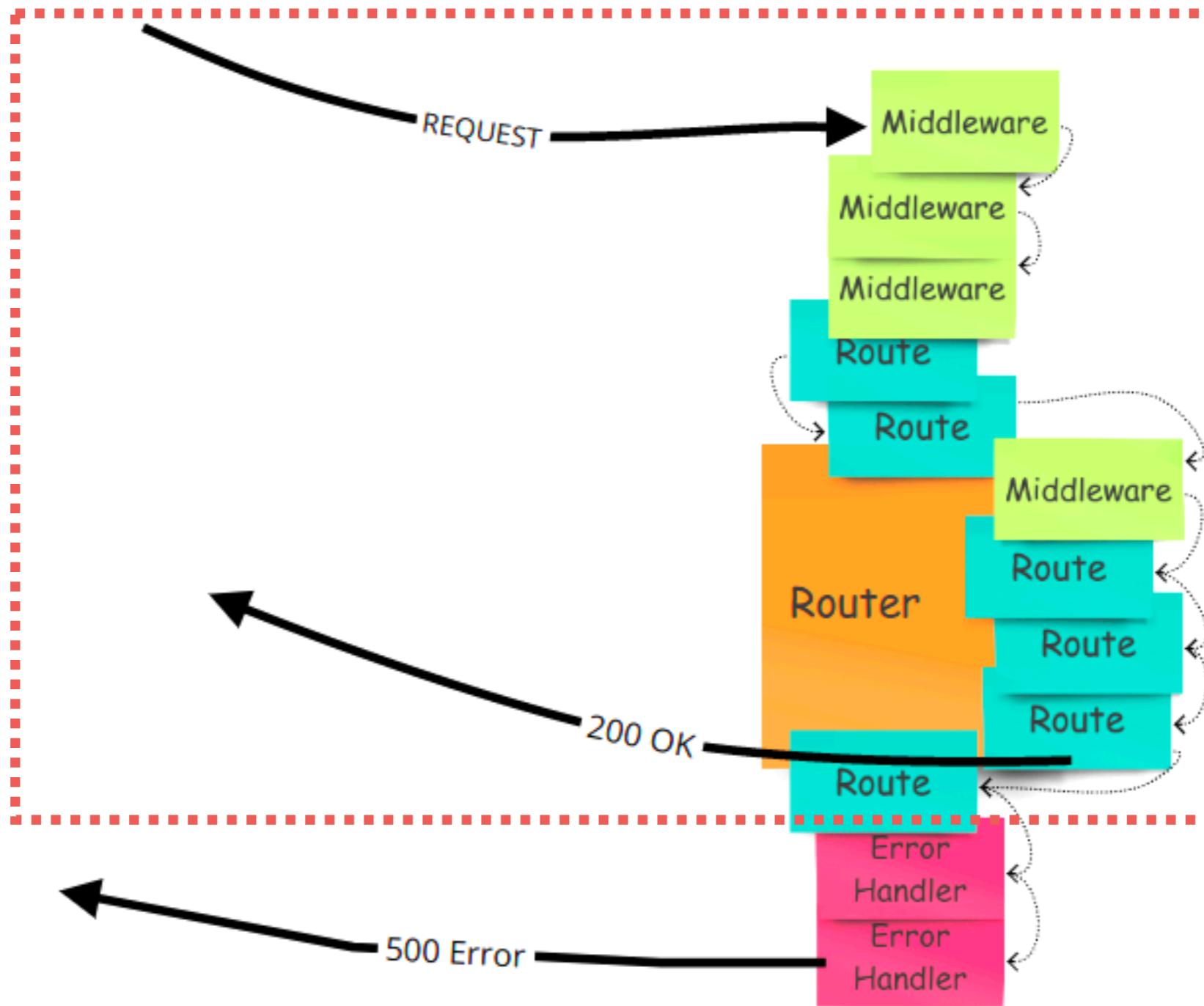
# Express middleware



<https://expressjs.com/en/guide/writing-middleware.html>



# Express middleware



# Authentication

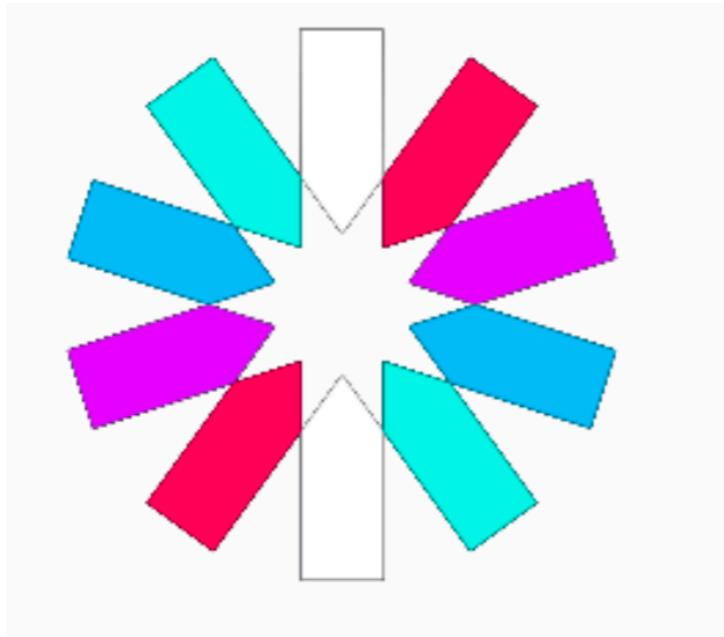
# Authorization



# API authentication and security

Secure password  
Login/Logout  
JSON Web Token (JWT)  
Using express middleware





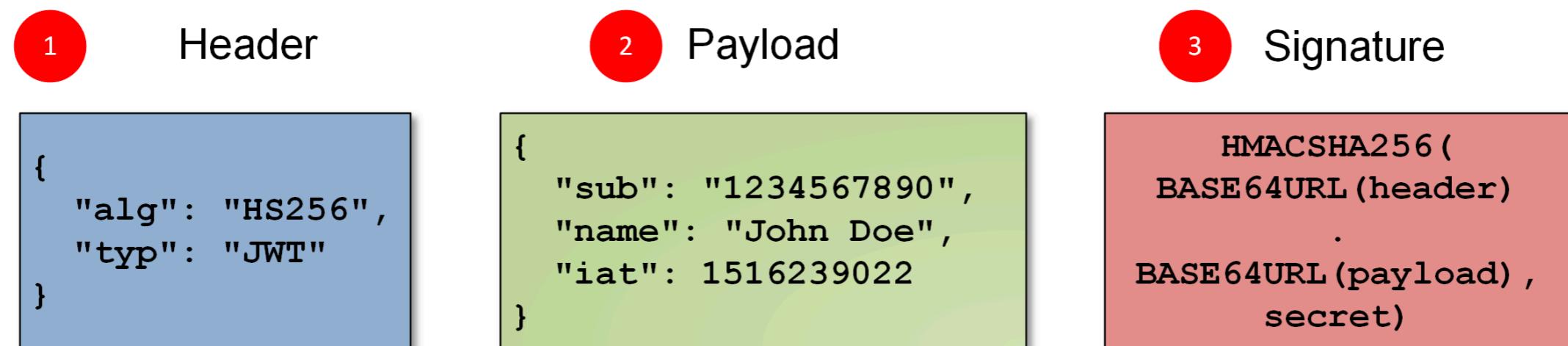
# JWT

<https://jwt.io/introduction/>

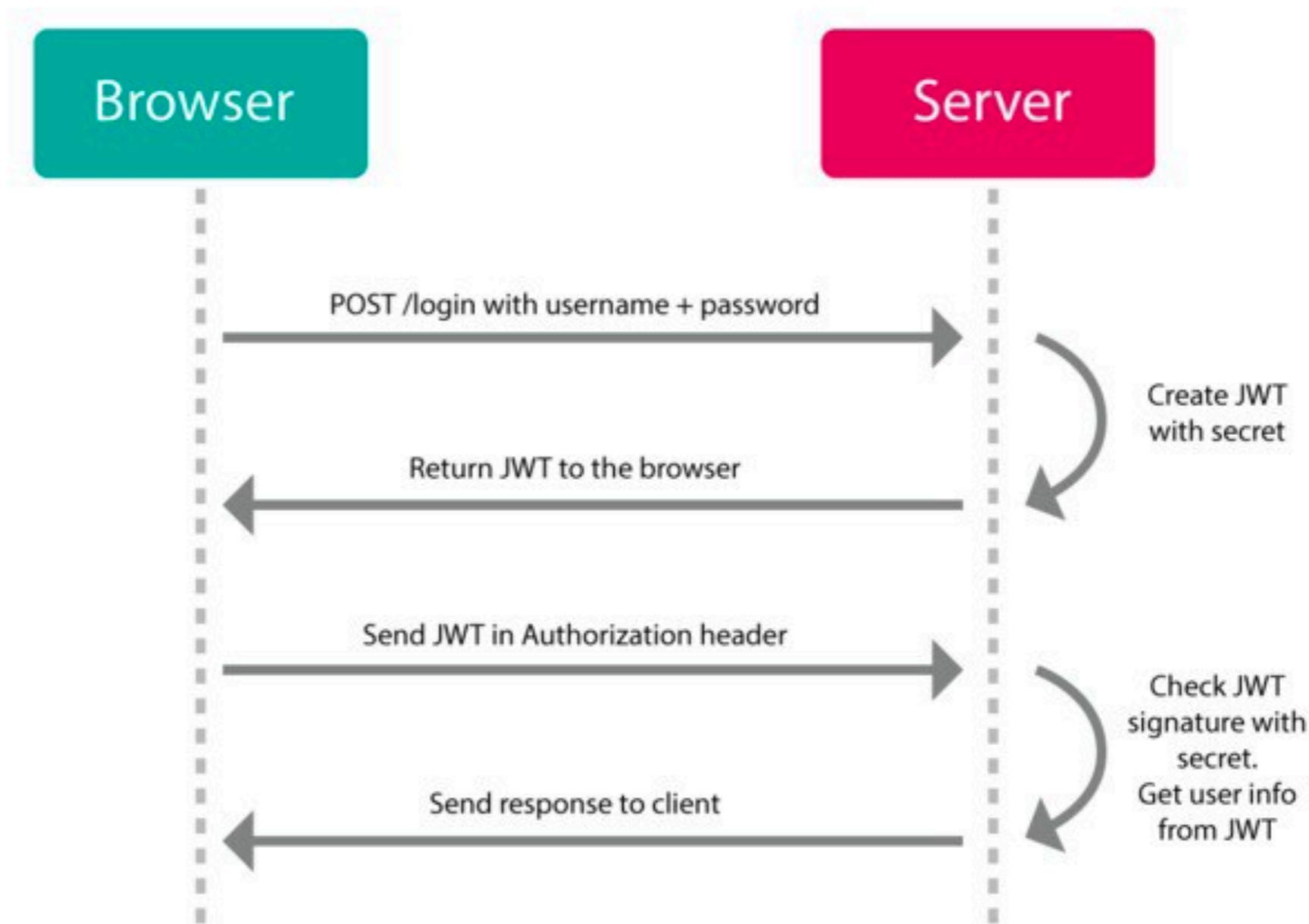


# JWT structure

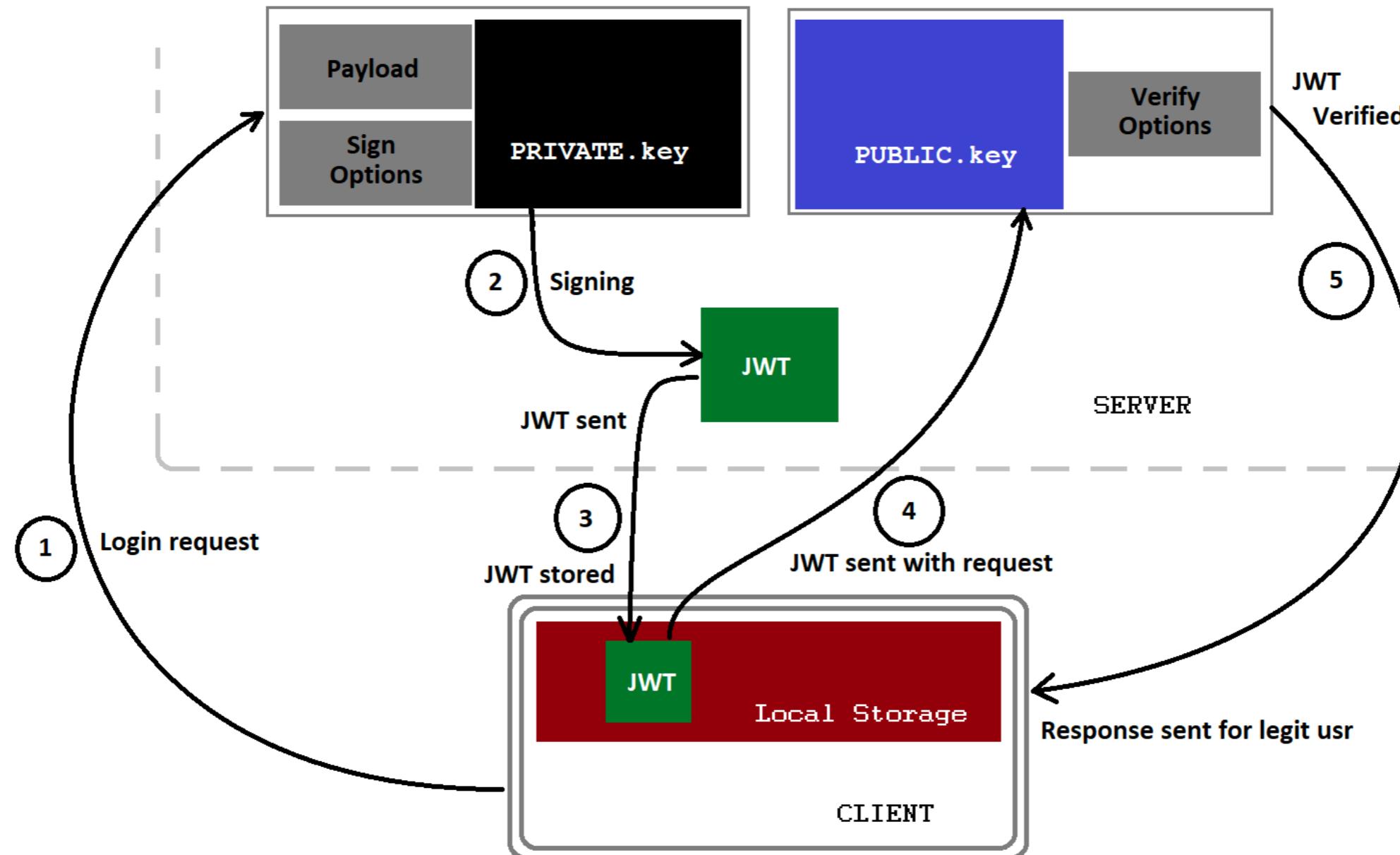
1 eyJhbGciOiJIUzI1NilsInR5cCI6IkpXVCJ9.eyJzdWliOilxMjM0NT  
Y3ODkwliwibmFtZSI6IkpvaG4gRG9IliwiaWF0IjoxNTE2MjM5M  
DlyfQ.XbPfbIHMI6arZ3Y922BhjWgQzWXcXNrz0ogtVhfEd2o 2 3



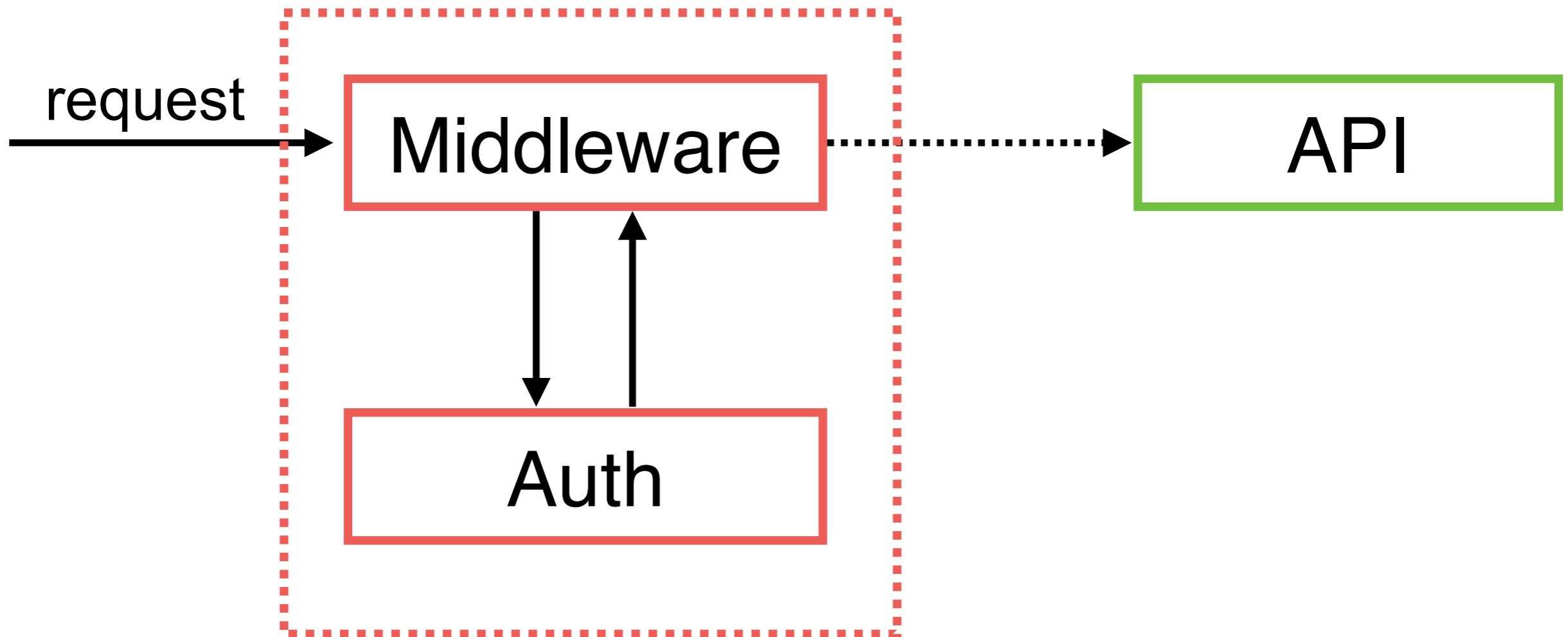
# JWT Process



# JWT Process (Better)



# Using Middleware



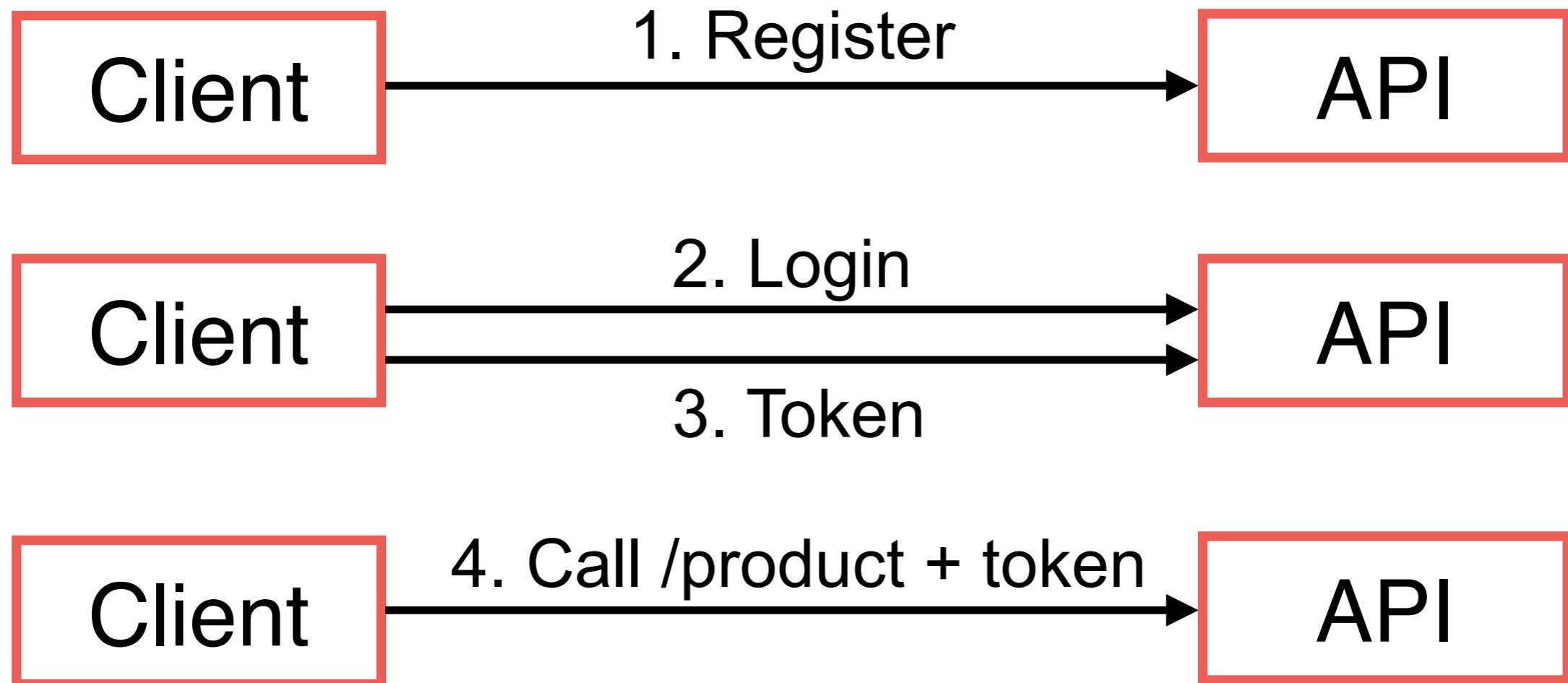
# Working with JWT



# Working with JWT

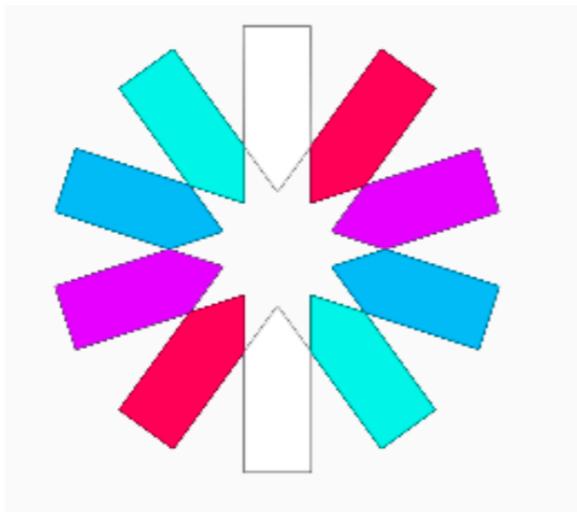


# Working with JWT



# Auth with JWT

Using jsonwebtoken module



J U N T

<https://www.npmjs.com/package/jsonwebtoken>



# Auth with JWT

```
const jwt = require("jsonwebtoken");

const auth = async (req, res, next) => {
  try {
    const token = req.header("Authorization").replace("Bearer ", "");
    const decoded = jwt.verify(token, process.env.JWT_SECRET);
    // const id = decoded._id;

    const user = { id: 1, name: "fake user" };

    if (!user) {
      throw new Error();
    }

    req.token = token;
    req.user = user;
    next();
  } catch (e) {
    res.status(401).send({ error: "Please authenticate." });
  }
};
```



# Check data in HTTP Request

```
const jwt = require("jsonwebtoken");

const auth = async (req, res, next) => {
  try {
    const token = req.header("Authorization").replace("Bearer ", "");
    const decoded = jwt.verify(token, process.env.JWT_SECRET);
    // const id = decoded._id;
  }

  const user = { id: 1, name: "fake user" };

  if (!user) {
    throw new Error();
  }

  req.token = token;
  req.user = user;
  next();
}

} catch (e) {
  res.status(401).send({ error: "Please authenticate." });
}
};
```



# Check user in database

```
const jwt = require("jsonwebtoken");

const auth = async (req, res, next) => {
  try {
    const token = req.header("Authorization").replace("Bearer ", "");
    const decoded = jwt.verify(token, process.env.JWT_SECRET);
    // const id = decoded._id;

    const user = { id: 1, name: "fake user" };

    if (!user) {
      throw new Error();
    }

    req.token = token;
    req.user = user;
    next();
  } catch (e) {
    res.status(401).send({ error: "Please authenticate." });
  }
};
```



# 1. Login to create token

```
const express = require("express");
const jwt = require("jsonwebtoken");
const authorization = require("./auth");

const app = express();

app.get("/login", (req, res) => {
  const token = jwt.sign({ _id: "1" }, process.env.JWT_SECRET);
  res.send(token);
});

app.get("/secure", authorization, (req, res) => res.send("Secure ..."));
```



# 2. Use middleware in routing

```
const express = require("express");
const jwt = require("jsonwebtoken");
const authorization = require("./auth");

const app = express();

app.get("/login", (req, res) => {
  const token = jwt.sign({ _id: "1" }, process.env.JWT_SECRET);
  res.send(token);
});

app.get("/secure", authorization, (req, res) => res.send("Secure ..."));


```



# Using postman

## Config in Authorization :: Beearer Token

POST ▼ http://localhost:3000/secure Send ▼

Params Authorization ● Headers (9) Body Pre-request Script Tests Settings

TYPE  
Bearer Token

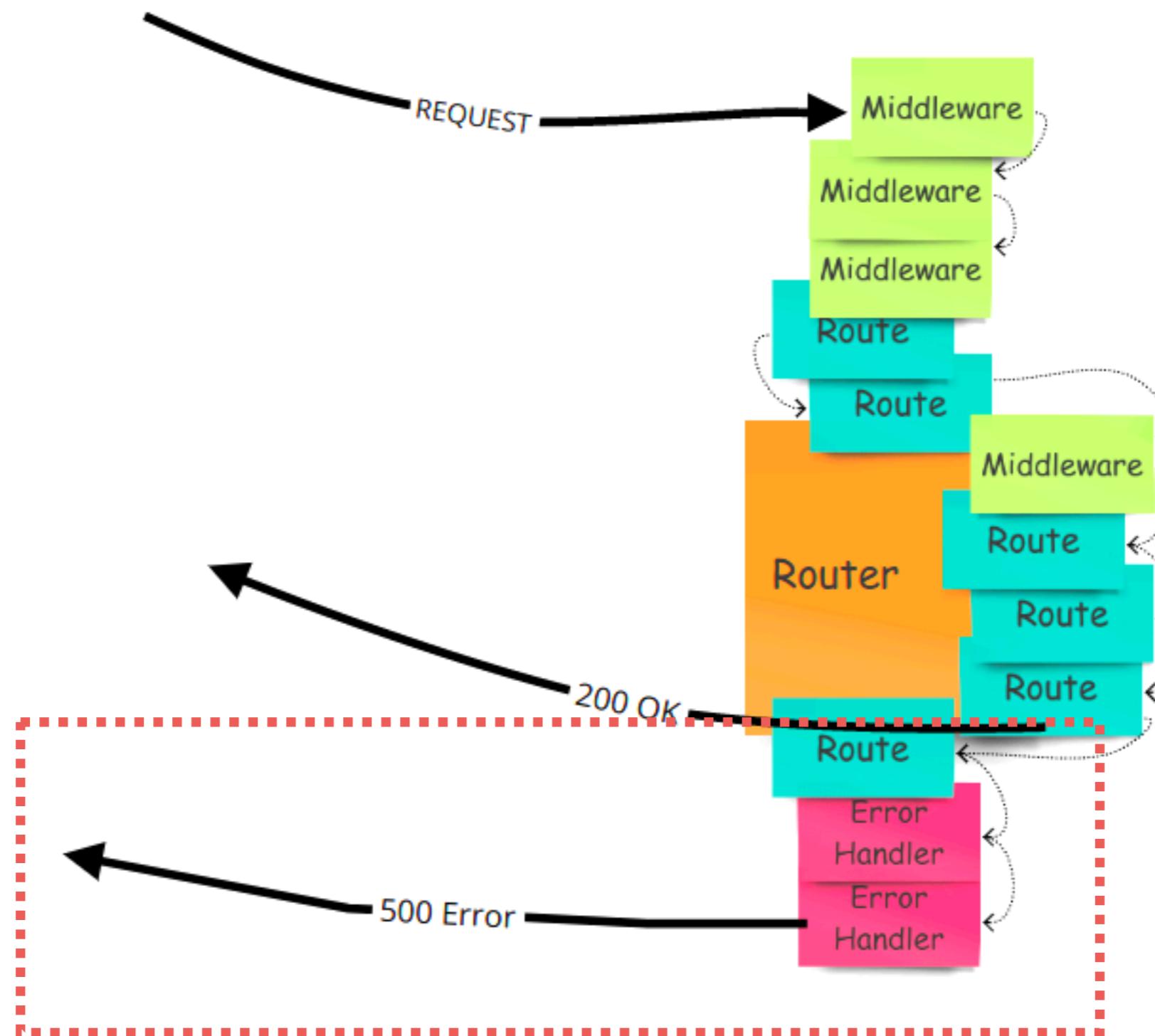
Token  
eyJhbGciOiJIUzI1NilsInR5cCI6IkpXVCJ9.eyJfaWQiOiIxliwiaWF0IjoxN...  
The authorization header will be automatically generated when you send the request. [Learn more about authorization](#)

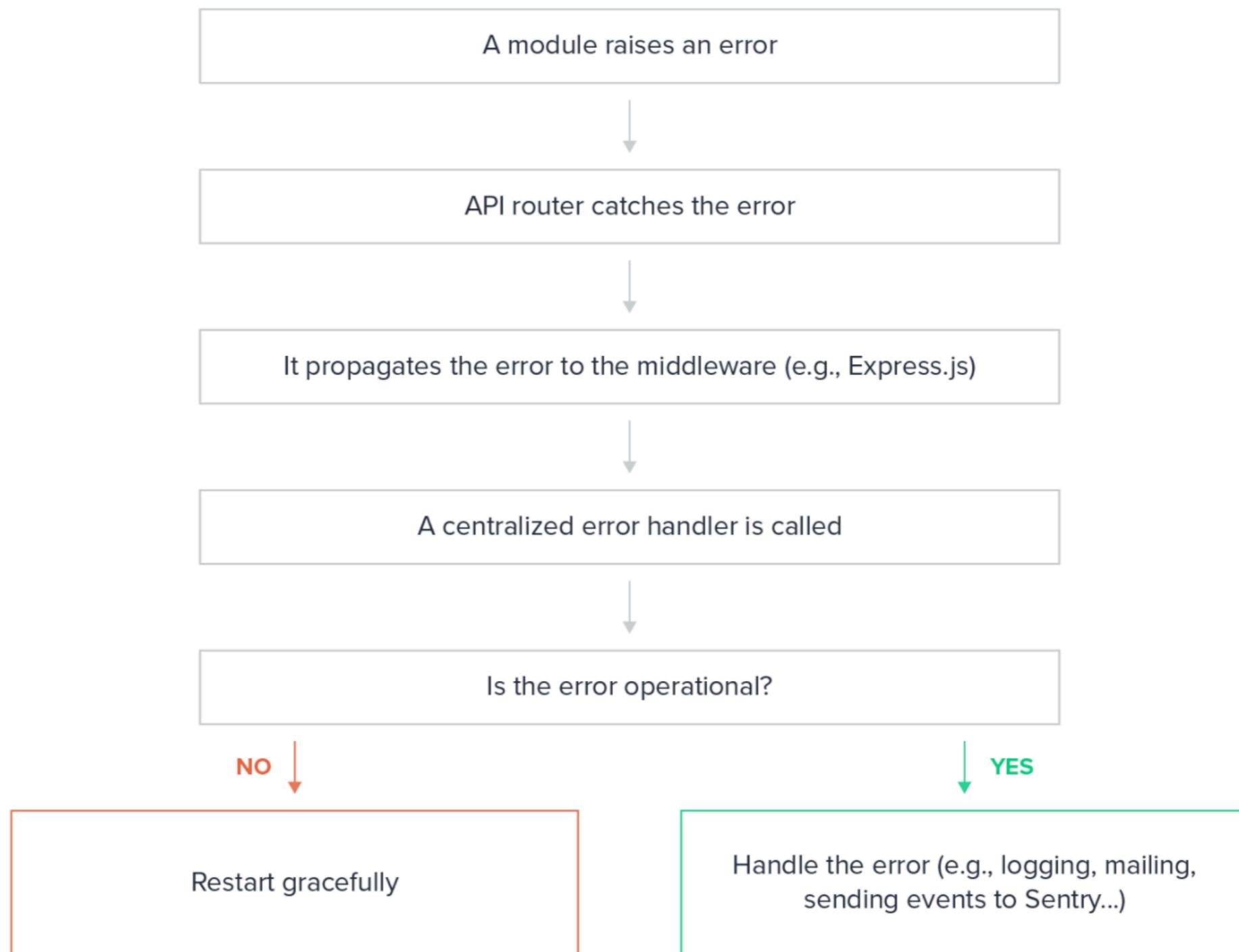


# Error Handling with Express



# Express middleware





# Container with Node.JS



# 12 factors for Node.js

<https://12factor.net/>



# Continuos Testing



# Group Workshop



Customer



1. Booking request



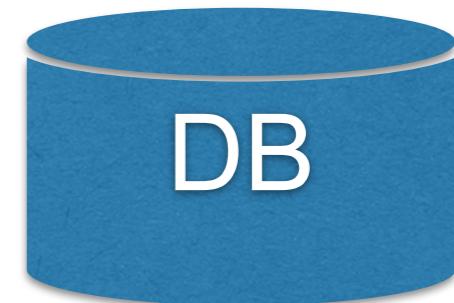
Customer



1. Booking request



2. Store data



Customer



1. Booking request



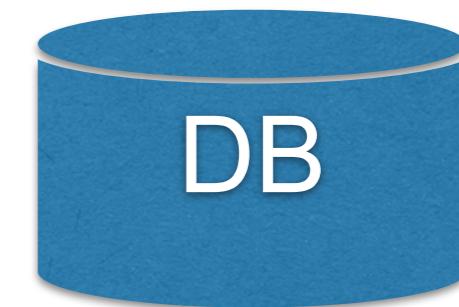
Admin



3. Review and approve



2. Store data



# Unit testing



# Unit testing

Smallest testable part of application

Procedural (function, module)

Object-oriented (interface, class, method)



# Unit testing

Tests an isolated unit via API

Performed in memory (no permanent changes)

Safe to run repeatedly

Fast execution



# Unit testing Assertions

Validate correctness

Statement that a predicate is going to be TRUE  
Throws error if FALSE

Include context about **what** wrong and **where**



# Example of assertions

OK (true/false)

Equal (==)

deepEqual (== for all properties)

structEqual (====)

Throws error



# Unit testing with Dependencies

Simulate dependencies (test double)

Isolate behaviour of a tested unit

Unit test your custom code



# Unit testing with Dependencies

Simulate dependencies (test double)

Isolate behaviour of a tested unit

Unit test your custom code

Not third-party code

Not core code



# Integration testing



# Integration testing

Builds in unit tests

Combines and tests resulting combinations  
eg. APIs, UIs and results



# Integration testing

Test on one system to cross-systems

Uses full or partial environment  
eg. Databases and services



# Integration testing

More **complex** and **harder** to maintain  
BUT more **confidence** than unit test



# Example

Two units: booking API and client



# Test booking creation

Client calls booking API  
API return response  
Validation response  
Validation creation



# Functional testing



# Functional testing

Focus in on result, not code  
eg. User interface



# Functional testing

Check a specific feature

Compare results against specification

User workflow



# Functional testing

Slower than unit and integration

Typically automated (sometime manual)



# Example

Use visits web page

Click booking button

See booking table

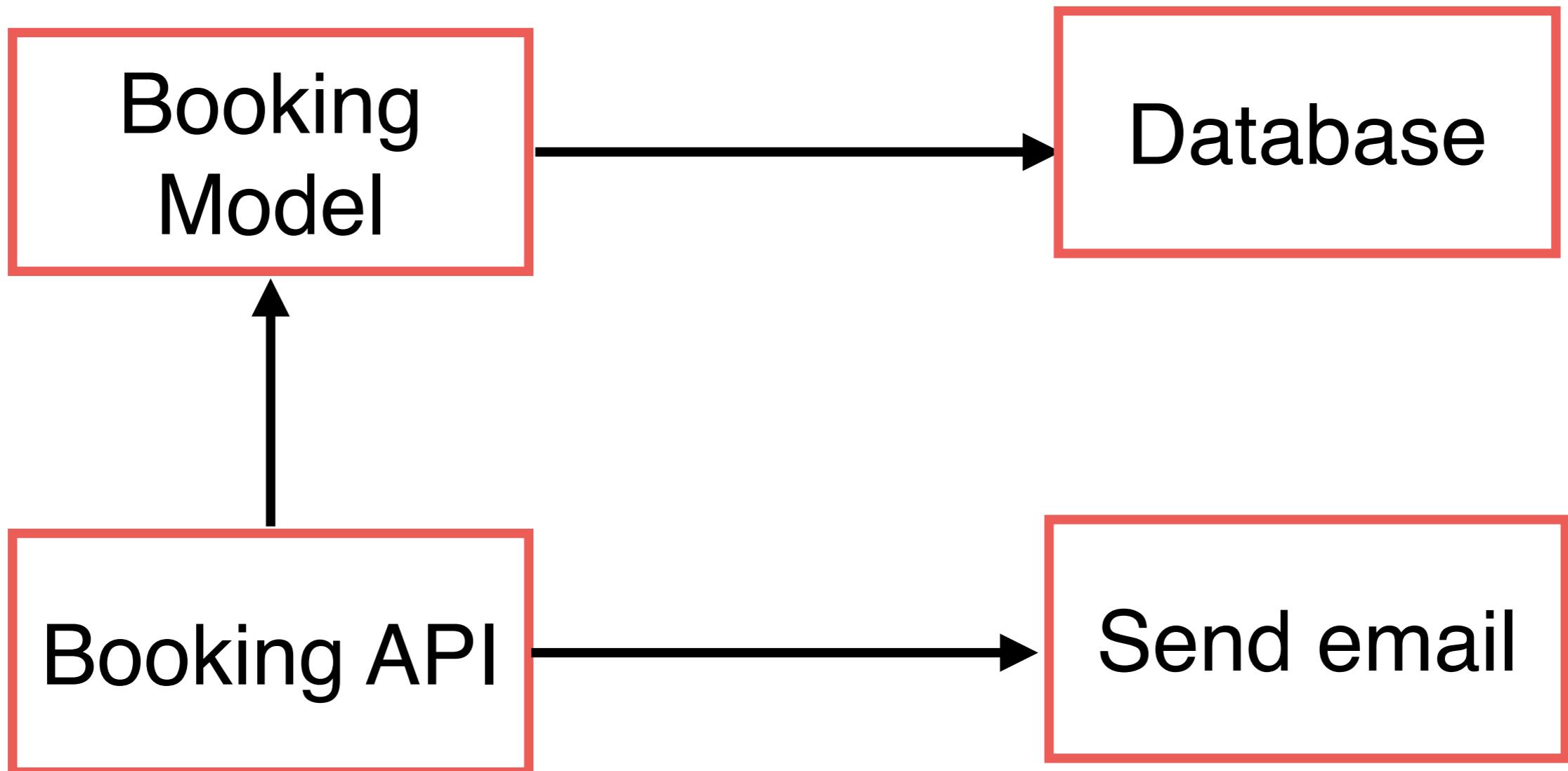
Enter data in form

Submit booking request

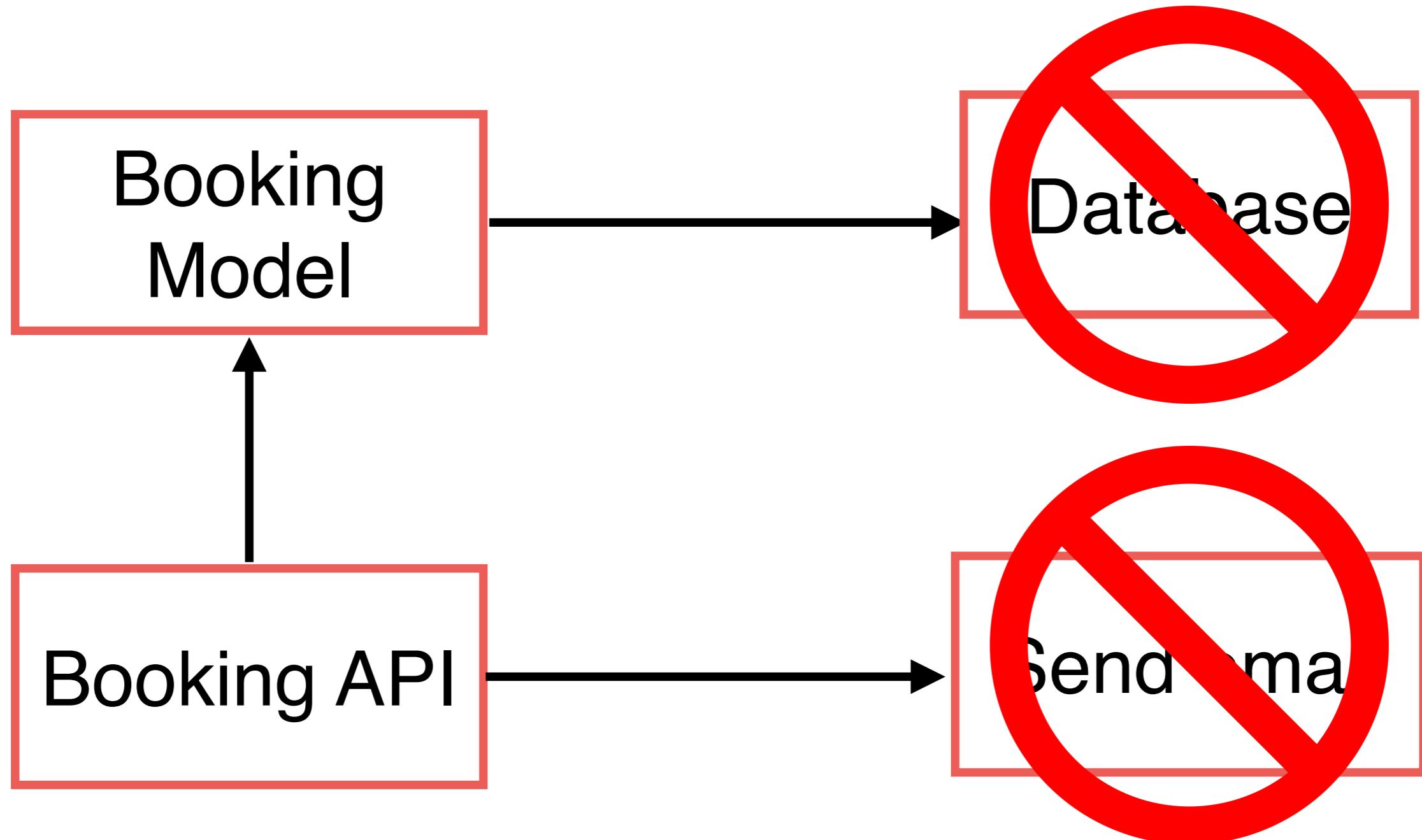
See success result in booking result page



# Testing relationship



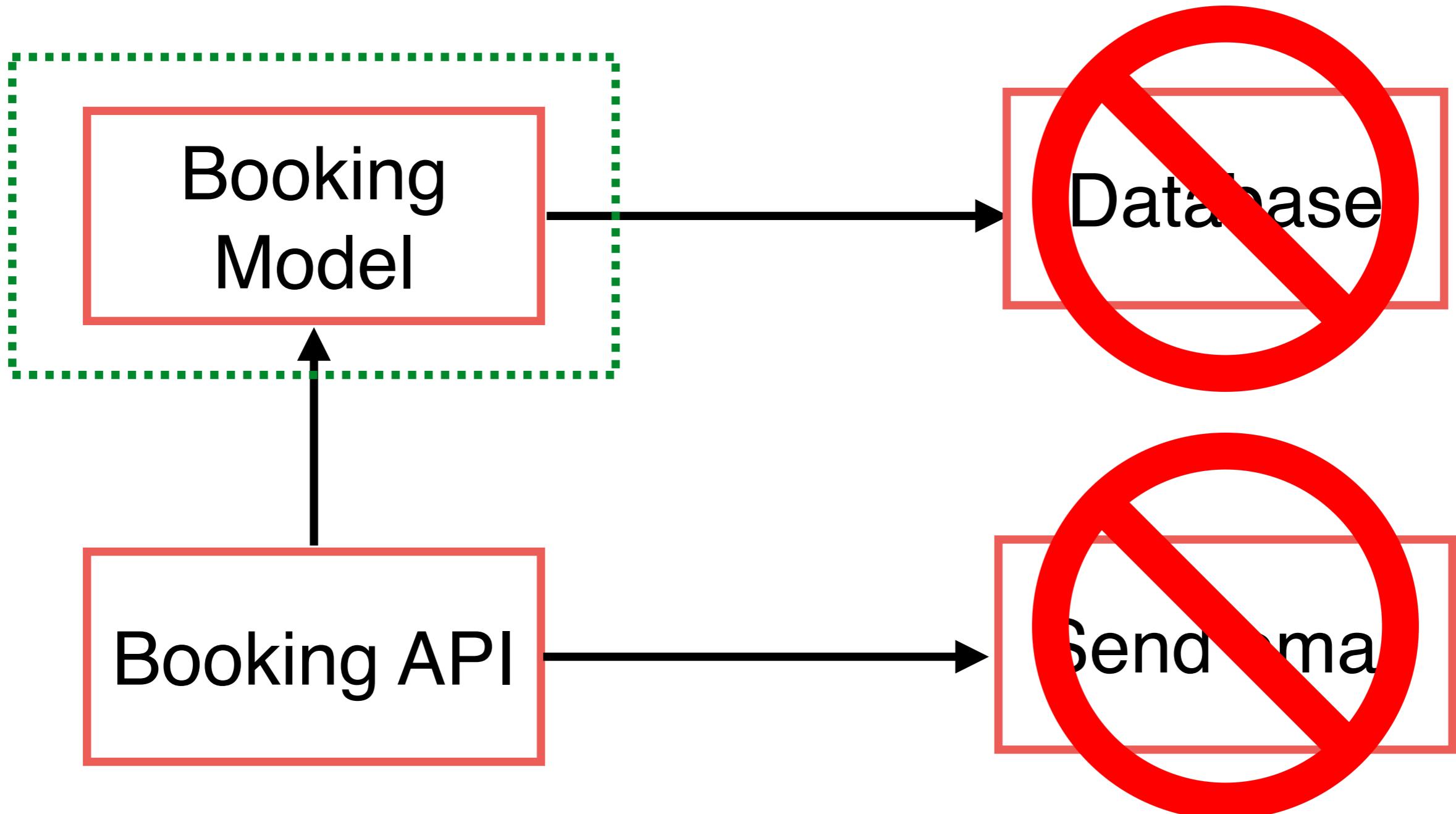
# Testing relationship :: Unit test



# What to tests ?



# Unit test



# Booking Model ?

Schema of data

Data type and formating

Validate data model



# Booking Model ?

Schema of data

Data type and formatting

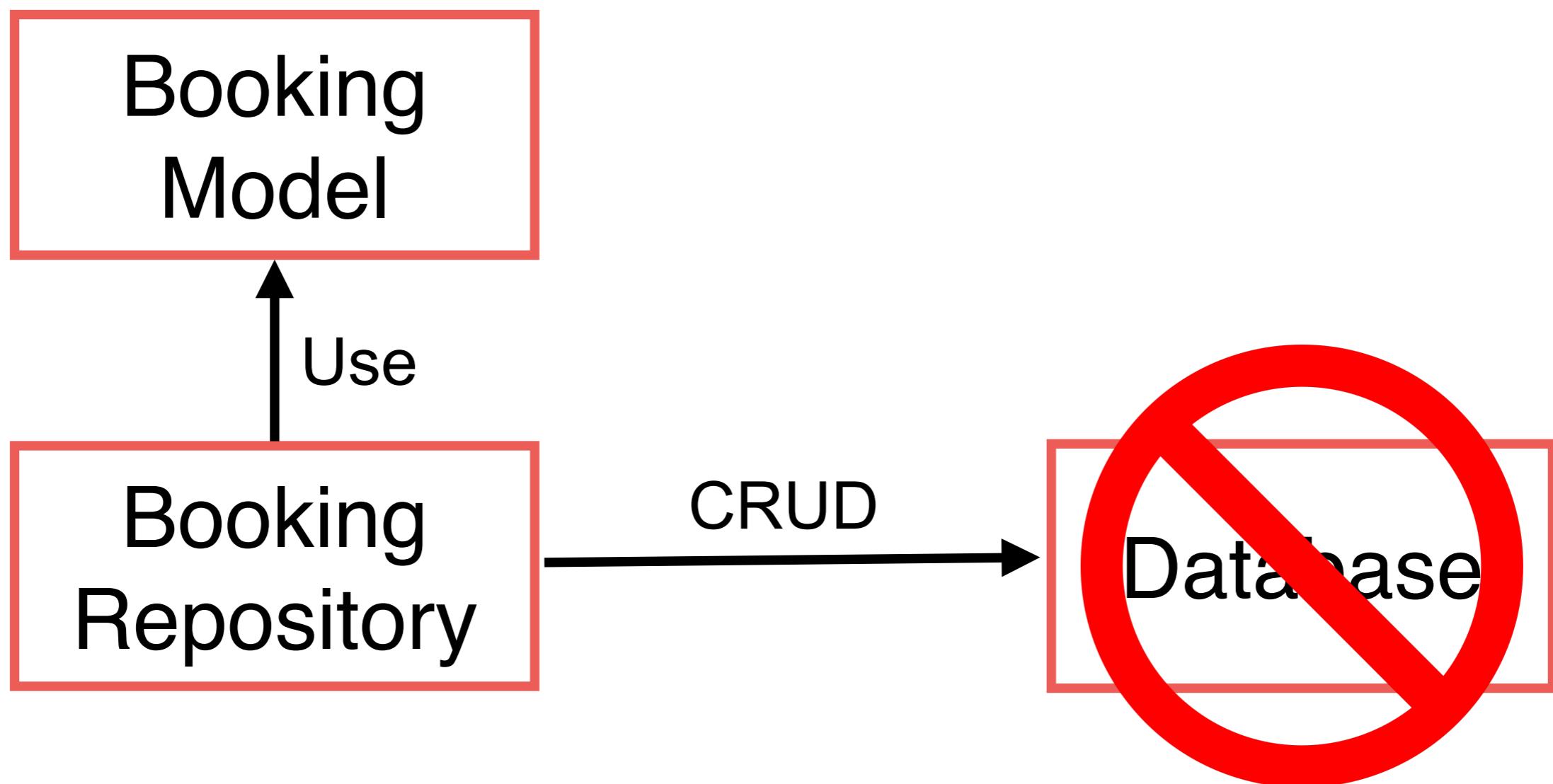
Validate data model

<https://www.npmjs.com/package/joi>



# Working with Database

Using test double



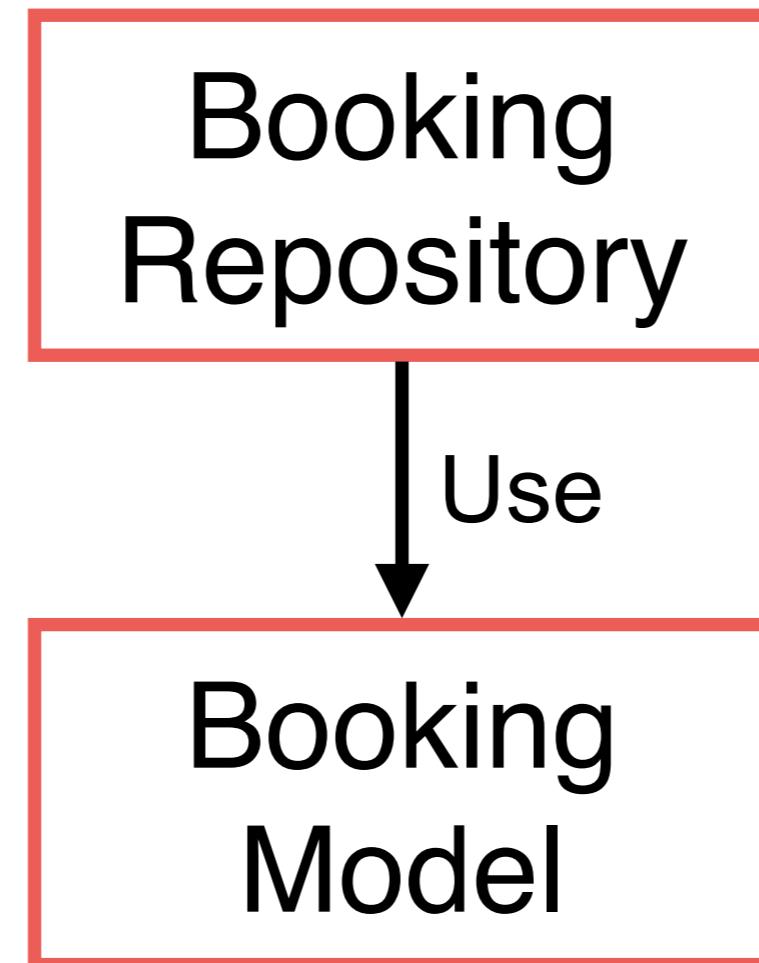
# Booking Repository ?

CRUD with Database  
Validate input

Booking  
Repository

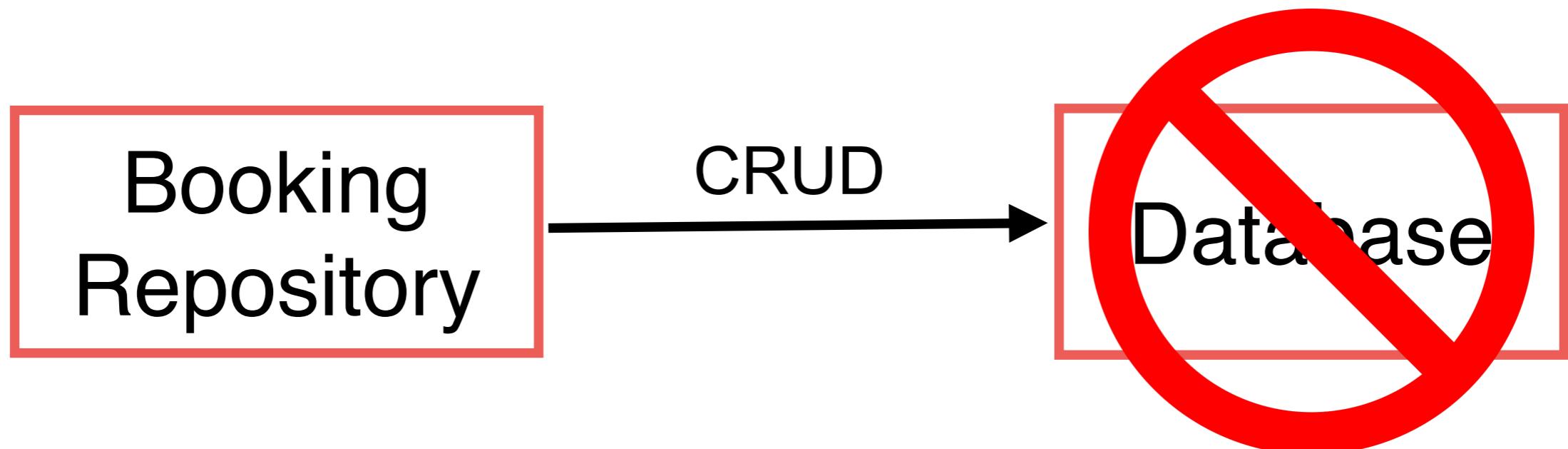


# Validate input ?



# Working with Database

Using test double



# Test double with Node.JS



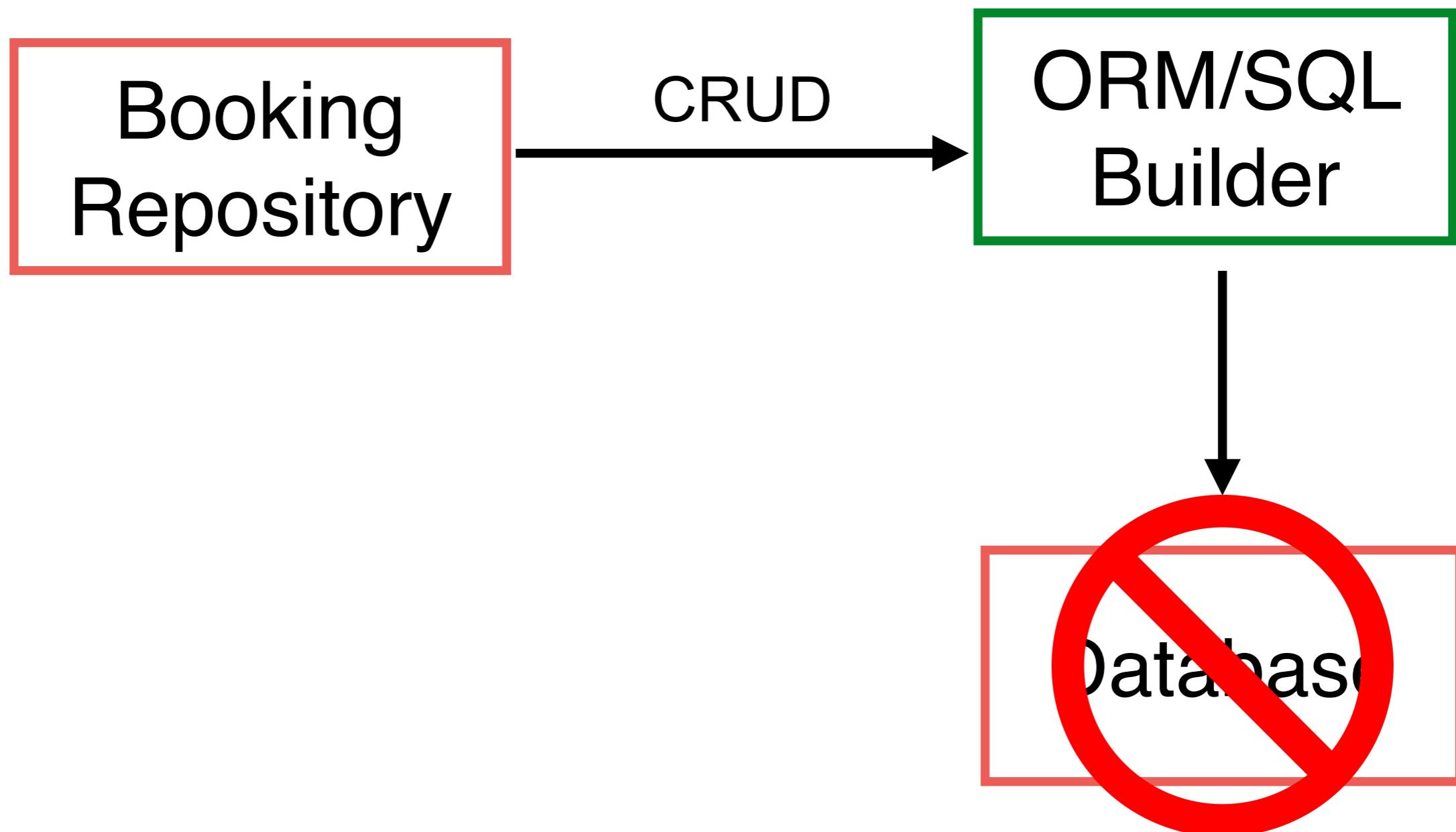
<https://jestjs.io/>



# Working with Database

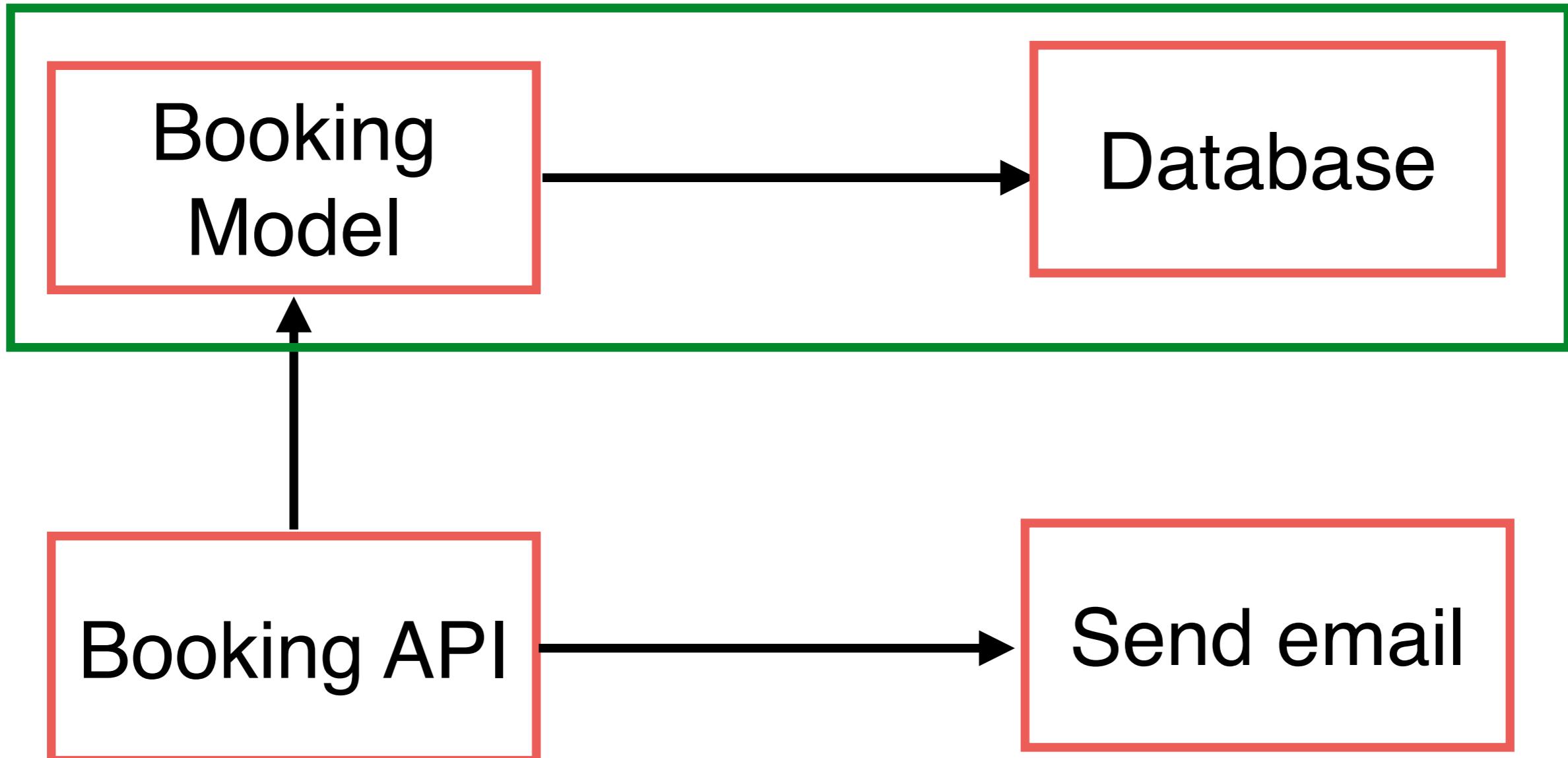
Knex

Sequelize ORM  
TypeORM

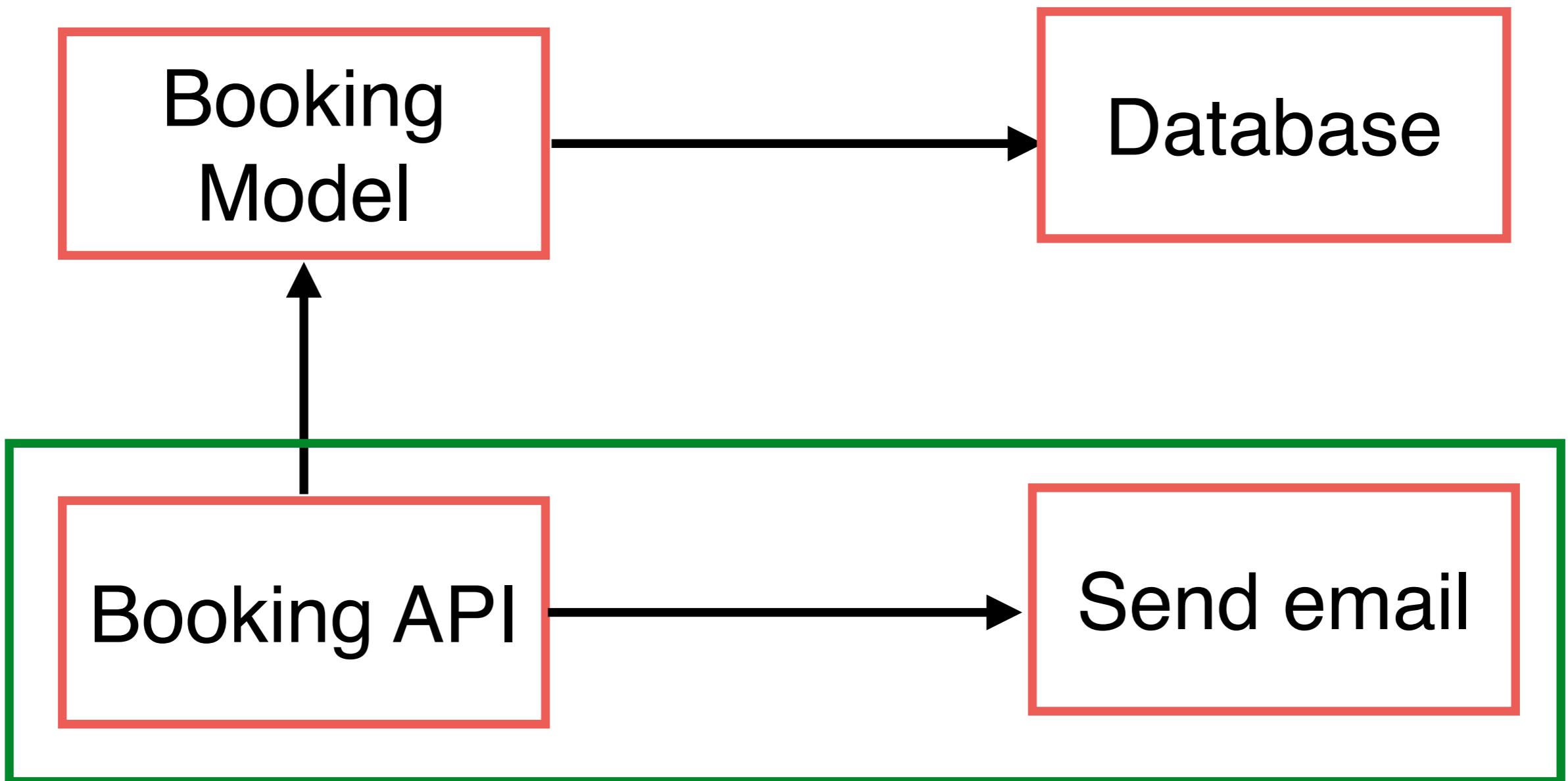


# Testing relationship ::

## Integration test

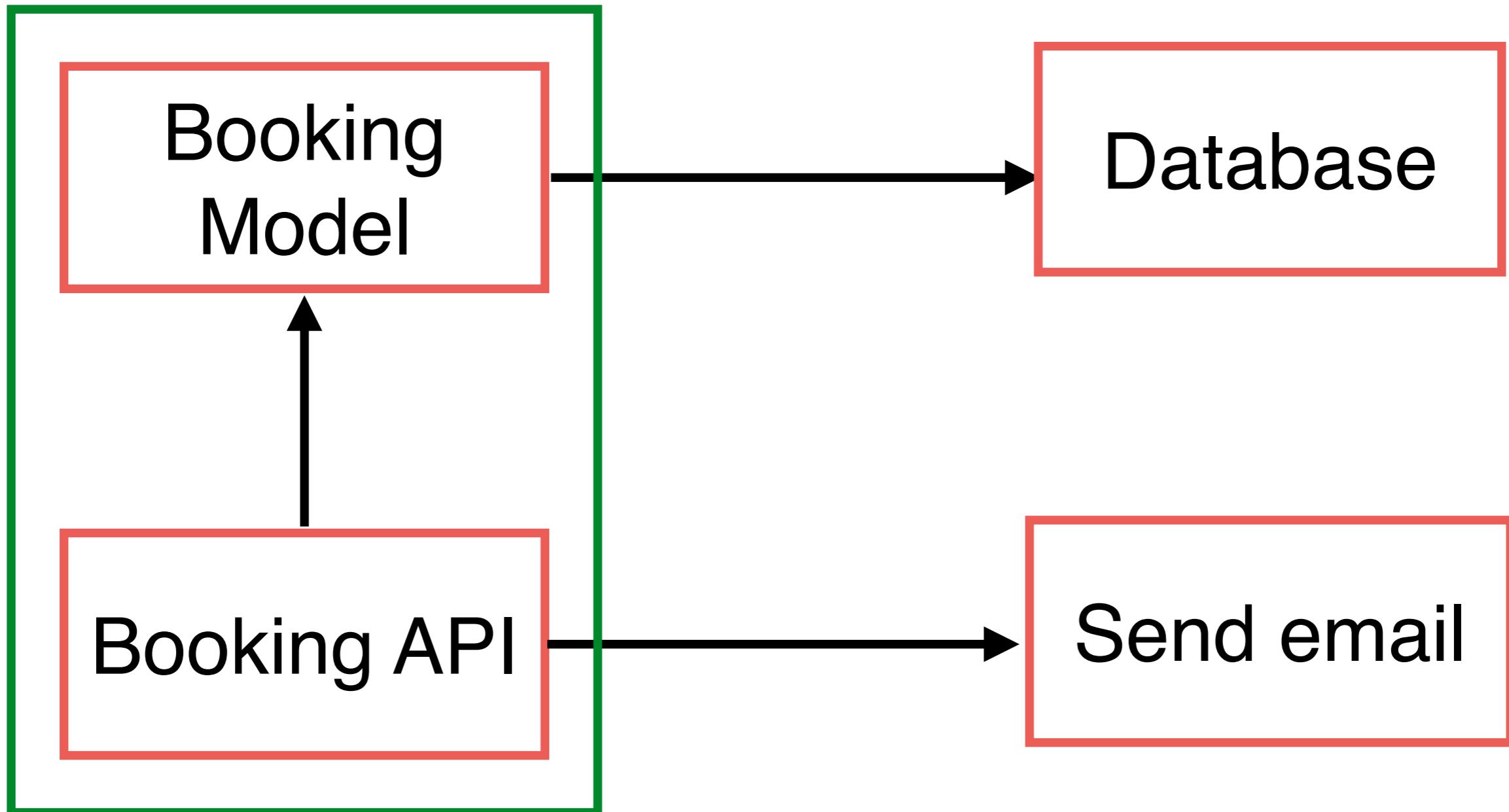


# Testing relationship :: Integration test



# Testing relationship ::

## Integration test



# What to tests ?

