Test-Driven Development Foundations

Yes, you're probably in the right place.

Things you can or should do while waiting on class start:

- Install mob tool. See https://github.com/remotemobprogramming/mob (see "how to install")
- git clone https://github.com/jlangr/tdd-javascript-jest-2021
  - Do an npm install
  - If using IDEA: Import as a project
  - Make sure you can run the tests (see the README.md, package.json)
- Either install Kahoot! on your phone, or navigate to kahoot.it
- Send me your cell # at jeff@langrsoft.com (for disconnect purposes)
  - note my cell #: 719-287-4335

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Test-Driven Development Foundations v1.4

Jeff Langr

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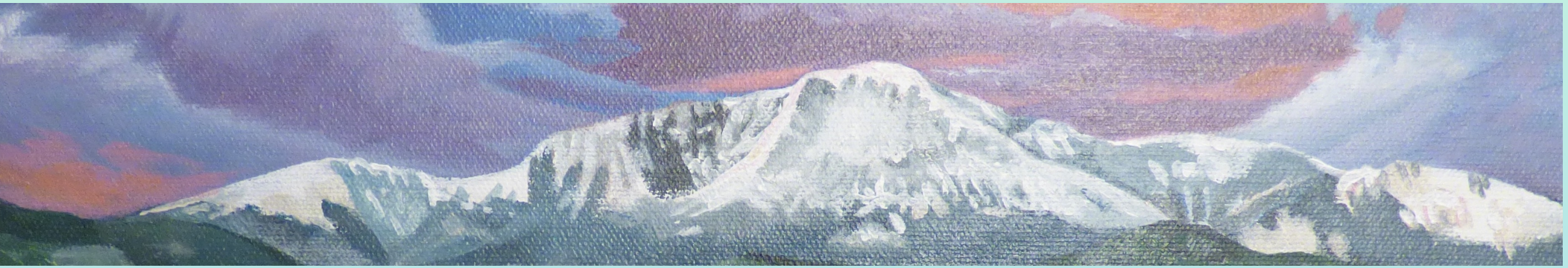
@JLangr



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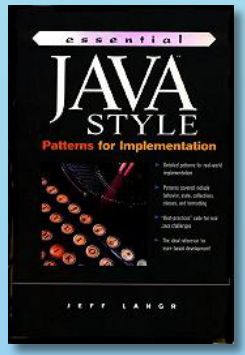
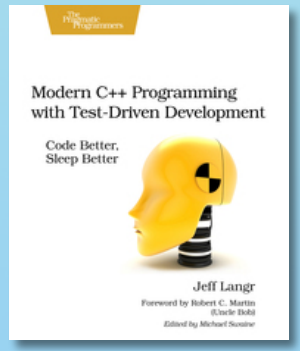
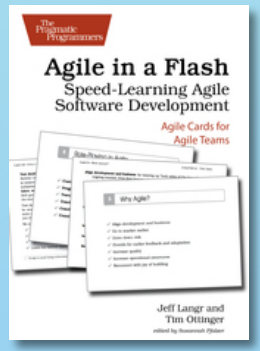
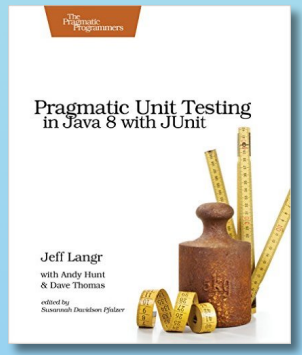
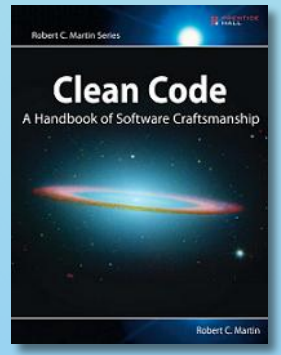
http://langrsoft.com











Overview

TDD fundamentals

Refactoring Tests & Code

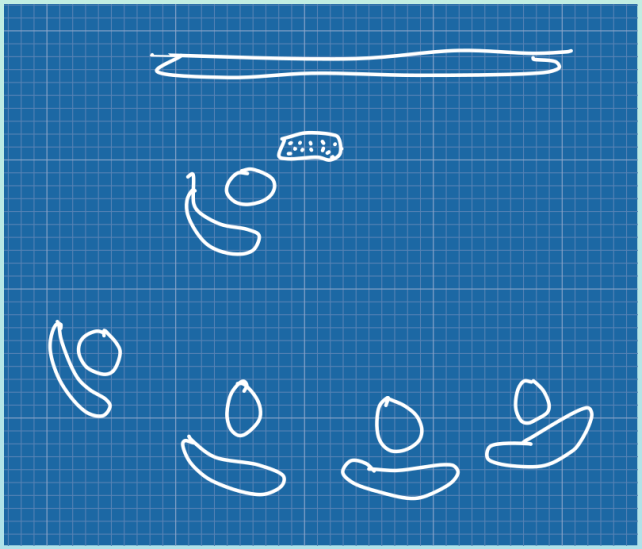
Test doubles (mocks)


Kahoot!

Exercise: Simple Outcomes

Flesh out the tests in ./src/misc/basics.test.js

A Tale of Two Mobbing Rules



Once upon a time, there was a quaint notion of an "office," a physical place where people could undistance and work together…

- Strong-style pairing
- Short, timed rotations

What's a Unit Test Look Like?

```
describe('something', () => {
  it('demonstrates some behavior', () => {
    // Arrange


    // Act


    // Assert
  })
})
```

The AAA mnemonic is courtesy of Bill Wake.

A Sample Unit Test

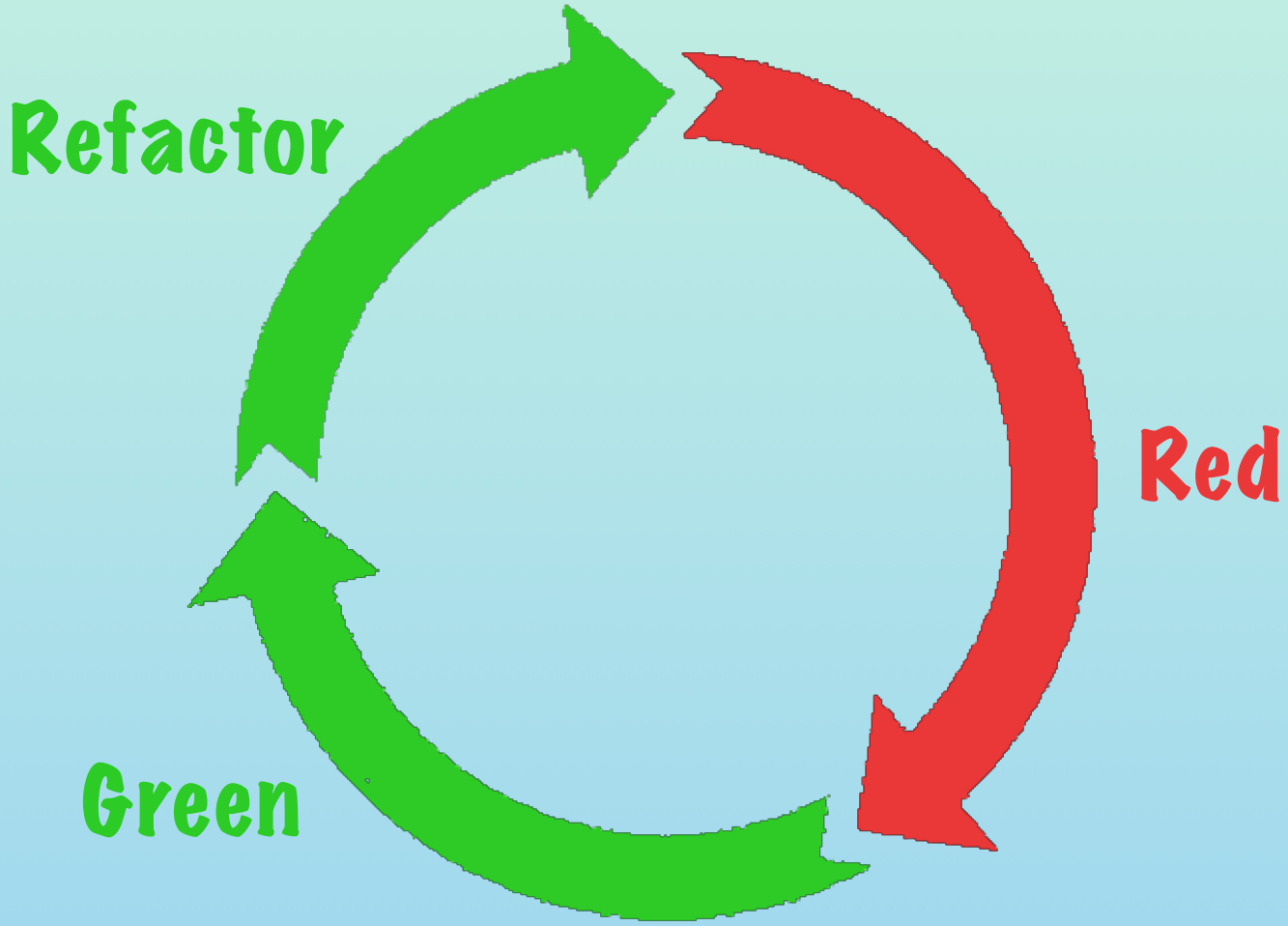
```
describe('an auto', () =>
  const auto = new Auto()

  it('idles engine when started', () => {
    auto.depressBrake()

    auto.pressStartButton()

    expect(auto.RPM()).toBeWithinRange(950, 1100)
  })
})
```

What's an Assertion Look Like?

```
expect(someCondition).toBe(true)
expect(idleSpeed).toBe(1000)
expect(alphabetizedName).toEqual('Schmoo, Kelly Loo')
expect(someArray).toEqual(['O','T','F','F','S','S'])
expect(alphabetizedName).toMatch(/^S.*,/)
expect(idleSpeed).not.toEqual(42)
expect(alphabetizedName).not.toEqual("Smelt"))))
expect(someVariable).toBeUndefined
expect(someArray).toHaveLength(3)
expect(someArray).toContain(42)
expect(someArray).toContainEqual({ name: 'Amit' })
```

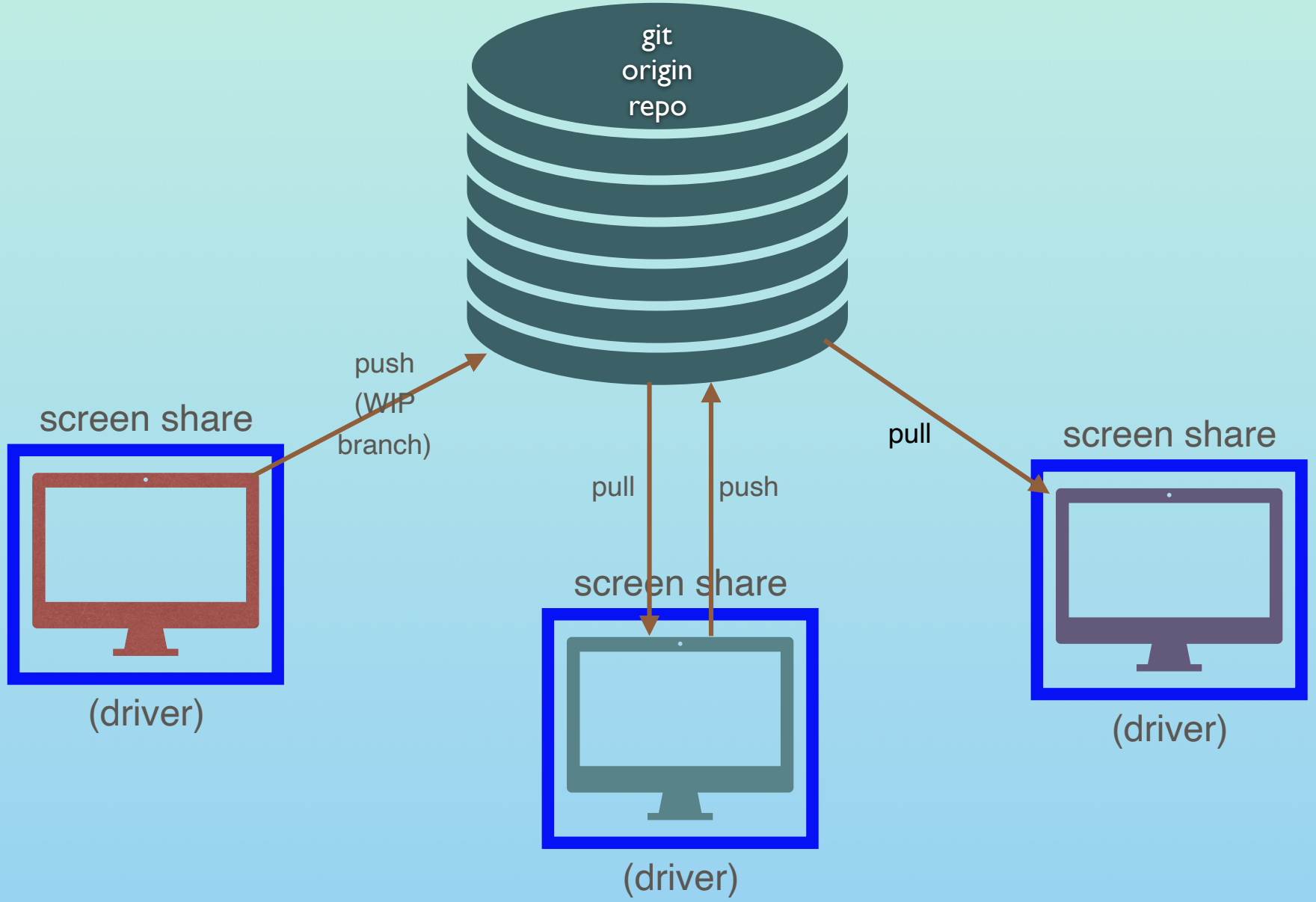
See https://jest-bot.github.io/jest/docs/expect.html

Test-Driven Development

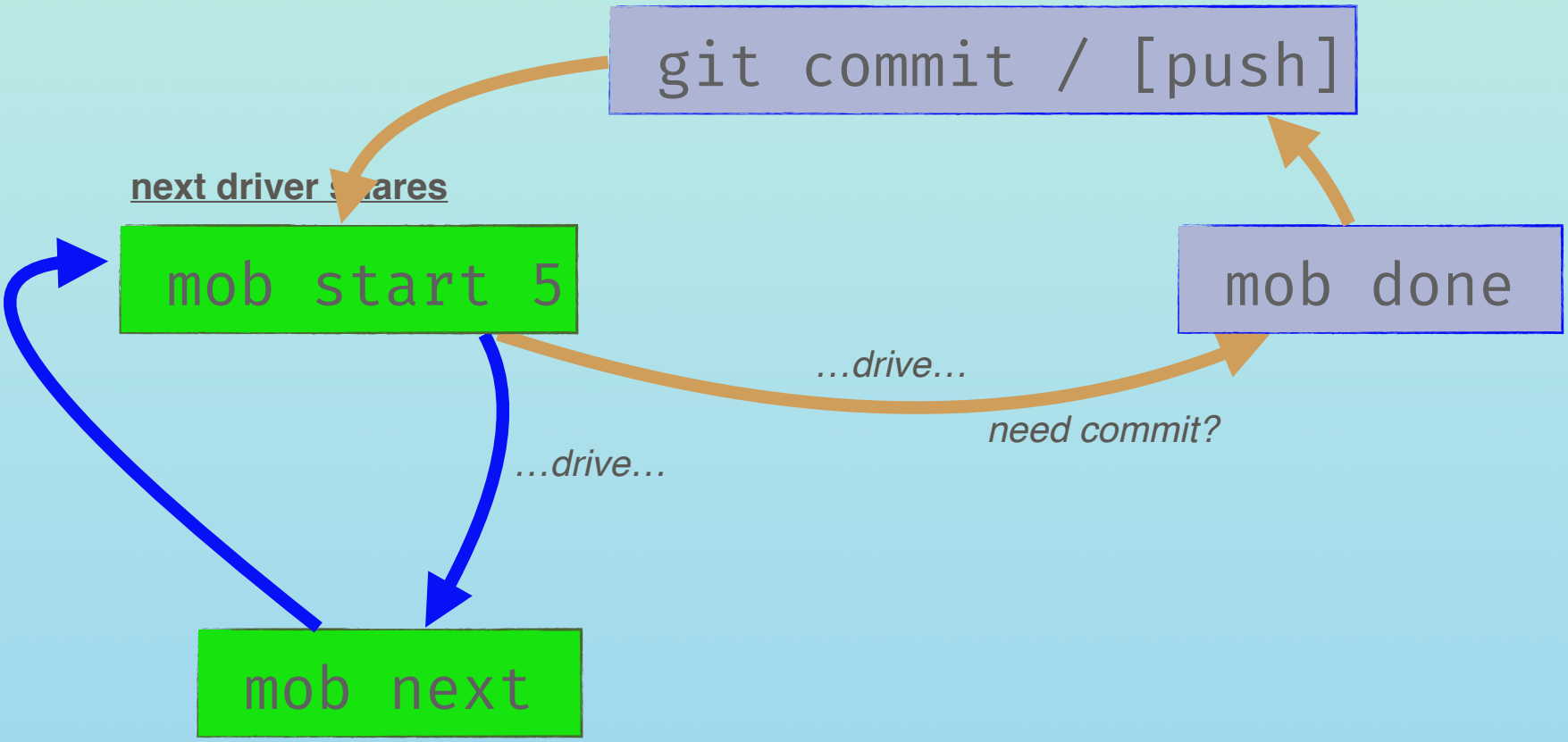


An incremental design technique

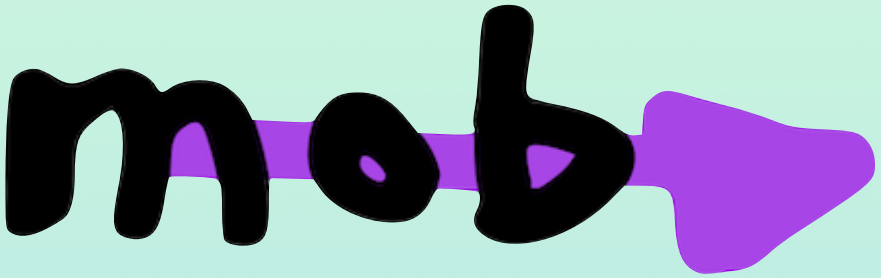
Git handover



Git handover with mob



how about a demo?



flow reminder

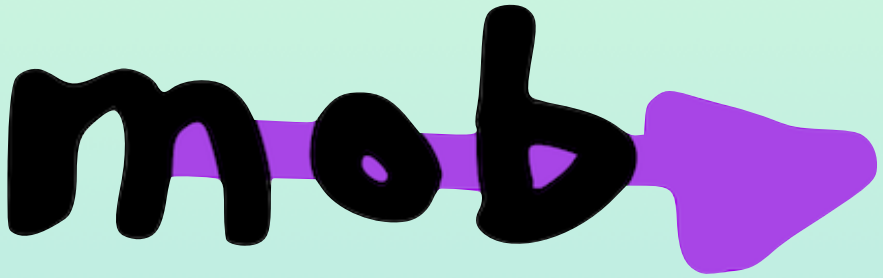
Share screen

git status

mob start 5

listen & drive

mob next



tips

Let mob do the git commands for you

Do a git status when unsure

Learn what the tool does for you

End the day with a commit

Do a mob done to create small commits frequently

Stay calm… it's probably all still there

- Stash / reflog
- Your undo chain won't transfer, though!

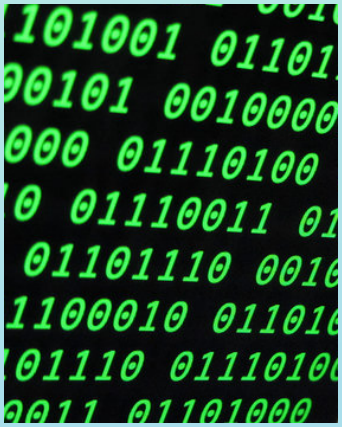
Exercise: (Test)-Code-Refactor

TDD Paint by Numbers

See ./src/misc/name-normalizer.test.js

npm run test:watch

Why???

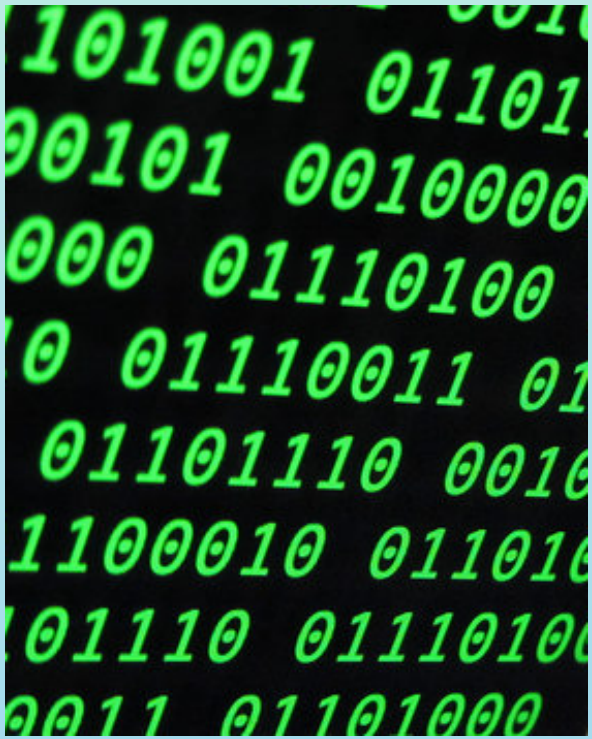


Keep yer code clean

Document choices

Gate defects

Core TDD Themes



- Drive *behavior*
- Specification by example
- Small increments
- Stick to the cycle
  - Always see red
  - Always refactor

It's just code!


Kahoot!

Stepping Back: Writing Tests

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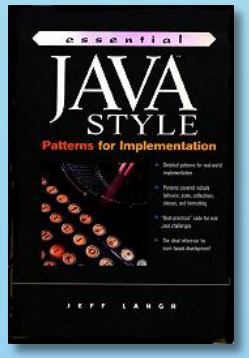
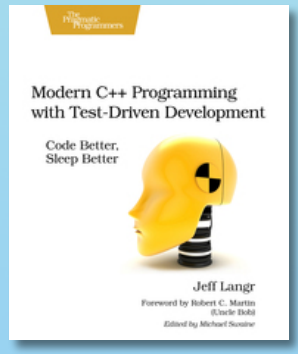
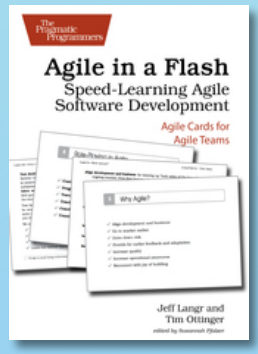
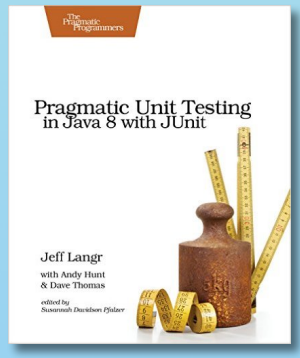
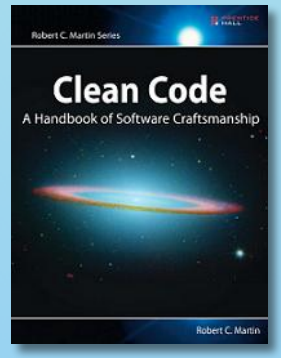










Recent File List

Manage a list of recently-opened files (max: 5) for use in a GUI application.

What tests do we need?

const recents = openFile(existingRecents, filepath)

ZOMBIES!

- **Z**ero
- **O**ne
- **M**any
- **B**oundaries
- **I**nterface definition
- **E**xceptional behavior
- **S**imple Solutions & Scenarios

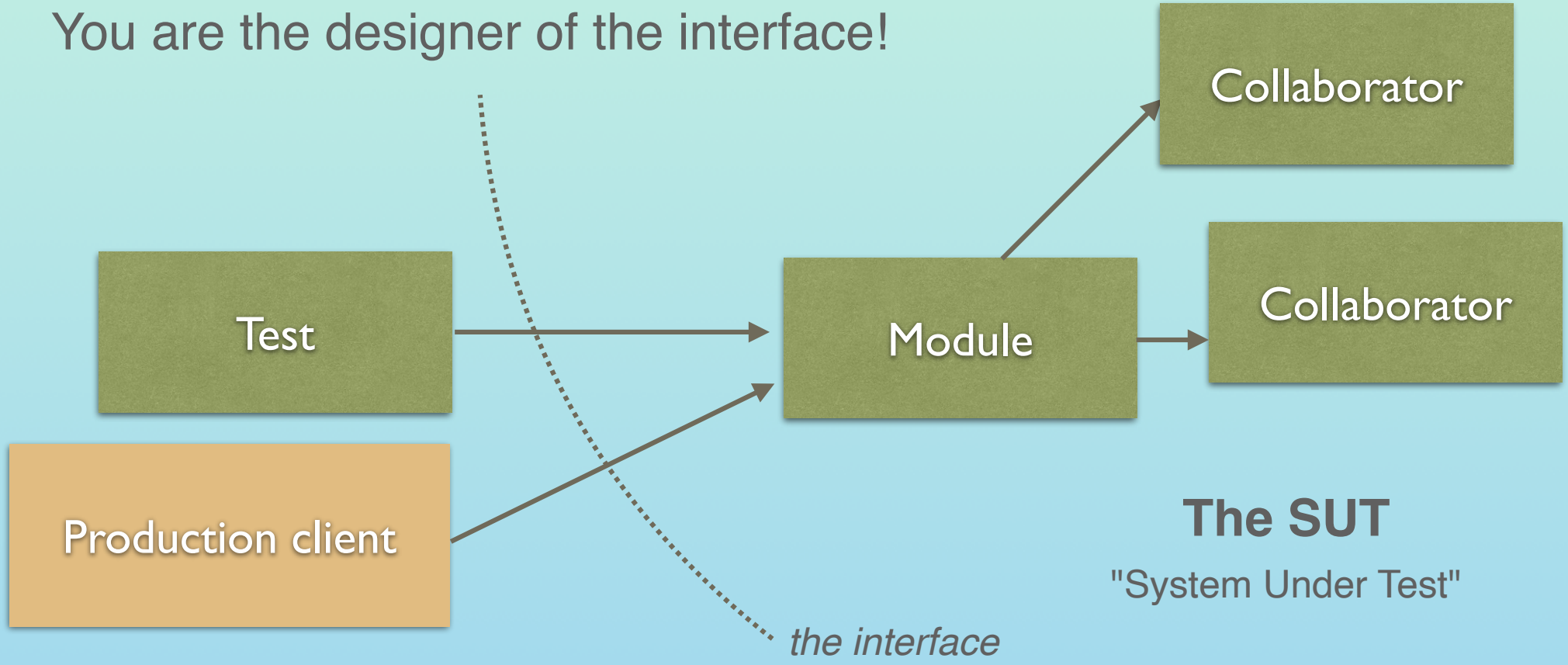
http://blog.wingman-sw.com/archives/677

Test Lists

- **Z**: No files opened
- **O**: One file opened
- **M**: Multiple files opened
- **B**: One more than capacity opened
- **E**: File opened twice

Your Test Is the First Client

You are the designer of the interface!



The SUT

"System Under Test"

Structuring the Test

"sifts duplicate filename to top of recently-used list"

Arrange	Add file with name `opened-A.txt` Add file with name `opened-B.txt` Add file with name `opened-C.txt`
Act	Add file with name `opened-A.txt`

Assert	Expect recently-used list to equal:
	`opened-A.txt`
	`opened-C.txt`
	`opened-B.txt`

Assert-First

Consider working from the outcome.

"sifts duplicate filename to top of recently-used list"

```
expect(recentlyUsedList).toEqual([
  duplicateOfAddedFirst, '3rd', '2nd'])
```

Assert-First

Consider working from the outcome.

"sifts duplicate filename to top of recently-used list"

```
add(recentlyUsedList, duplicateOfAddedFirst)


expect(recentlyUsedList)
  .toEqual([duplicateOfAddedFirst, '3rd', '2nd'])
```

Assert-First

Consider working from the outcome.

"sifts duplicate filename to top of recently-used list"

```
add(recentlyUsedList, '1st')
add(recentlyUsedList, '2nd')
add(recentlyUsedList, '3rd')
const duplicateOfAddedFirst = '1st'


add(recentlyUsedList, duplicateOfAddedFirst)


expect(recentlyUsedList)
  .toEqual([duplicateOfAddedFirst, '3rd', '2nd'])
```

Exercise: Stock portfolio (i1)

- given a symbol and # of shares, make a purchase
- what is the count of unique symbols?

"Tokyo Stock Exchange," courtesy https://www.flickr.com/photos/31029865@N06/
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***** Remember! *****

Red: Ensure test fails

Green: Implement no more code than necessary

Refactor: Clarify and eliminate all duplication

A Functional Implementation

Store portfolio info in a state object:

```
{
  holdings:
  {
    IBM: 20,
    BAYN: 10
  }
}
```

Pass state to each function;
return updated state:

```
const create = () => ({ isEmpty: true })

const portfolio = create()
const newPortfolio = purchase(portfolio, 'BAYN', 42)
```

Ensure your function creates no side-effects!

i.e., **portfolio** should not change

Exercise: Stock portfolio (i2)

- how many shares exist for a given symbol?
- throw an exception when buying <= 0 shares

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***** Remember! *****

Red: Ensure test fails

Green: Implement no more code than necessary

Refactor: Clarify and eliminate all duplication

Exercise: Stock portfolio (i3)

is it empty or not?

How does this relate to the count of unique symbols?

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***** Remember! *****

Red: Ensure test fails

Green: Implement no more code than necessary

Refactor: Clarify and eliminate all duplication

Exercise: Stock portfolio (i4)

given a symbol and # of shares, sell the shares

What should happen when selling all of a symbol?
Or all of all symbols?

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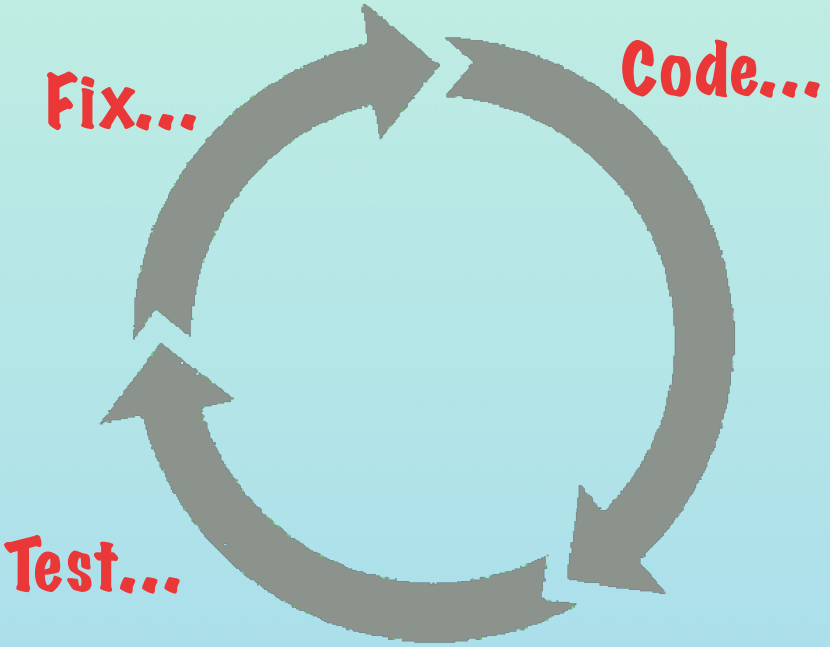
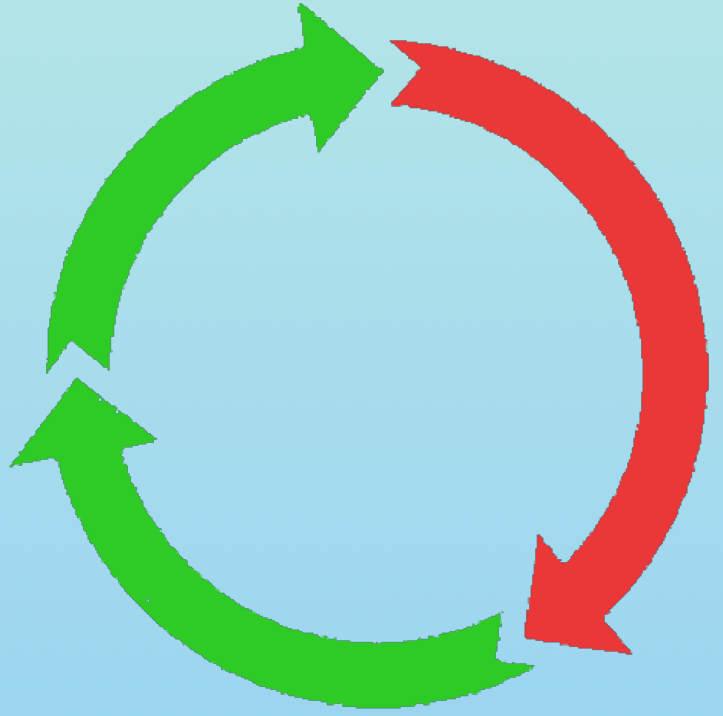
***** Remember! *****

Red: Ensure test fails
Green: Implement no more code than necessary
Refactor: Clarify and eliminate all duplication

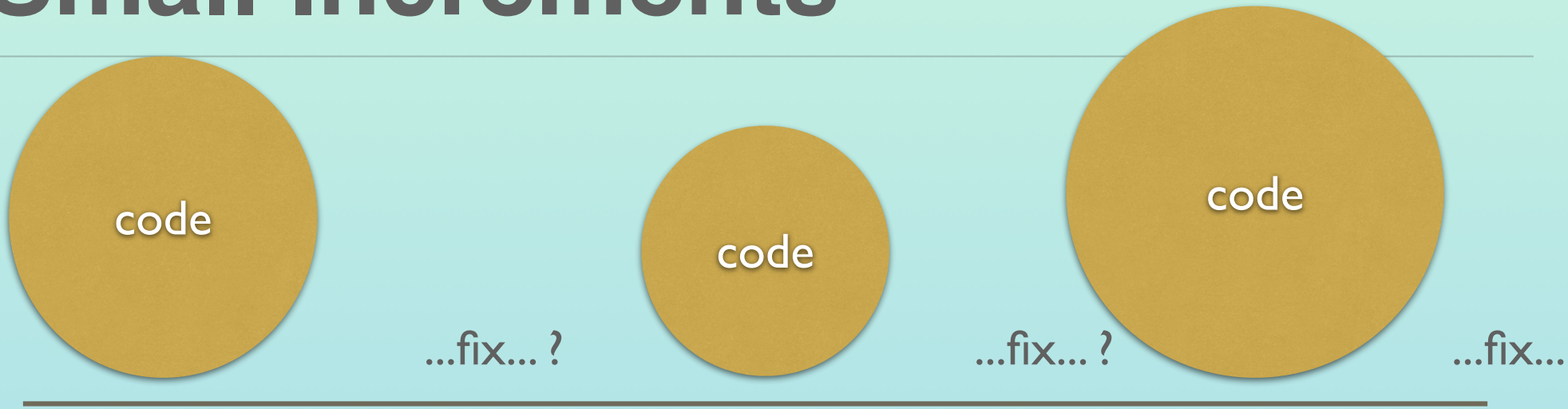
TAD** and TDD: What's the Difference?





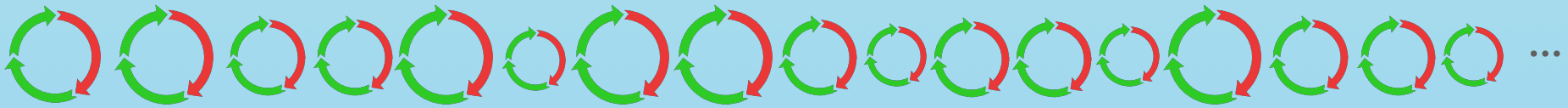
"Test-After Development"

Small Increments



TAD

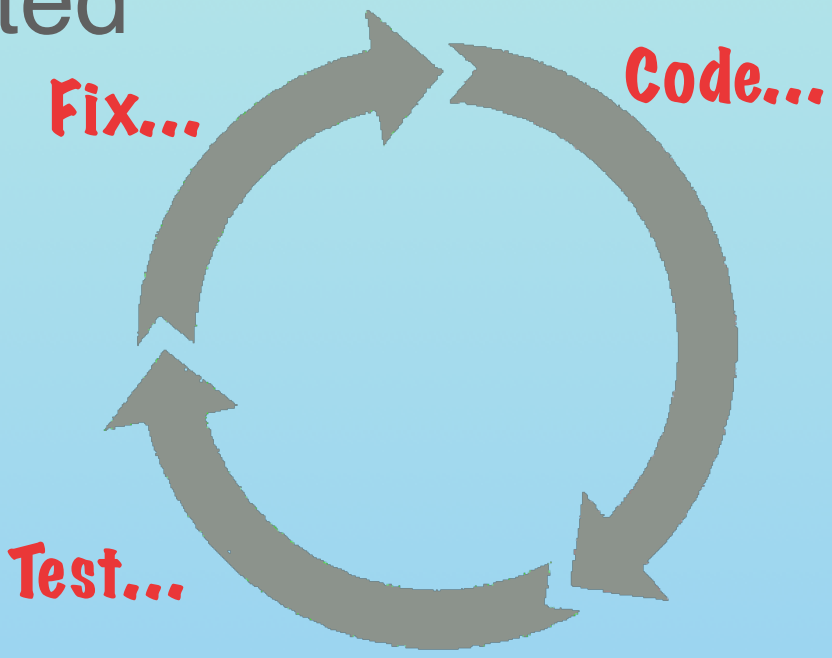
vs.



TDD

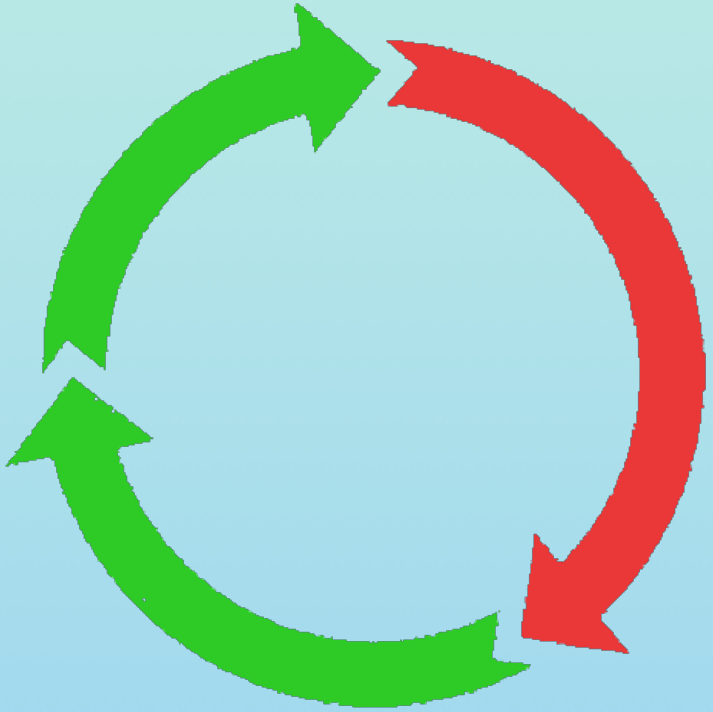
Test-After Development (TAD)

- Some refactoring accommodated
- Coverage: ~70%
- Design not usually impacted
- Some defect reduction
- Separate task?



Test-Driven Development (TDD)

- Continual refactoring
- Coverage for all intended features
- Incremental design shaping
- Significant defect reduction
- Minimized debugging
- Integral part of coding process
- Clarify / document needs / choices
- Continual forward progress
- Consistent pacing
- Continual feedback / learning
- Sustainable




Kahoot!

Katas

http://codekata.com

Other sites:

https://exercism.io

http://cyber-dojo.org

https://sites.google.com/site/tddproblems/

https://www.codewars.com

https://github.com/jlangr/name-normalizer

https://github.com/emilybache

https://projecteuler.net/archives

Roman Numeral Converter

Given a positive integer
from 1 up to 4000,
answer its Roman equivalent

Quick Feedback

How do you feel?

5 Great

4 Good

3 Whatever

2 Eh

1 WTF

Where Does TDD Fit?

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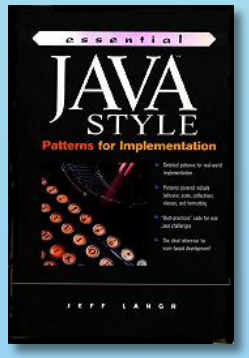

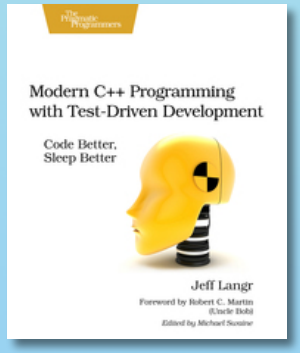

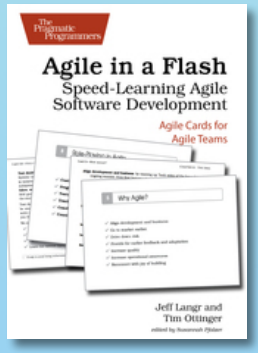

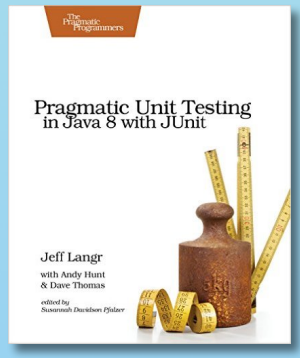

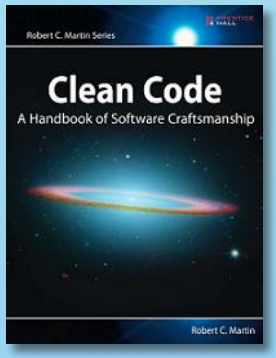

Unit Testing: Insufficient!

Manual Exploratory
(Tester)

UI

AT'S / BDD
(Customer)

"Integration"
(Programmer)

Unit (Programmer)

Cost
per Test

Automated

Eye image: Frank Boston, https://www.flickr.com/photos/fixersphotos/4019797096/
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A Re-leveled Pyramid

Manual Exploratory (Tester)

hours/days

many minutes/hours

UI

up to a couple dozen

Regression Feedback

Acceptance / BDD

minutes/hours

up to a few hundred

Count

minutes

"Integration"

a few dozen

< 10 seconds

Unit ("Fast")

thousands

Automated

Feedback Q's

:-)	What have I learned of value?
%-I	What, if anything, am I unclear about regarding the discussion / exercises?
?:-/	What, if anything, did I find disturbing / disconcerting?

Documenting Unit Behaviors

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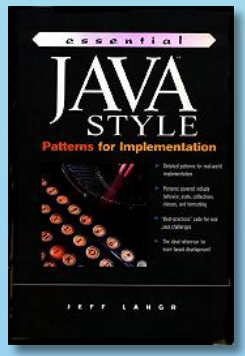
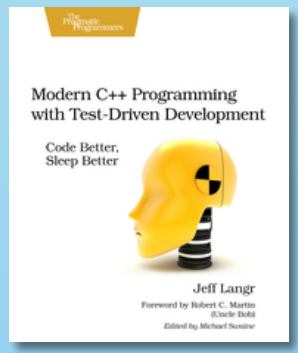
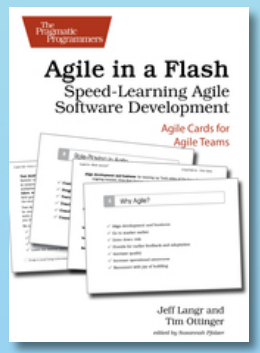
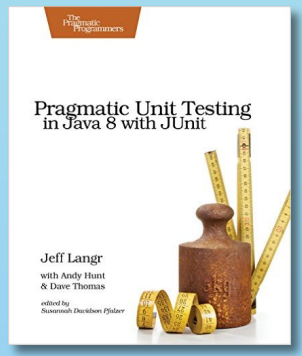
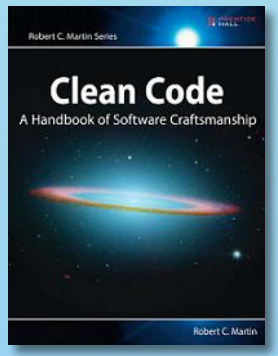










Tests as Documents

what we're describing

the generalized behavior it supports

an example of that behavior

```
describe('an unstarted auto', () => {
  let auto
  beforeEach(() => { auto = new Au
  it('idles engine when started', () => {
    auto.depressBrake()

    auto.pressStartButton()

    expect(auto.RPM()).
      toBeWithinRange(950, 1100)
  })
})
```

Seek to first understand through the tests.

Behavior-Driven Structuring

```
describe('given some context', () => {
  describe('when some event occurs', () => {
    it('then can be verified', () => {

    })
  })
})
```

BDD Structuring Example

```
describe('given a checked-out material', () => {
  let dueDate

  beforeEach(() => {
   dueDate = borrow(AgileJava, PatronId)
  })

  describe('when returned late', () => {
    let daysLate
    beforeEach(() => {
      daysLate = returnMaterial(AgileJava)
    })

    it('is marked as available', () => {})
    it('generates a late fine', () => {})
    it('notifies patrons with hold', () => {})
  })
})
```

Iterative Naming

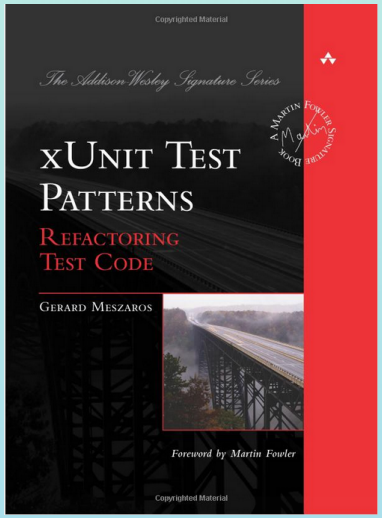
- Re-consider name continually

```
it('x', …

it('verifies engine start', …

it('verifies engine start idle speed', …

it('has low idle on engine start', …
```

- Review often and holistically!

Sustainable Tests

The long answer:



A quicker route:

- Single behavior tests
- AAA
- Correlate result with context
- Test abstraction

Exercise: Test Smells

Find and fix test smells.

Paraphrase cleaned tests
to your pair.

Further instructions: ./src/pos/routes/checkout.test.js


Kahoot!

Continual Design

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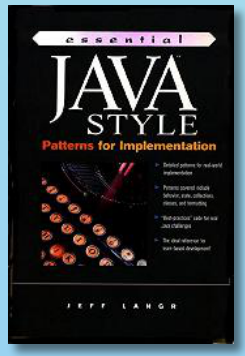
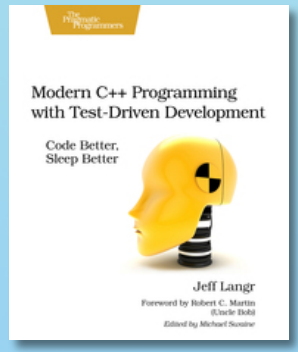
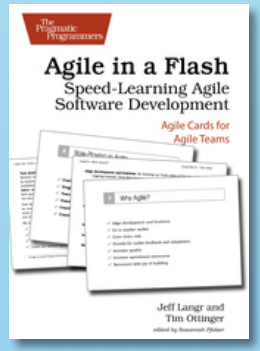
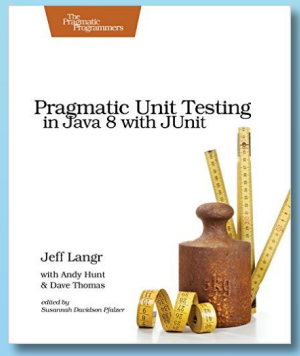
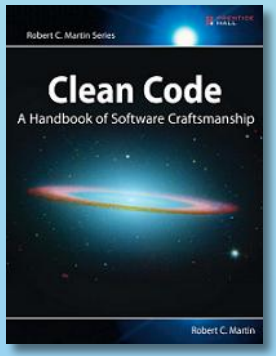




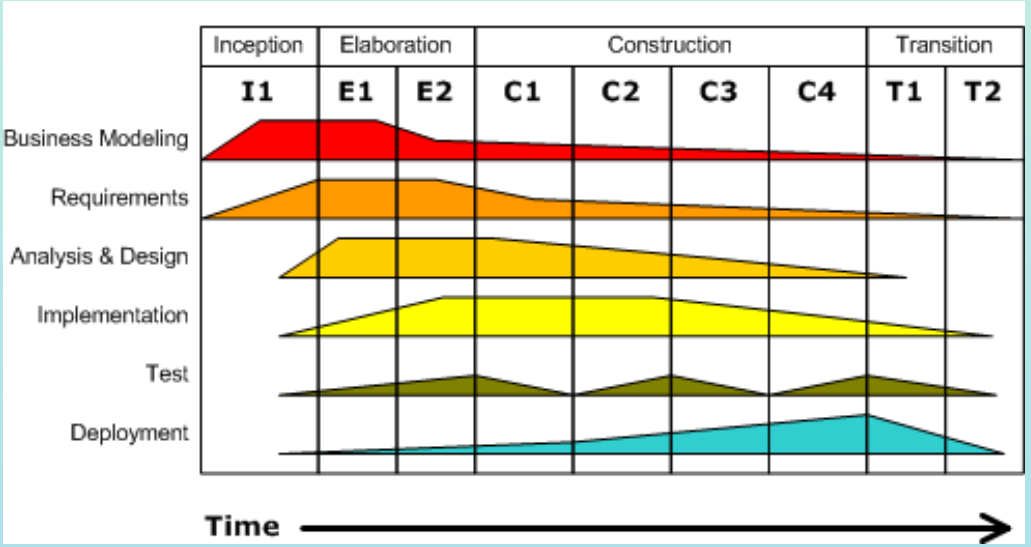






Software Development

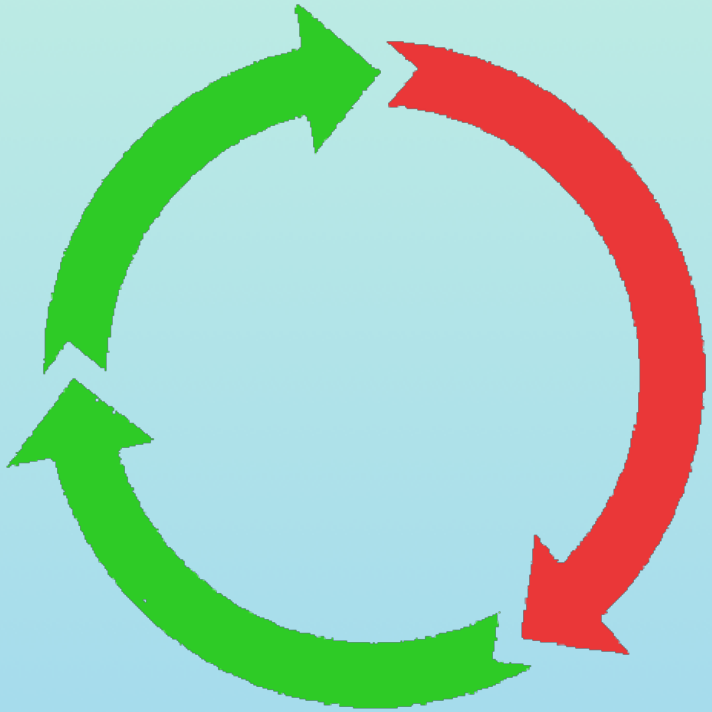
- Activities:
  - Analysis, design, coding, testing, review, documentation, planning, deployment, ...



- Agile:
  - *All activities all the time*

TDD: Continual ...

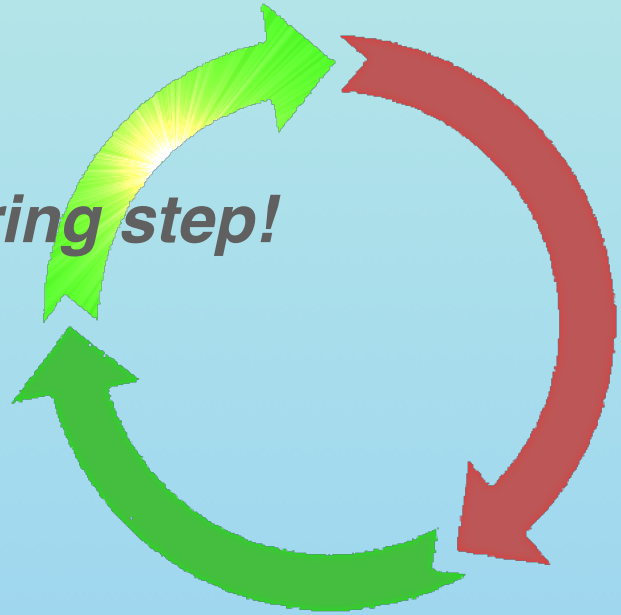
- Testing
- Coding
- Design
- Documentation
- Review



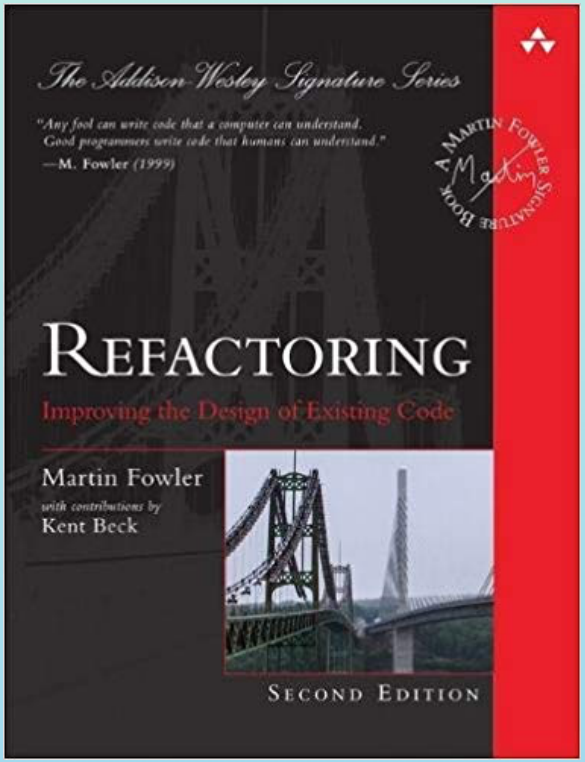
Continual Design

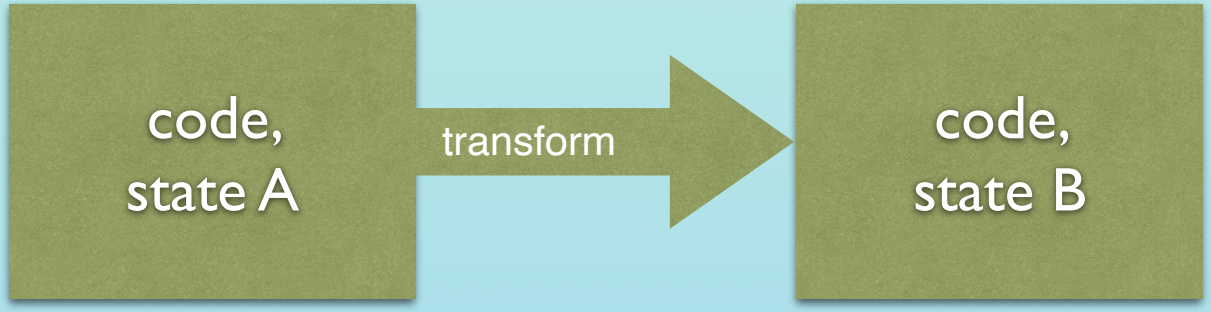
- Always retain an optimal design
- Entropy is unavoidable

Never skimp on the refactoring step!



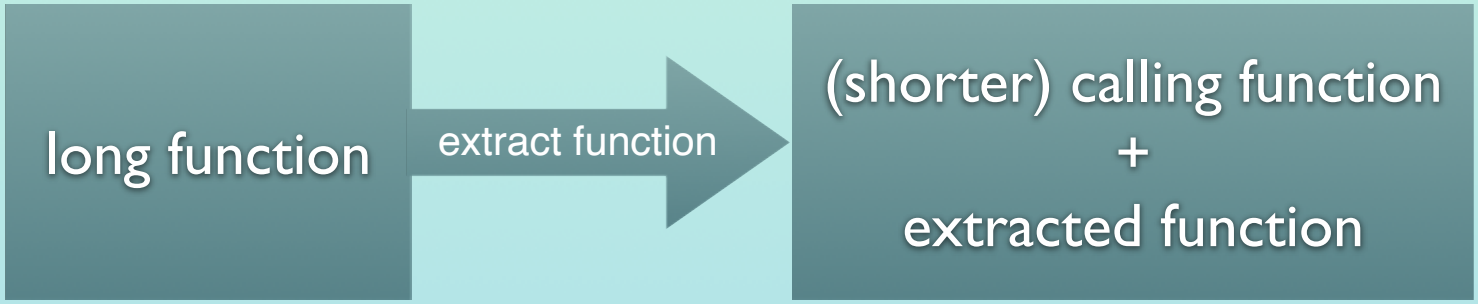
Refactoring





Same *"externally recognized"* behavior

For *(almost)* Every Transform...



Code Smells

An aroma?

- Comments
- Duplicate Code
- Feature Envy
- Large Module
- Long Function
- Long Parameter List
- Primitive Obsession
- Shotgun Surgery
- Speculative Generality
- Switch Statements
- **. . . and many more**

…or a stink?

"A complete code smells reference:"

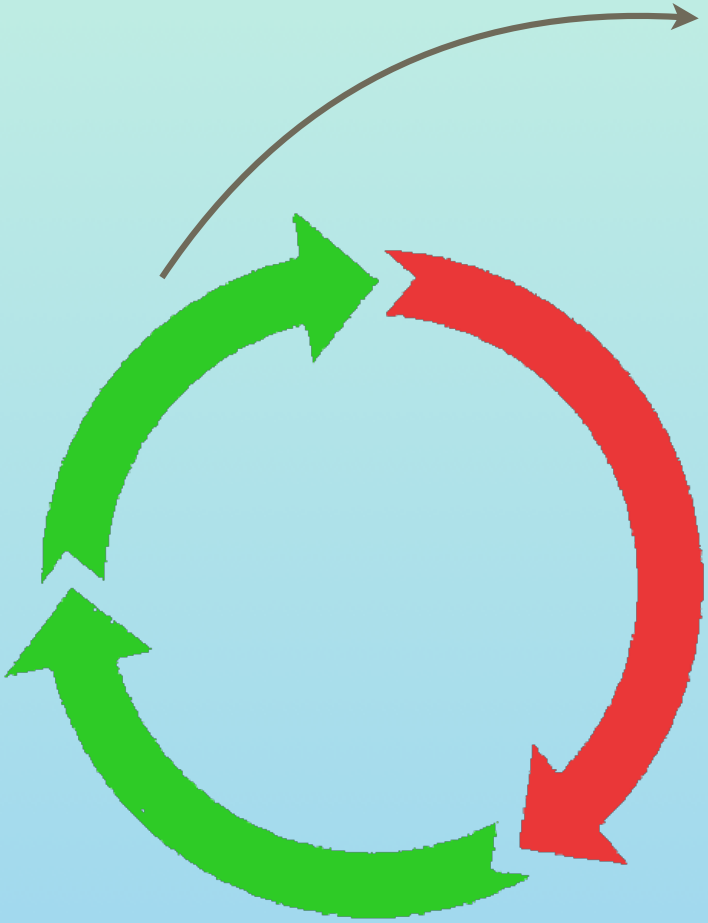
https://github.com/lee-dohm/code-smells

Exercise: Code Smells

Identify code smells.

See ./src/pos/routes/checkout.js

Refactoring Opportunities



small cleanup

verify

small cleanup

verify

...

One thing at a time!

Break things once in a while.

Refactoring: Extract Function

```
const uglyFunction = () => {
   // stuff a
   ...
   // stuff b
   ...
   // some smaller behavior
   doSomething()
   doSomethingElse()
   // ...
   // stuff c
   // ...
}
```

```
const uglyFunction = () => {
   // stuff a   ...
   // stuff b
   ...
   someSmallerBehavior()
   // ...
   // stuff c
   // ...
}

const someSmallerBehavior = () => {
   doSomething()
   doSomethingElse()
}
```

Why?

Single-Line Extract?

```
catch(err) {
  const { sev, system, module, msg } = err
  const errMsg = `${new Date()}: ${system}-${module} ${sev} ${trunc(msg, 80)}`
  log(errMsg)
  throw new Error(errMsg, err)
}
```

```
  catch(err) {
    const { sev, system, module, msg } = err
    const errMsg = formatErrorMessage(sev, system, module, msg)
    log(errMsg)
    throw new Error(errMsg, err)
  }

const formatErrorMessage = (sev, system, module, msg) =>
  `${new Date()}: ${system}-${module} ${sev} ${trunc(msg, 80)}`
```

Exercise: Extract Function

- In ./src/pos/routes/checkout.js
  - Do a single-line function extract on `postCheckoutTotal`
  - Otherwise focus on renaming and eliminating lies

Refactoring-Inhibiting Temp

```
checkout.items.forEach(item => {
  let price = item.price;
  const isExempt = item.exempt;
  if (!isExempt && discount > 0) {
    const discountAmount = discount * price;
    const discountedPrice = price * (1.0 - discount);

    // add into total
    totalOfDiscountedItems += discountedPrice;

    let text = item.description;
    // format percent
    const amount = parseFloat(Math.round(price * 100) / 100).toFixed(2)
    const amountWidth = amount.length;

    let textWidth = LineWidth - amountWidth;
    messages.push(pad(text, textWidth) + amount);

    total += discountedPrice;

    // discount line
    const discountFormatted = '-' + parseFloat(Math.round(discountAmount * 100) / 100).toFixed(2)
    textWidth = LineWidth - discountFormatted.length;
    text = `   ${discount * 100}% mbr disc`;
    messages.push(`${pad(text, textWidth)}${discountFormatted}`);

    totalSaved += discountAmount;
  }
```

Refactoring: Replace Temp With Query

```
      const discountAmount = discount * price;
      // . . .

      // discount line
      const discountFormatted = '-' + parseFloat(Math.round(discountAmount * 100) / 100).toFixed(2)
      textWidth = LineWidth - discountFormatted.length;
      text = `   ${discount * 100}% mbr disc`;
      messages.push(`${pad(text, textWidth)}${discountFormatted}`);

      totalSaved += discountAmount;
```

```
  // discount line
  const discountFormatted =
    '-' + parseFloat(Math.round(discountAmount(discount, price) * 100) / 100).toFixed(2)
  textWidth = LineWidth - discountFormatted.length;
  text = `   ${discount * 100}% mbr disc`;
  messages.push(`${pad(text, textWidth)}${discountFormatted}`);

  totalSaved += discountAmount(discount, price);
  // …
});

const discountAmount = (discount, price) => discount * price;
// . . . . . .
```

Replace Temp With Query

Steps:

- Make temp const
- Extract Function on the rhs
- Replace temp references with the query
- Remove temp

Why?

Concerns?

Can we go the other way?

Exercise: Replace Temp with Query

- In ./src/pos/routes/checkout.js
  - Apply Replace Temp with Query in `postCheckoutTotal` as appropriate
  - Extract as many additional functions as you can

Code Smell: Feature Envy

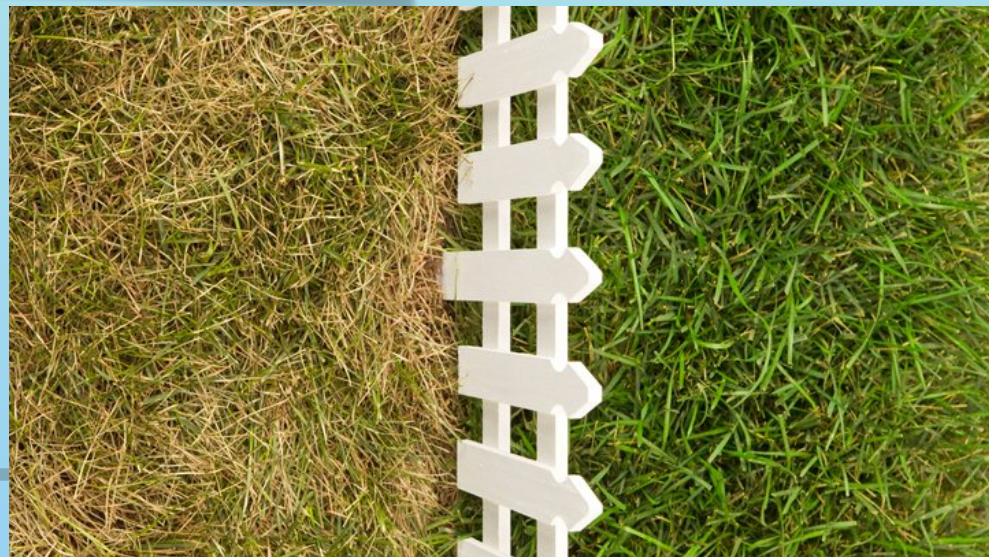
```
import * as GreenerGrass from './otherside'

const thisSideFunction = () => {
  const x = helperFunction(someValue)
  ...
}

const helperFunction = someValue => {
  const result = GreenerGrass.doStuff(someValue)
  const newResult = GreenerGrass.doMoreStuff(result)
  return GreenerGrass.answer(newResult)
}
```

thisside.js

What's the problem?



Refactoring: Move Function

```
import * as GreenerGrass from './otherside'

const thisSideFunction = () => {
  const x = GreenerGrass.helperFunction(someValue)
  ...
}
```

thisside.js

```
export const homebodyMethod = someValue => {
  const result = doStuff(someValue)
  const newResult = doMoreStuff(result)
  return answer(newResult)
}
```

otherside.js

What must you also do when you move a function?

Exercise: Move Function

- In ./src/pos/routes/checkout.js
- Move at least 2 envious functions to better (or new!) homes
- Ensure you've added documentation (i.e tests)!

Planning: Up-Front Design

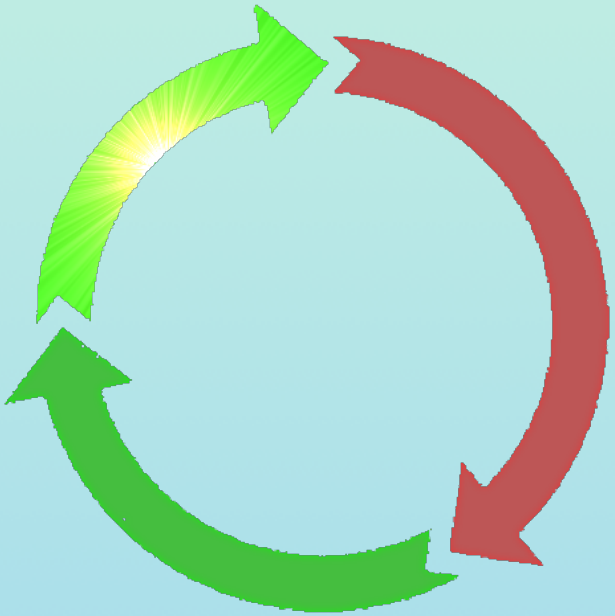
- Not just once!
  - Planning: project, release, iteration, day, task, test
  - Any estimation
- **Minimal**: sketches & conversations
  - Not detailed specs

Premature Generalization

- Need might never materialize
- Details might change
- Interim complexity $

Refactoring Guidelines

Never skip!



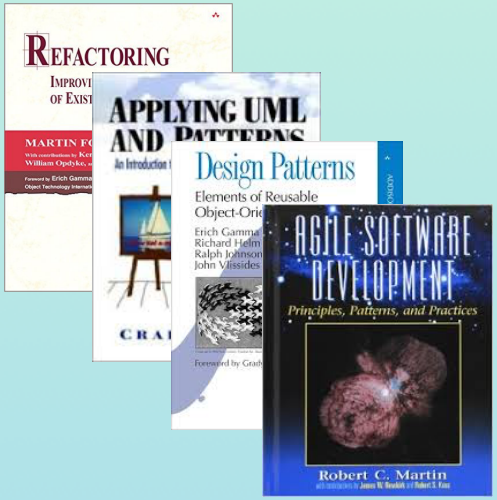
Single-goal

Run *all* tests

It's your responsibility

Design Drivers / Guidelines

- Code smells
- SOLID
- Design patterns
- GRASP
- Simple design
- DRY
- ...

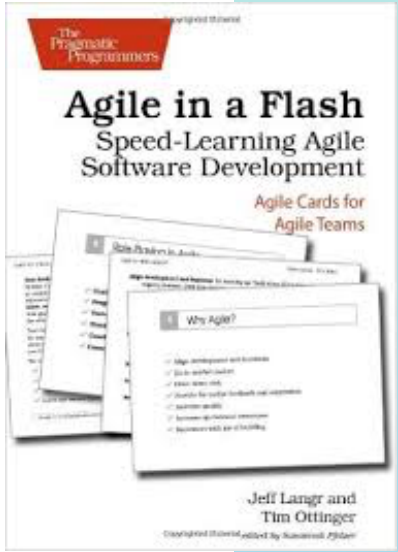


It's all good!

Does everything point to the same place?

41 Build Superior Systems with Simple Design

- All tests must pass
- No code is duplicated
- Code is self-explanatory
- No superfluous parts exist



Kent Beck's (ordered) rules for emergent design

Exercise: Simple Design Rules

- In ./src/pos/routes/checkout.js
  - Stamp out duplication!
  - Strive for rapid readability
  - Have you gone too far?


Kahoot!

Test Doubles

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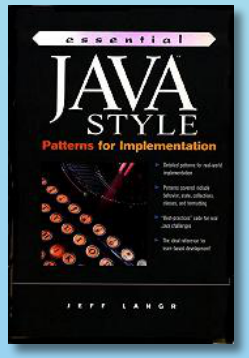
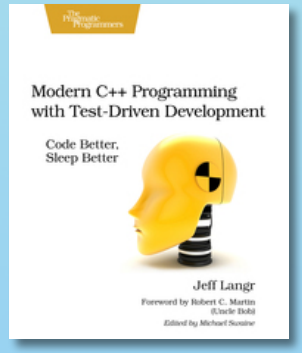
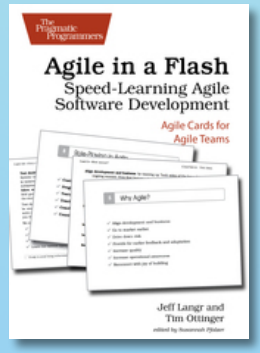
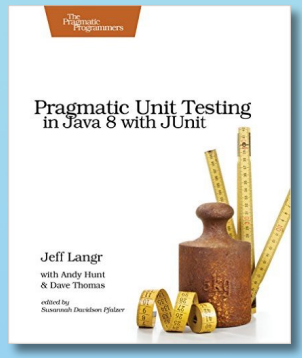
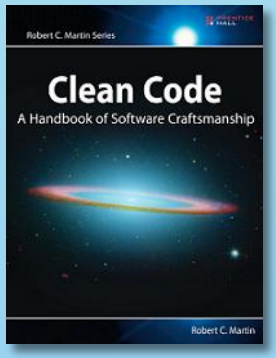


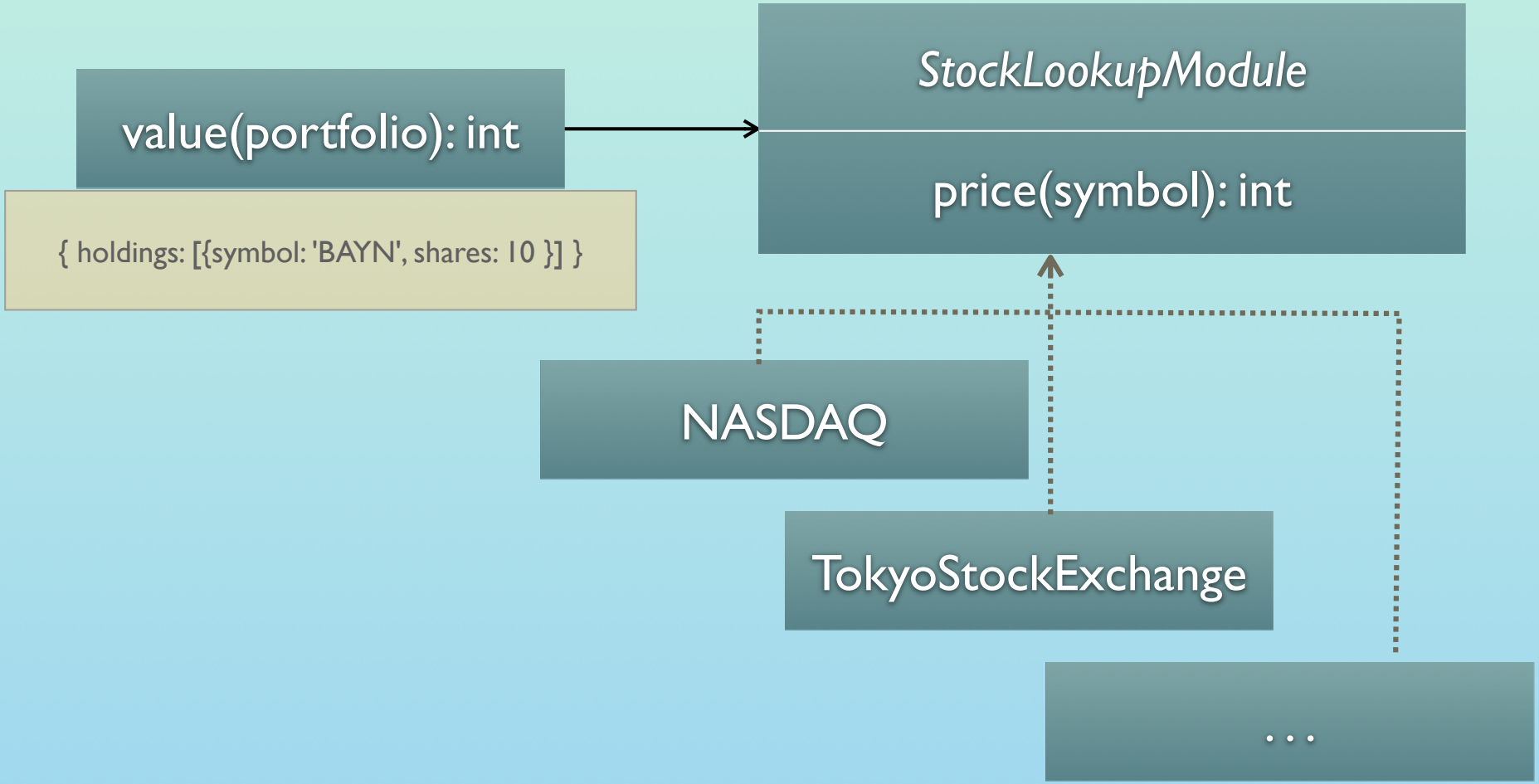




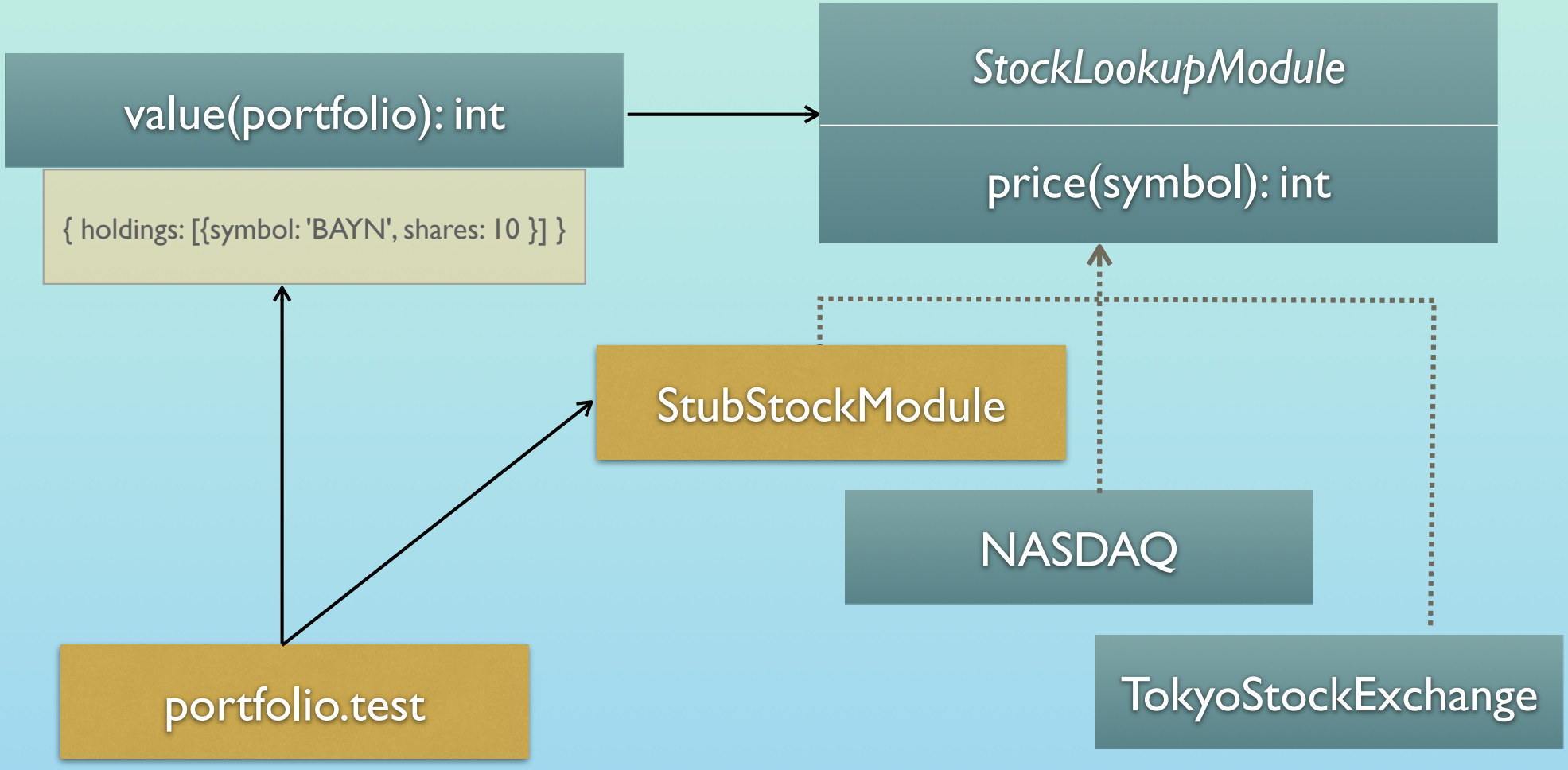




Testing Challenge: Portfolio



Using a Test Double



Portfolio Code

Test-Driving from portfolio.test.js:

```
import * as StockLookupService from './stock-lookup-service'

describe('portfolio value with stub', () => {
  it('is symbol price for single-share purchase', () => {
    portfolio = purchase(portfolio, 'IBM', 1)
    expect(value(portfolio)).to.equal(42) // how to make this work?
  })
})
```

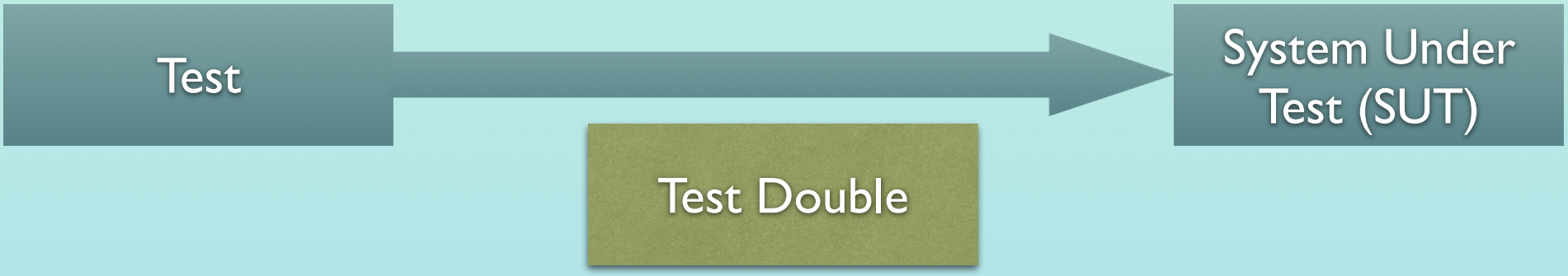
Some notion of an implementation in portfolio.js:

```
import { symbolLookup } from './stock-lookup-service'
export const value =
  portfolio => symbolLookup(Object.keys(portfolio.holdings)[0])
```

The troublesome dependency in stock-lookup-service.js:

```
export let symbolLookup = _symbol => { /* prod code */ }
```

Test Double Injection Techniques



Functional

Function argument

import * Function Override

exports injection

OO

Constructor / setter

Prototype

Method override

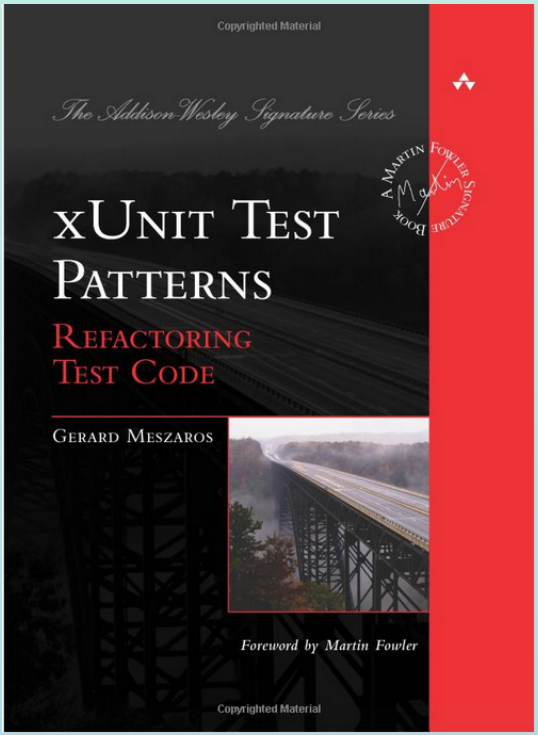
Test Double Terms

Stub: dumb emulation

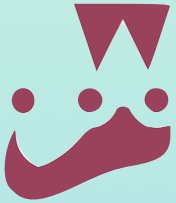
Spy: captures values to verify

Mock: self-verifies

Fake: whole collaborator emulation



Mock Tools



History suggests more & changes coming!

Jest: A Simple Stub

https://jestjs.io

What if the cities are ordered differently?

```
const temperatureServerStub = jest.fn()
temperatureServerStub.mockReturnValueOnce(96)
temperatureServerStub.mockReturnValueOnce(88)

const result = averageTemp(['Miami', 'St. Louis'], temperatureServerStub)

expect(result).toEqual(92)
```

```
export const currentTemperature = _city => {
  throw Error('server down')
}

export const averageTemp = (cities, currentTemperature) => {
  return cities
    .map(city => currentTemperature(city))
    .reduce((sum, temp) => sum + temp, 0) / cities.length
}
```

jest-when

https://github.com/timkindberg/jest-when

```
import { when } from 'jest-when'
// ...
const temperatureServerStub = jest.fn()
when(temperatureServerStub).calledWith('Miami').mockReturnValue(96)
when(temperatureServerStub).calledWith('St. Louis').mockReturnValue(88)

const result = averageTemp(['Miami', 'St. Louis'], temperatureServerStub)

expect(result).toEqual(92)
```

npm install --save-dev jest-when

Mocks Are Trackers

https://jestjs.io/docs/en/mock-function-api.html

`mockFn.mock.calls`: list of arguments for all calls to `mockFn`

`mockFn.mock.results`: list of results for all calls to `mockFn`

jest.fn() shorthand

```
jest.fn(() => doSomething())
```

is equivalent to:

```
jest.fn().mockImplementation(() => doSomething())
```

Exercise: Jest Stubs

Test-drive the `value()` function for your Portfolio solution, using Jest for stubs.

Jest: Exceptions

```
it('answers 0 when price retrieval throws', () => {
  const portfolio = {}
  purchase(portfolio, "BAYN", 1)

  const priceRetrieveStub =
    jest.fn(() => { throw new Error() })
  const result = value(portfolio, priceRetrieveStub)

  expect(result).toEqual(0)
})
```

Exercise: Jest Exceptions

When calculating the portfolio value,
use zero dollars for the current stock price
if the symbol lookup throws an error.

Verifying a "Tell" (*aka* Spying)

How to test-drive?

```
const sell = (portfolio, symbol, shares, auditor) {
  portfolio[symbol] -= shares
  auditor('sell made')
}
```

```
const portfolio = {}
purchase(portfolio, "BAYN", 10)
const auditorSpy = jest.fn()

sell(portfolio, "BAYN", 3, auditorSpy)

expect(auditorSpy).toHaveBeenCalled()
```

Jest: Was It Called?

```
expect(mock).toHaveBeenCalled()

expect(mock).toHaveBeenCalledTimes(2)

expect(mock).toHaveBeenCalledWith(arg1, arg2, ...)

expect(mock).toHaveBeenCalledWith(1, arg1, arg2, ...)
expect(mock).toHaveBeenCalledWith(2, arg1, arg2, ...)

expect(mock).toHaveReturned() // i.e. did not throw error
expect(mock).toHaveReturnedWith('some value')

expect(mock).toHaveLastReturnedWith('...')
...
```

Jest Spying: Verifying Arguments

```
expect(auditorStub)
  .toHaveBeenCalledWith('sold shares of BAYN', 3)
```

```
const sell = (portfolio, symbol, shares, auditor) => {
  portfolio[symbol] -= shares
  auditor(`sold shares of ${symbol}`, shares)
}
```

Jest Argument Matching

How to verify the date?

```
  auditor(`sold shares of ${symbol}`, shares, Date.now())
```

Use `expect.any(constructor)`:

```
expect(auditorStub)
  .toHaveBeenCalledWith(
    'sold shares of BAYN',
    3,
    expect.any(Number))
```

Spy Exercise

Verify that the portfolio sends an appropriate audit message on all buy & sell transactions.

The audit function should take on a description,
the current timestamp,
and the number of shares involved.

Jest: Replace a Module Function

```
import * as TemperatureServer from './temperature-server'

TemperatureServer.currentTemperature = jest.fn()

it('calculates average temperature', () => {
  TemperatureServer.currentTemperature.mockReturnValueOnce(83)
  TemperatureServer.currentTemperature.mockReturnValueOnce(52)

  const result = averageTemperature(['Miami', 'St. Louis'])

  expect(result).toEqual(67)
})
```

Not as common as mocking a module (next!)

Mocking a Module

```
import { currentTemperature} from './temperature-server'

jest.mock('./temperature-server.js')

it('calculates average temperature', () => {
  currentTemperature.mockReturnValueOnce(82)
  currentTemperature.mockReturnValueOnce(52)

  const result = averageTemperature(['Miami', 'St. Louis'])

  expect(result).toEqual(67)
})
```

***All** exports in a module are initialized to jest.fn()*

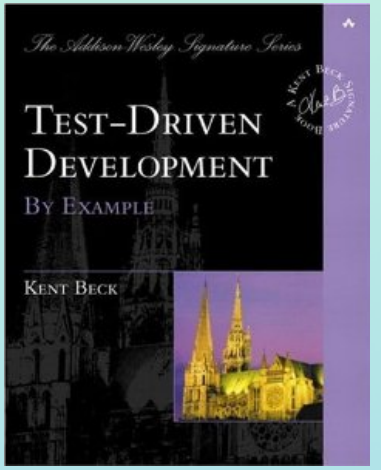
Jest: Is That All?

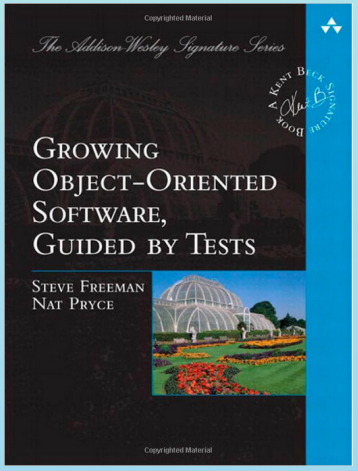
No.

- Manual mocks
- Alternate ways to create an ES6 class mock
- Partial module mocks ("bypassing module mocks")
- Fake timers (`setTimeout`, `setInterval`, etc.)

Schools of Mock

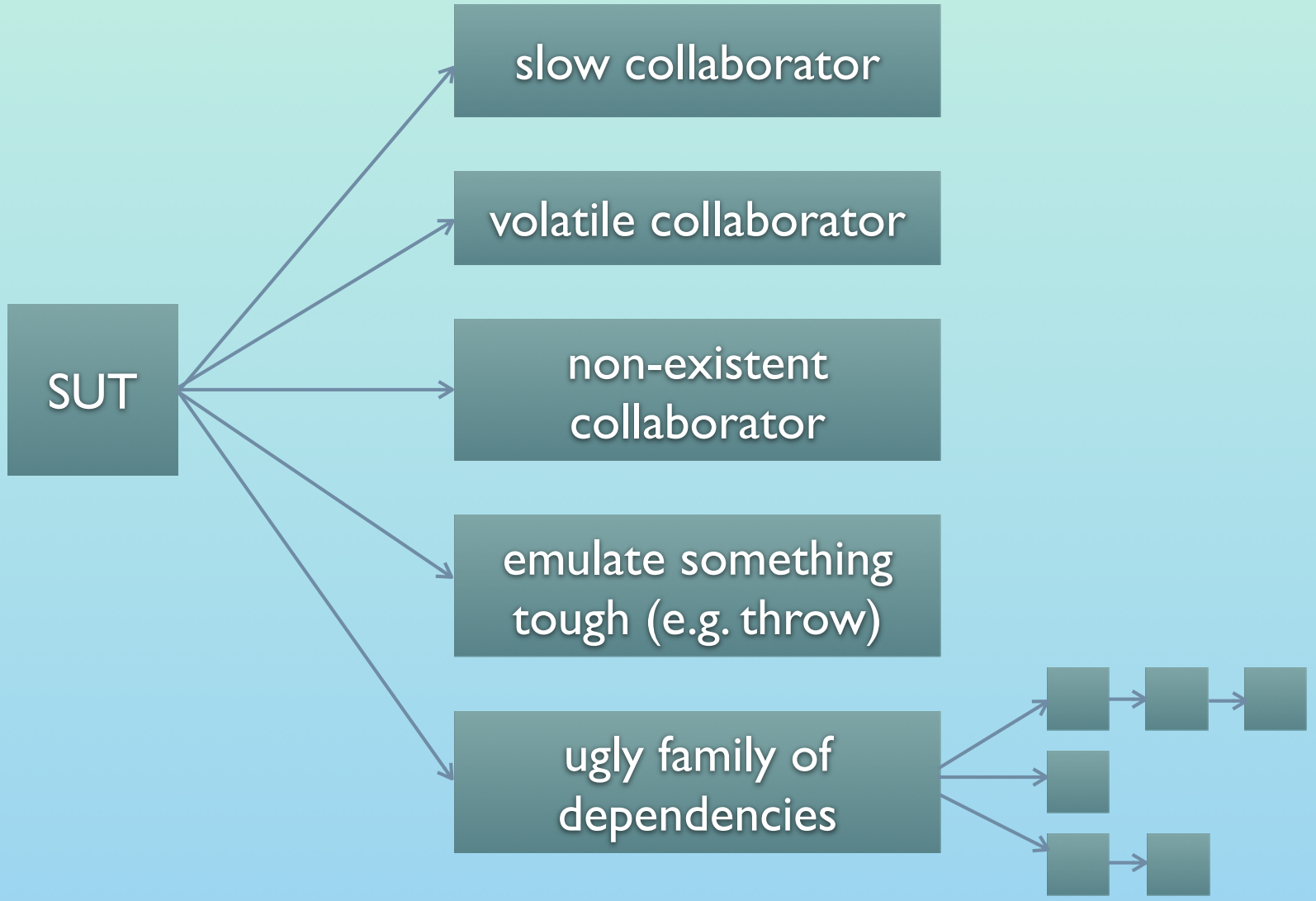
Classic ("Detroit")	algorithmic approach
	verification of state
	tests drive code from specific to general
London	roles, responsibilities, and interactions
	"Fake it until you make it"
	drive incrementally from the outside in





Read Martin Fowler's "Mocks Aren't Stubs"

Classic School: When to Mock



When *Not* to Mock?

Can you inject the data or a generator instead?

The Pragmatic Mocker

- Writes integration tests where mocks are used
- Watches coupling between tests & implementation
- Seeks to mock only direct collaborators
- Avoids mocking what they don't own
- Avoids fakes (and if necessary, test-drives 'em!)
- Isolates, minimizes the use of test doubles
  - But prefers testability


Kahoot!

Growing & Sustaining TDD

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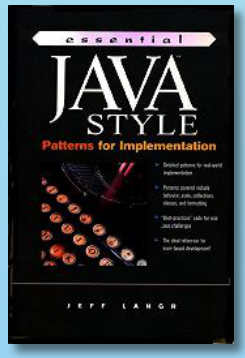

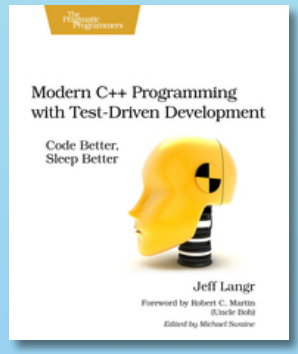

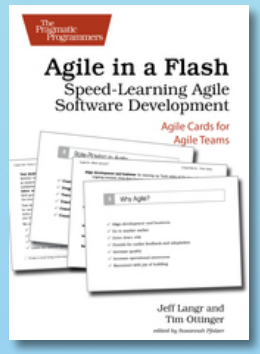

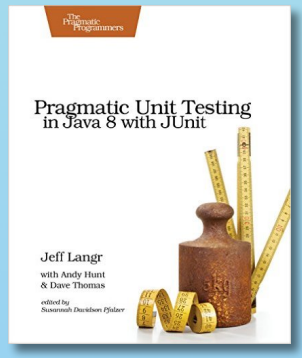

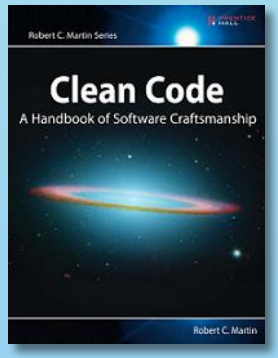

Next Week

- Establish team policies & standards around TDD
- Ensure your build pipeline supports it
- Reviews must include the tests
- Consider pairing / mobbing

Growing TDD

- Sharing sessions
- Challenges / contests
- Coaches & champions
- "Stop the line" mentality
- Influential, dynamic metrics
- More mobbing

Sustaining TDD

- Daily stand-down / discussions / retros
- "Why" reminders
- Review standards regularly
- Keep tests fast!
- Always use tests as an entry point
- Refactor, refactor, refactor
  - Tests too!

Mastering TDD

TDD is a skill.

Practice, practice, practice.

Miscellaneous Topics

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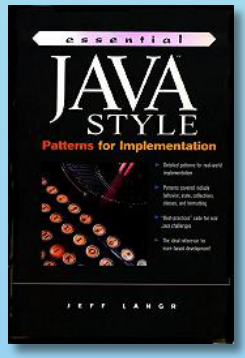
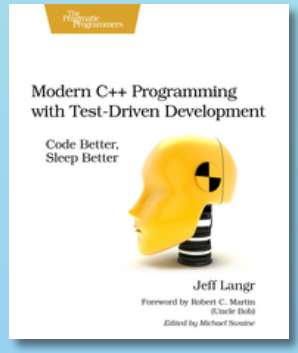
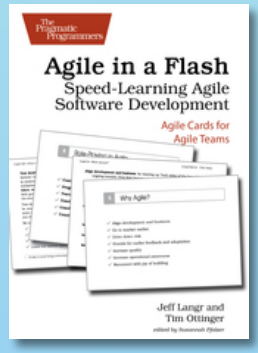
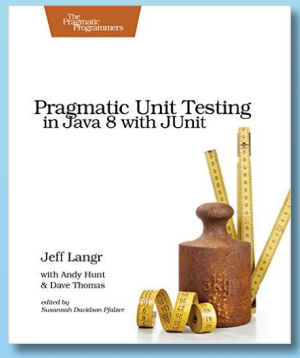
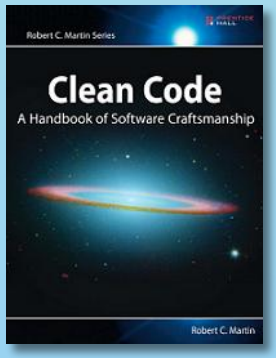










Testing With Promises: ES6

```
const funcReturningPromise = () =>
  new Promise((resolve, _reject) => setTimeout(resolve, 500, 42))
```

Nope:

```
describe('testing promises', () => { // doesn't work!
  const x = funcReturningPromise()
  expect(x).to.equal(41)
})
```

ES6: await

```
describe('testing promises', async () => {
  const x = await funcReturningPromise()
  expect(x).to.equal(41)
})
```

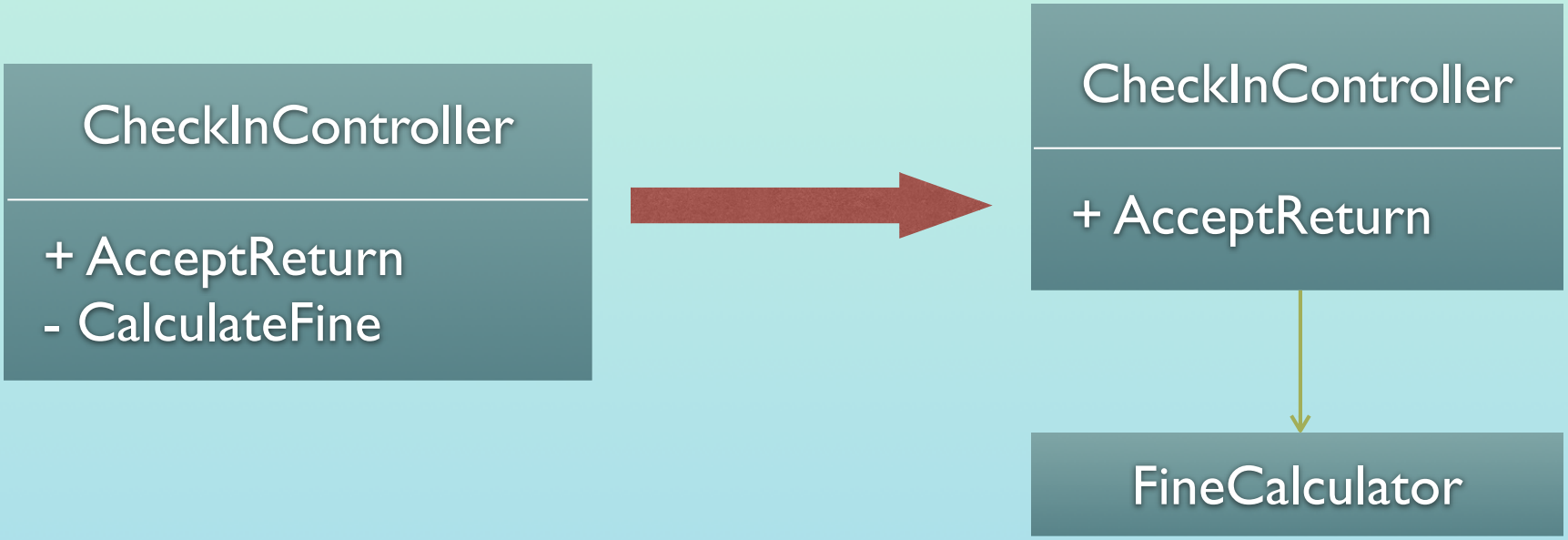
Testing With Promises: Old School

```
it('is worth share price for single share purchase', done => {
  portfolio.retrievePrice = () => Promise.resolve({ symbol: IBM, price: 100 });
  portfolio.purchase(IBM, 1);

  portfolio.value()
    .then(result => {
      expect(result).to.equal(IBM);
      done();
    });
});
```

If that doesn't work:

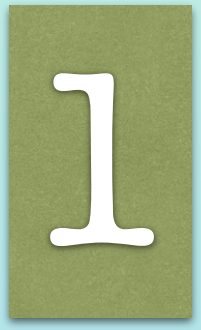
```
it('is worth share price for single share purchase', done => {
  portfolio.retrievePrice = () => Promise.resolve({ symbol: IBM, price: 100 });
  portfolio.purchase(IBM, 1);

  portfolio.value()
    .then(result => { expect(result).to.equal(100); })
    .then(done, done);
});
```

Testing Non-Public Behavior?



Or simply relax access.

Rules of Ten



Green & clean in < 10 (minutes)

Delete and repeat if you're late!

... taking smaller steps this time.

Rules of Ten

Debate stops at 10 (minutes)

"Show me."

Rules of Ten

All unit tests run in < 10 (seconds).

Fixing a Slow Test Run

Warn on tests < ***n*** *ms*

Fail on tests > ***n*** ms

Running a subset of tests increases risk.

Uncle Bob's TPP

Transformations have a preferred ordering, which if maintained by ordering of tests, prevents "long outages" in TDD.

The Priority List

({}->nil) no code at all->code that employs nil
(nil->constant)
(constant->constant+) a simple constant to a more complex constant
(constant->scalar) replacing a const. with a variable or an argument
(statement->statements) adding more unconditional statements.
(unconditional->if) splitting the execution path
(scalar->array)
(array->container)
(statement->tail-recursion)
(if->while)
(statement->recursion)
(expression->function) replacing expression w/ a function or algorithm
(variable->assignment) replacing the value of a variable.
(case) adding a case (or else) to an existing switch or if

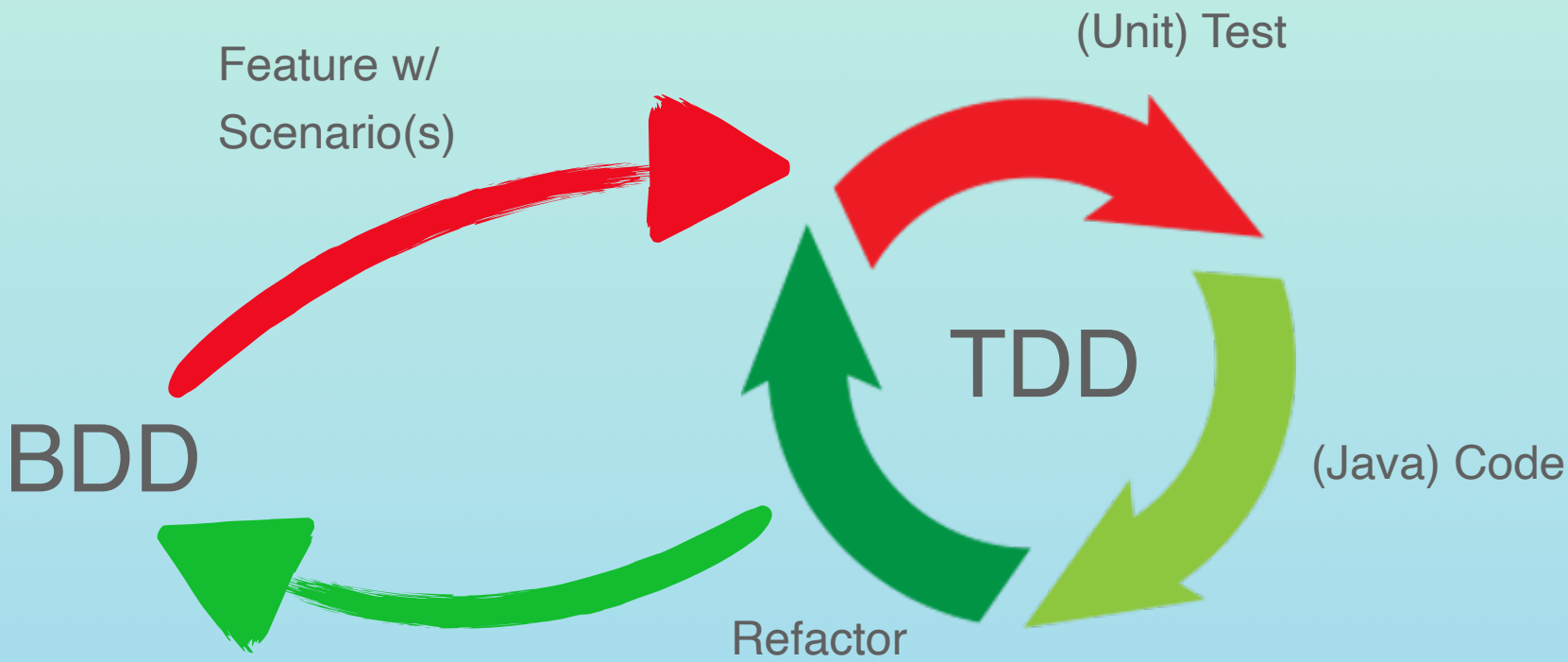
"As the tests get more specific, the code gets more generic."

http://thecleancoder.blogspot.com/2011/02/fib-t-p-premise.html

https://8thlight.com/blog/uncle-bob/2013/05/27/TheTransformationPriorityPremise.html

Per and updated by Uncle Bob.

Behavior-Driven Development (BDD)



Terminology

TDD = test-driven development

Usually: **"driving code units by describing examples"**

also ...

"driving a system guided by examples"

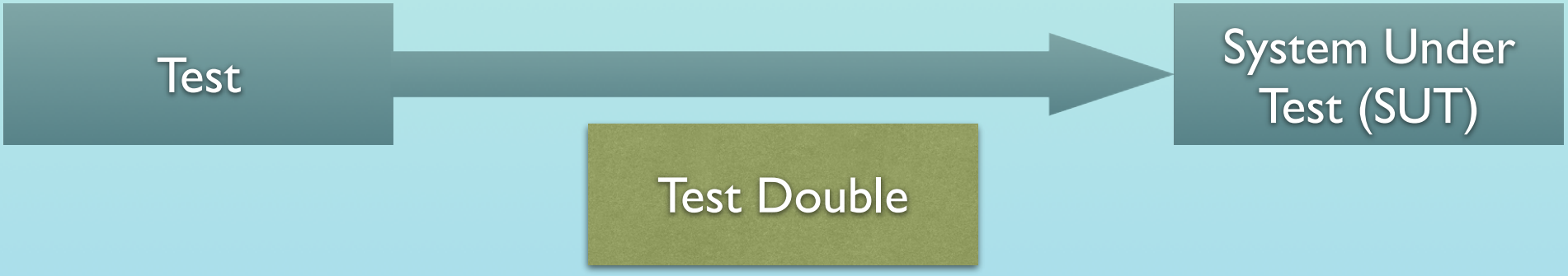
BDD = behavior-driven development

Usually: **"driving a system by describing examples"**

also ...

"driving code units guided by examples"

Alternate Test Double Injection Techniques



ES6: Function Override

(using `import * as`)

portfolio.test.js

```
import * as StockLookupService from './stock-lookup-service'

describe('portfolio value with stub', () => {
  it('is symbol price for single-share purchase', () => {
    StockLookupService.symbolLookupStub(_ => 42)
    portfolio = purchase(portfolio, 'IBM', 1)
    expect(value(portfolio)).to.equal(42)
  })
})
```

stock-lookup-service.js

```
export let symbolLookup = _symbol => { /* prod code */ }
export const symbolLookupStub = stub => symbolLookup = stub
```

portfolio.js

```
import { symbolLookup } from './stock-lookup-service'
export const value =
  portfolio => symbolLookup(Object.keys(portfolio.holdings)[0])
```

Exercise: Function Override

using `import * as`

Prototype Injection

```
PortfolioObj.prototype.value = function() {
  if (this.size() === 0) return 0
  return this.lookupPrice('BAYN')
    .then(function({_symbol, price
      return price
    })
}

PortfolioObj.prototype.lookupPrice
  return ax.get(`http://localhost
    .then(function(response) {
      return { symbol: symbol, pr
    })
}
```

```
let realLookupPrice

beforeEach(() => {
  realLookupPrice = PortfolioObj.prototype.lookupPrice
  PortfolioObj.prototype.lookupPrice =
    function() {
      return Promise.resolve(
        { symbol: Monsanto, price: MonsantoValue })
    }
})

afterEach(() => {
  PortfolioObj.prototype.lookupPrice = realLookupPrice
})

it('...', async () => {
  portfolio.purchase(Monsanto, 1)
  const result = await portfolio.value()
  expect(result).to.equal(MonsantoValue)
})
```

Exercise: Prototype Injection

Flesh out the portfolio value function, using TDD, starting with `./src/misc/portfolio-obj.test.js` and `./src/misc/portfolio/portfolio-obj.js`

Start simple! Add in small increments!

You should end up with at least three tests, perhaps four.

Jest: Method Dependency

https://jestjs.io/docs/en/es6-class-mocks

```
class TemperatureService {
  currentTemperature(_city) {
    throw Error('server *really* down')
  }
}

const averageTemperature = (cities, temperatureService)  => {
  return cities
    .map(city => temperatureService.currentTemperature(city))
    .reduce((sum, temp) => sum + temp, 0) / cities.length
};
```

Jest Method Stub

```
class TemperatureService {
  currentTemperature(_city) {
    // ...
  }}
```

```
import TemperatureService from './temperature-class'
import { when } from 'jest-when'

const mockCurrentTemperature = jest.fn()

jest.mock('./temperature-class', () =>
  jest.fn().mockImplementation(() => ({ currentTemperature: mockCurrentTemperature }))
)
    TemperatureService.mockClear() // in beforeEach
    mockCurrentTemperature.mockClear() // in beforeEach

    const temperatureService = new TemperatureService()
    when(mockCurrentTemperature).calledWith('Miami').mockReturnValueOnce(82)
    when(mockCurrentTemperature).calledWith('St. Louis').mockReturnValueOnce(52)

    const result =  averageTemperature(['Miami', 'St. Louis'], temperatureService)

    expect(result).toEqual(67)
```

require() Dependency Challenge

portfolio.js

```
var symbolLookup = require('./stock-lookup-service').symbolLookup

// ... other funcs ...

var value = function(portfolio) {
  var sumValues = function(totalValue, symbol) {
    return totalValue + symbolLookup(symbol) * sharesOf(portfolio, symbol)
  }
  return empty(portfolio) ? 0 :
    Object.keys(portfolio.holdings).reduce(sumValues, 0)
}

module.exports = { /* ... */, value: value }
```

stock-lookup-service.js

```
module.exports = {
  symbolLookup: function(symbol) { /* ... */ }
}
```

Exports Injection: Old School

portfolio.js

```
var value = function(symbolLookup, portfolio) {
  var sumValues = function(totalValue, symbol) {
    return totalValue + symbolLookup(symbol) * sharesOf(portfolio, symbol)
  }
  return empty(portfolio)
    ? 0
    : Object.keys(portfolio.holdings).reduce(sumValues, 0)
}

module.exports = function(symbolLookup) {
  return {
    // ... other funcs ...
    value: value.bind(null, symbolLookup)
  }
}
```

Injecting Via Exports

portfolio.test.js

```
var stubSymbolLookup = jest.fn()
var Portfolio = require('./portfolio')(stubSymbolLookup)

describe('portfolio value', function() {
  it('is symbol price for single-share purchase', function() {
    stubSymbolLookup.mockReturnValueOnce(IBMPrice)
    var portfolio = createPortfolio()

    portfolio = purchase(portfolio, 'IBM', 1)

    expect(value(portfolio)).toEqual(IBMPrice)
  })
})
```

References / Reading List

"Chat" icon courtesy Gregor Cesnar, Noun Project (Creative Commons)

[Beck2002] Beck, Kent. **Test-Driven Development: By Example**. Addison-Wesley, 2002.

[Ellnestam2014] Ellnestam, O. and Brolund, D. **The Mikado Method**. Manning, 2014.

[Feathers2005] Feathers, Michael. **Working Effectively With Legacy Code**. Prentice Hall, 2005.

[Fowler1999] Fowler, Martin. **Refactoring: Improving the Design of Existing Code**. Addison-Wesley, 1999.

[Freeman, 2009]. Freeman, S. and Pryce, N. **Growing Object-Oriented Software, Guided By Tests**. Addison-Wesley, 2009.

[Langr2005] Langr, Jeff. **Agile Java: Crafting Code With Test-Driven Development**. Prentice Hall, 2005.

[Langr2011] Langr, Jeff and Ottinger, Tim. **Agile in a Flash**. Pragmatic Programmers, 2011.

[Langr2013] Langr, Jeff. **Modern C++ Programming With Test-Driven Development**, Pragmatic Programmers, 2013.

[Langr2015] Langr, Jeff, et. al. **Pragmatic Unit Testing in Java 8 with Junit.** Pragmatic Programmers, 2015.

[Martin2002] Martin, Robert C. **Agile Software Development: Principles, Patterns, and Practices**. Prentice Hall, 2002.

[Meszaros2007] Meszaros, Gerard. **xUnit Test Patterns: Refactoring Test Code**. Addison-Wesley, 2007.

Thank you!

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