Schools of TDD

@MarcoEmrich

codecentric

ABOUT TDD

WHEN?

WHO?

1957

INVENTED

JOHN VON NEUMAN

1989

REDISCOVERED

KENT BECK

30 YEARS OF TDD

…OR 60 ?

WHAT HAPPENED IN THESE YEARS?

IMPROVING TDD-SKILLS TODAY?

SCHOOLS

> *There are a large number of distinct styles and schools of martial arts.*

— Wikipedia: List_of_martial_arts

AIKIDO

NINJITSU

THE BASIC SCHOOL
MCMAP

SHALIN KUNGFU-FU

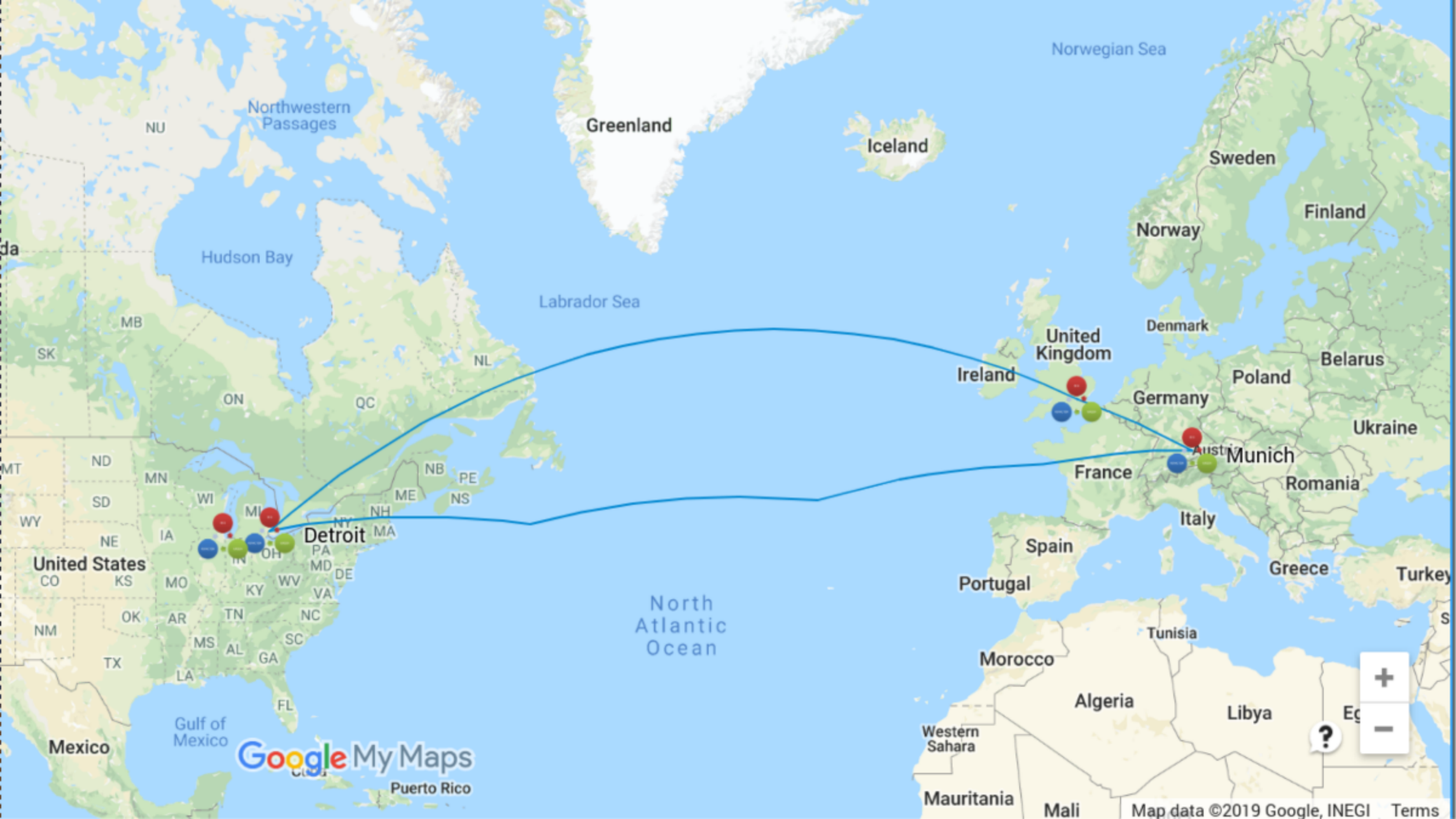
BRIDE-FU
SEANMCLIN.COM/WEDDINGS

CAT-FU

> *Martial arts can be grouped by type or focus, or alternatively by* ***regional origin****.*

— Wikipedia: List_of_martial_arts

THREE (?) SCHOOLS OF TDD


Northwestern Passages
NU
Greenland
Iceland
Norwegian Sea
Sweden
Finland
Norway
Hudson Bay
Labrador Sea
MB
SK
NL
ON
QC
Denmark
United Kingdom
Ireland
Belarus
Poland
Germany
Ukraine
Munich
France
Romania
Italy
ND
MN
WI
MI
NB
PE
ME
NS
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United States
CO
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MO
KY
WV
VA
OK
AR
TN
NC
NM
MS
AL
SC
TX
GA
LA
FL
Spain
Portugal
Greece
Turkey
North Atlantic Ocean
Tunisia
Morocco
Algeria
Libya
Western Sahara
Mauritania
Mali
Gulf of Mexico
Mexico
Puerto Rico
Google My Maps
Map data ©2019 Google, INEGI
Terms

> *Sometimes, schools or styles are introduced by* ***individual teachers*** *or masters, ...*

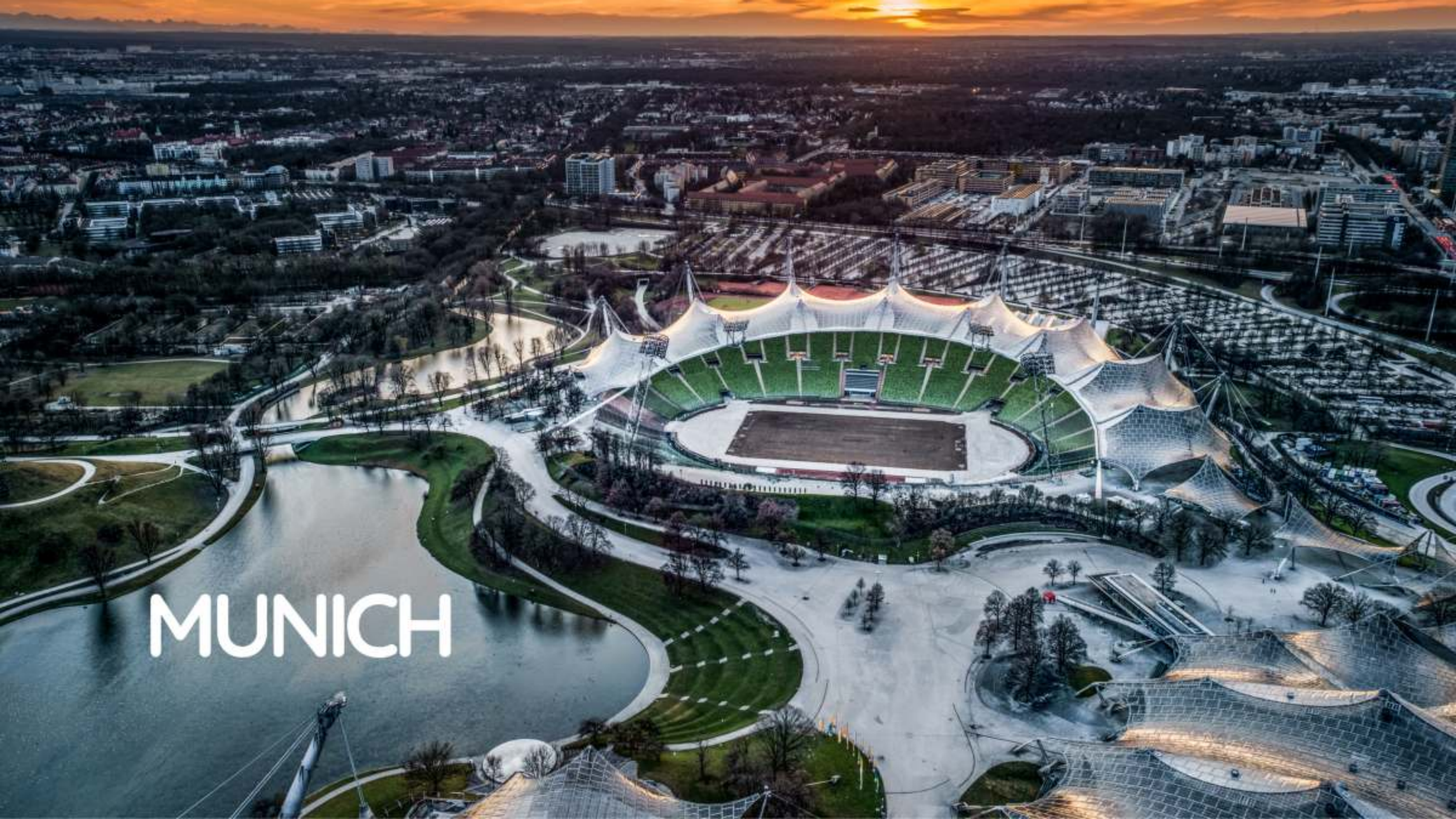
— Wikipedia: List_of_martial_arts

CHICAGO

KENT BECK

LONDON

NAT PRICE & STEVE FREEMAN


MUNICH

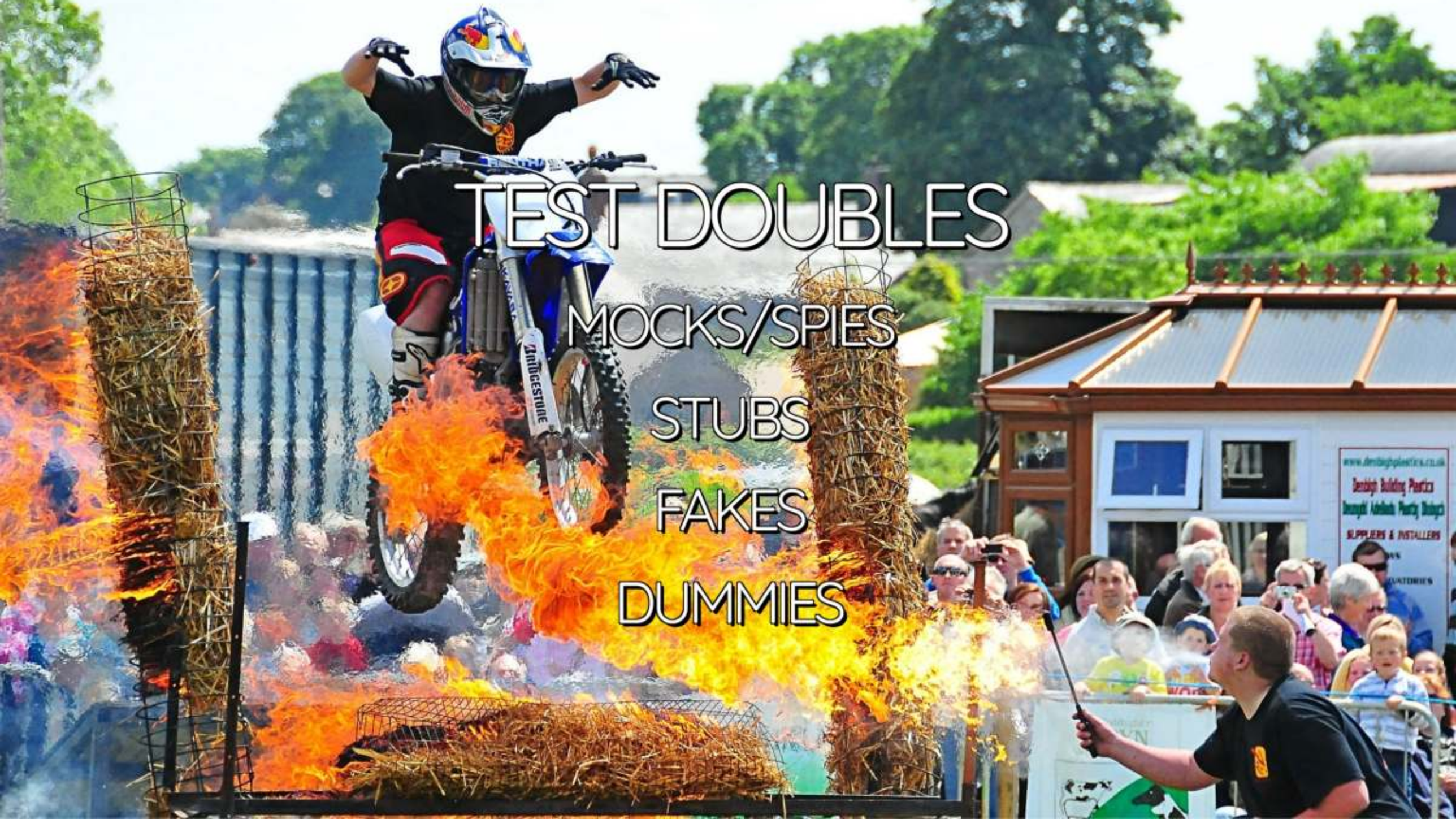
DAVID VÖLKEL

TERMS
&
BUILDING BLOCKS

SUBJECT UNDER TEST

SUBJECT UNDER TEST: SUT

- Object
- Function / Method
- Module
- Software System
- ... something else?


TEST DOUBLES
MOCKS/SPIES
STUBS
FAKES
DUMMIES

ASSERTIONS

&

EXPECTATIONS

FRONTDOOR TESTING

VS

BACKDOOR TESTING

FRONTDOOR TESTING

- Result Verification
- State Verification

RESULT VERIFICATION

```
test('add adds up two numbers', () => {
  expect( add(3, 4) ).toEqual(7);
});
```

STATE VERIFICATION

```
test('addCardOnTop should increase number of Cards in Deck', () => {
  deck = new DeckOfCards();
  deck.addCardOnTop("♥9")
  expect(deck.numberOfCards).toEqual(1);
  expect(collectionSpy.topCard).toEqual("♥9");
});
```

BACKDOOR TESTING

- Behavior verification
- Test Doubles: Mocks & Spys

BEHAVIOR VERIFICATION

```
test('addCardOnTop should call shuffle on collection', () => {
  const collectionSpy = {randomizeOrder: jest.fn()};
  deck = new DeckOfCards(collectionSpy);
  deck.shuffle();
  expect(collectionSpy.randomizeOrder).toHaveBeenCalled();
});
```

QUERIES VS COMMANDS

QUERY

```
deck.numberOfCards
```

COMMAND

```
deck.addCardOnTop("♥9")
```

COMMAND/QUERY VERIFICATION

QUERY

- Result Verification

COMMAND

- State Verification
- Behavior Verification

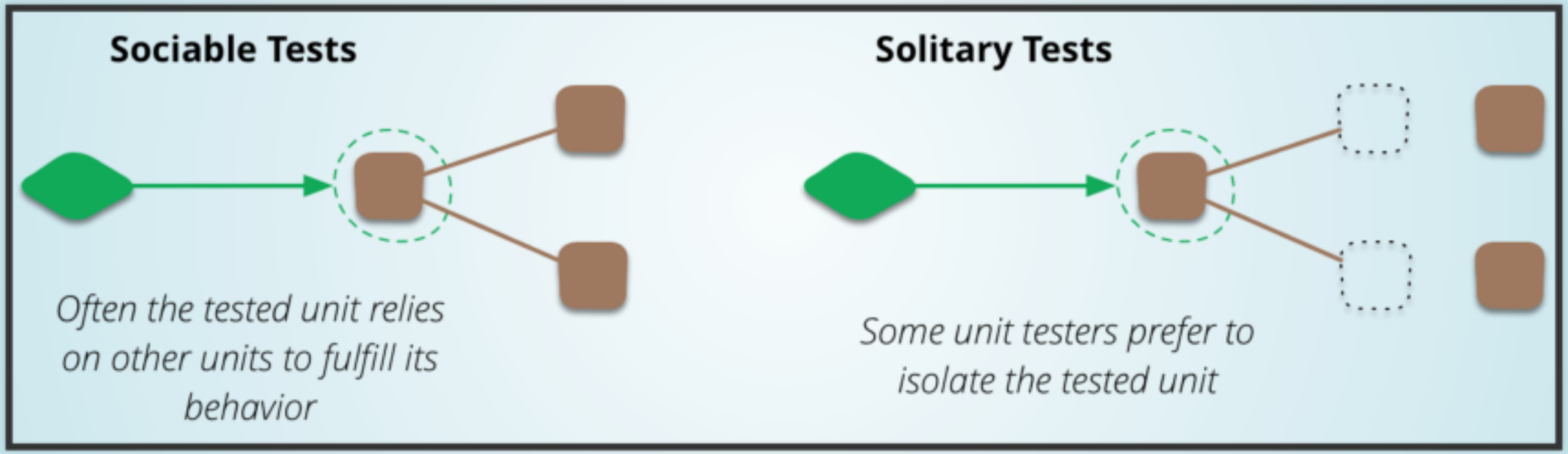
J.B. RAINSBERGER

INTEGRATED TESTS VS ISOLATED TESTS

MARTIN FOWLER / JAY FIELDS

SOCIABLE TESTS VS SOLITARY TESTS

SOCIABLE VS SOLITARY*



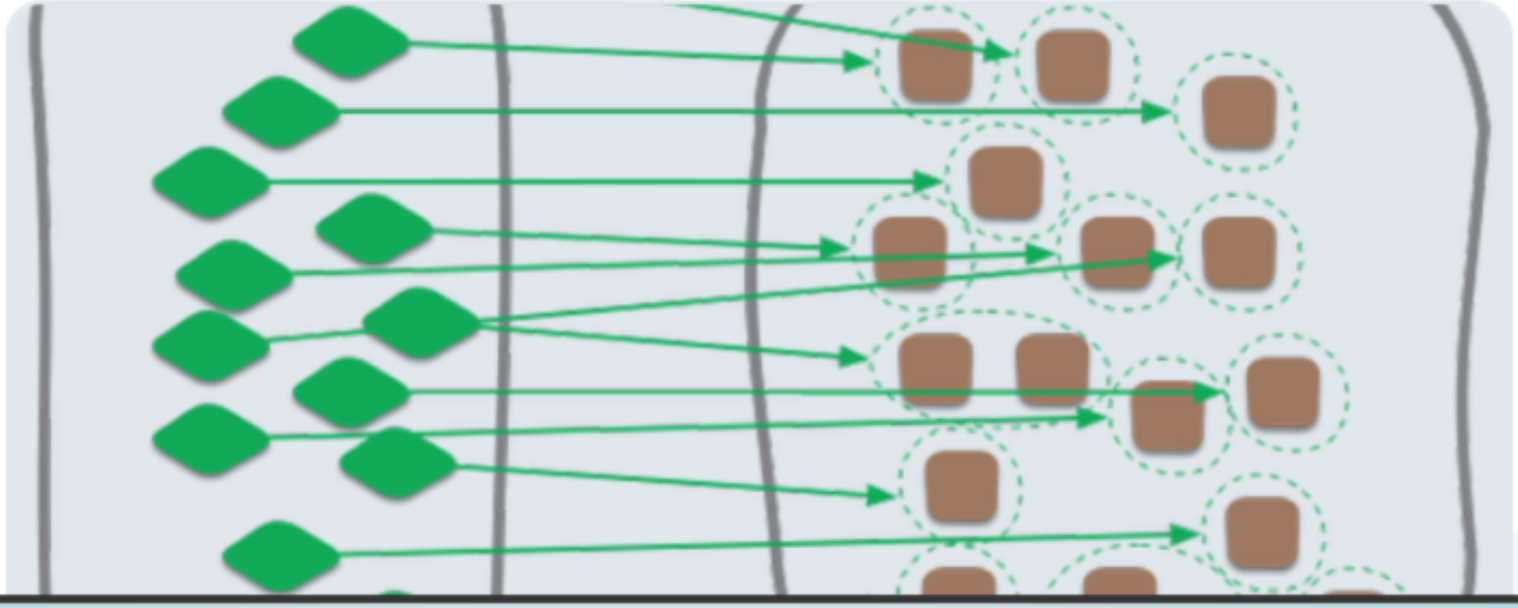
(*) stolen from M. Fowler

Marco Emrich @marcoemrich · 23. Mai 2018

@jbrains **is there a difference between your notion of "isolated vs integrated tests" and** @martinfowler 's "solitary **vs** sociable test" martinfowler.com/bliki/UnitTest… ?

Do you have a definition for "**isolated** test"?

Tweet übersetzen



J. B. Rainsberger @jbrains · 23. Mai 2018

Antwort an @marcoemrich

I think my "isolated test" and @martinfowler's "solarity test" can be safely interchanged. They might even me identical.

Tweet übersetzen

1 2

Martin Fowler @martinfowler · 23. Mai 2018

I do hear "isolated" to mean the same as "solitary". I now prefer to avoid "isolated" for this as it also means not using mutable shared fixture. (Older versions of that bliki entry mentioned this.)

Tweet übersetzen

1 2

J. B. Rainsberger @jbrains · 23. Mai 2018

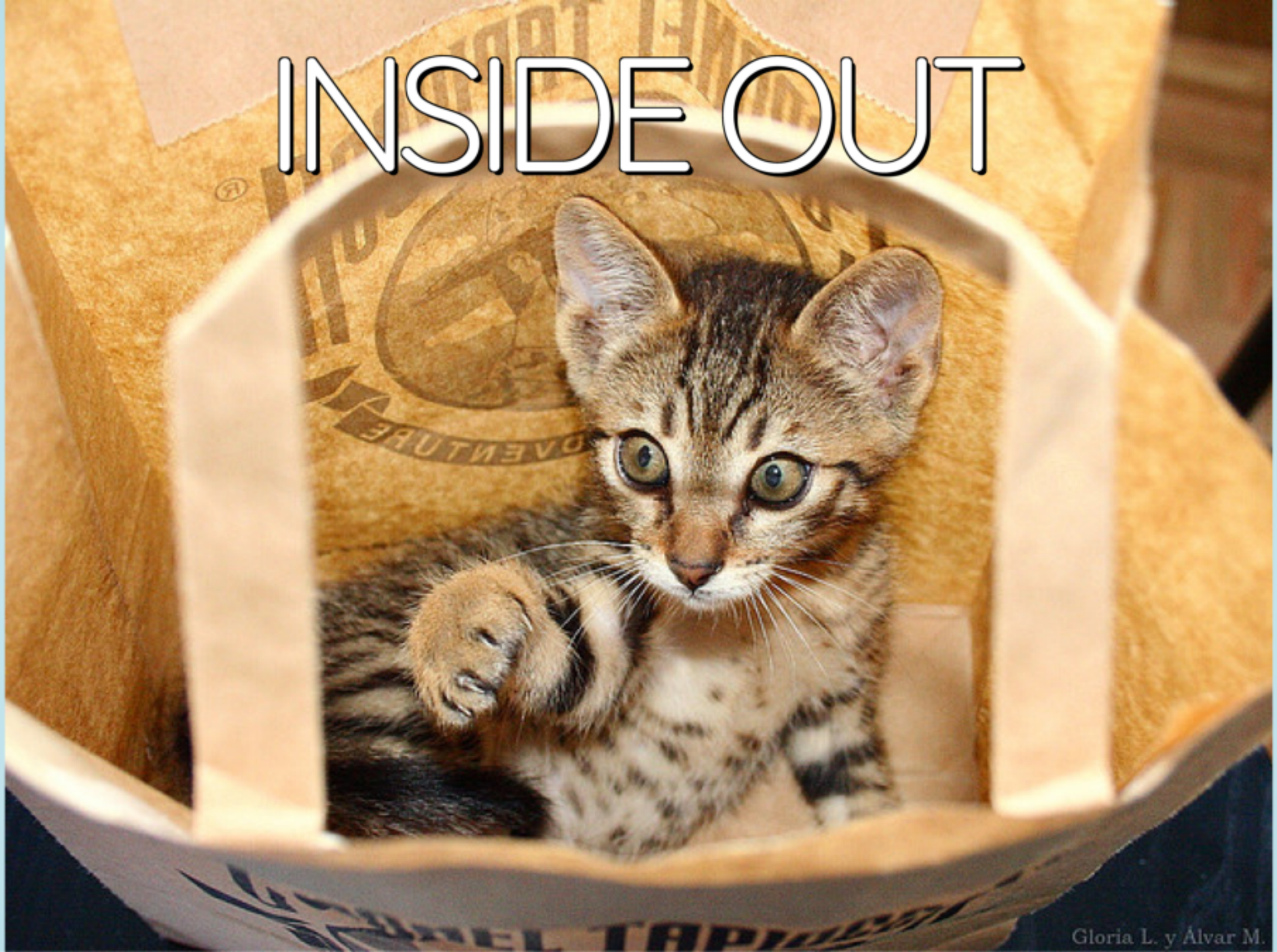
Interesting. I could see that. I chose it for alliteration with "integrated".

INSIDE OUT

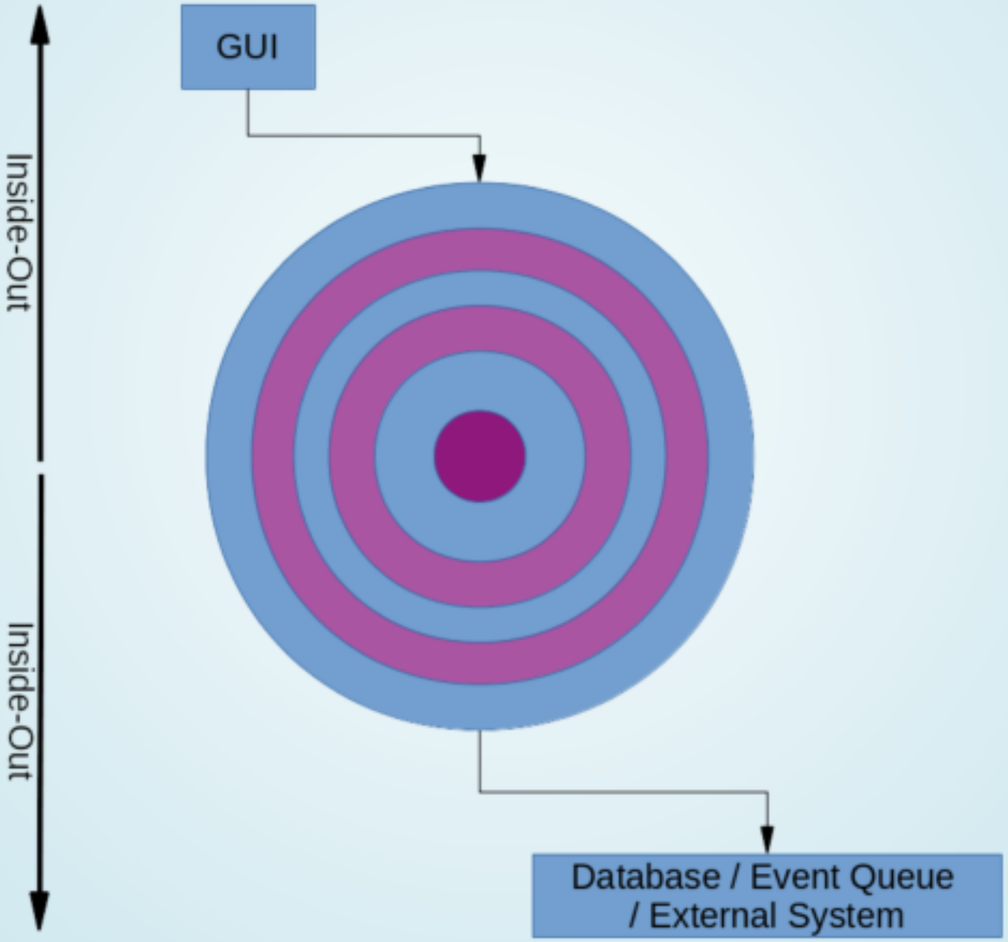
VS

OUTSIDE IN

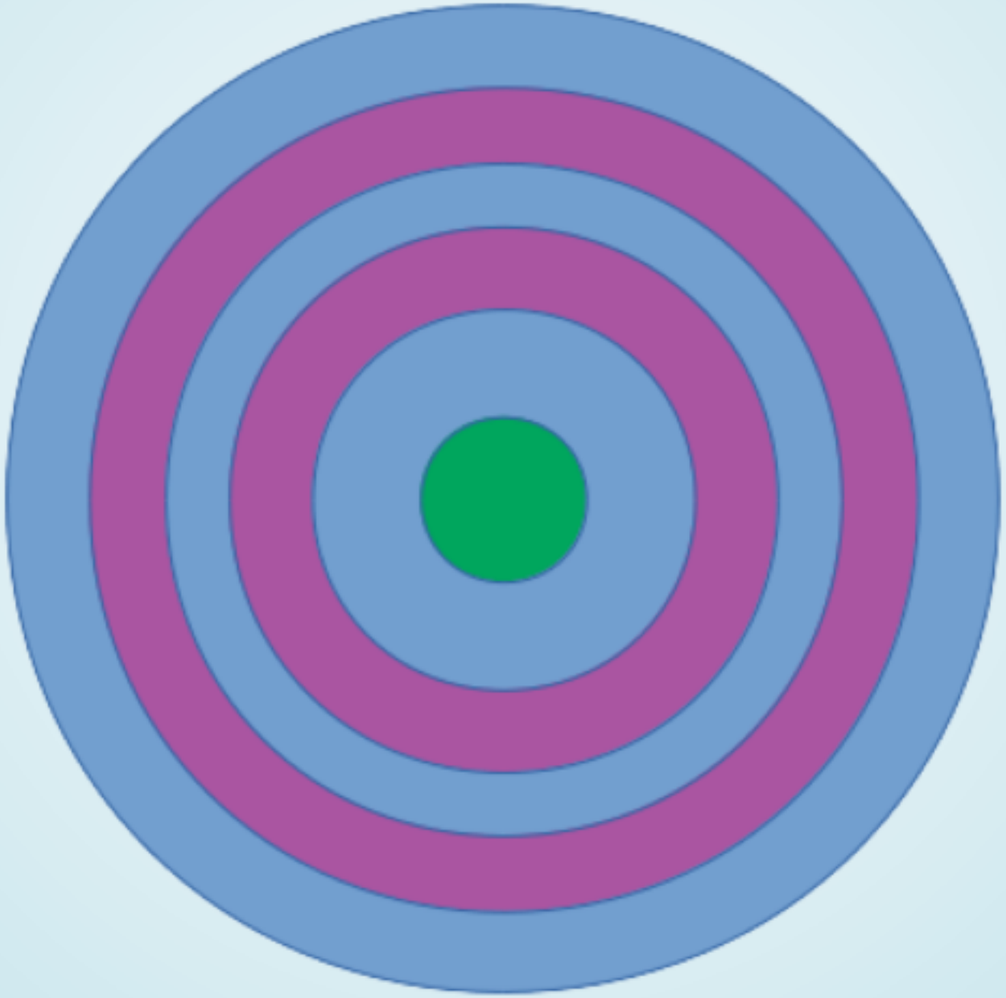
INSIDE OUT



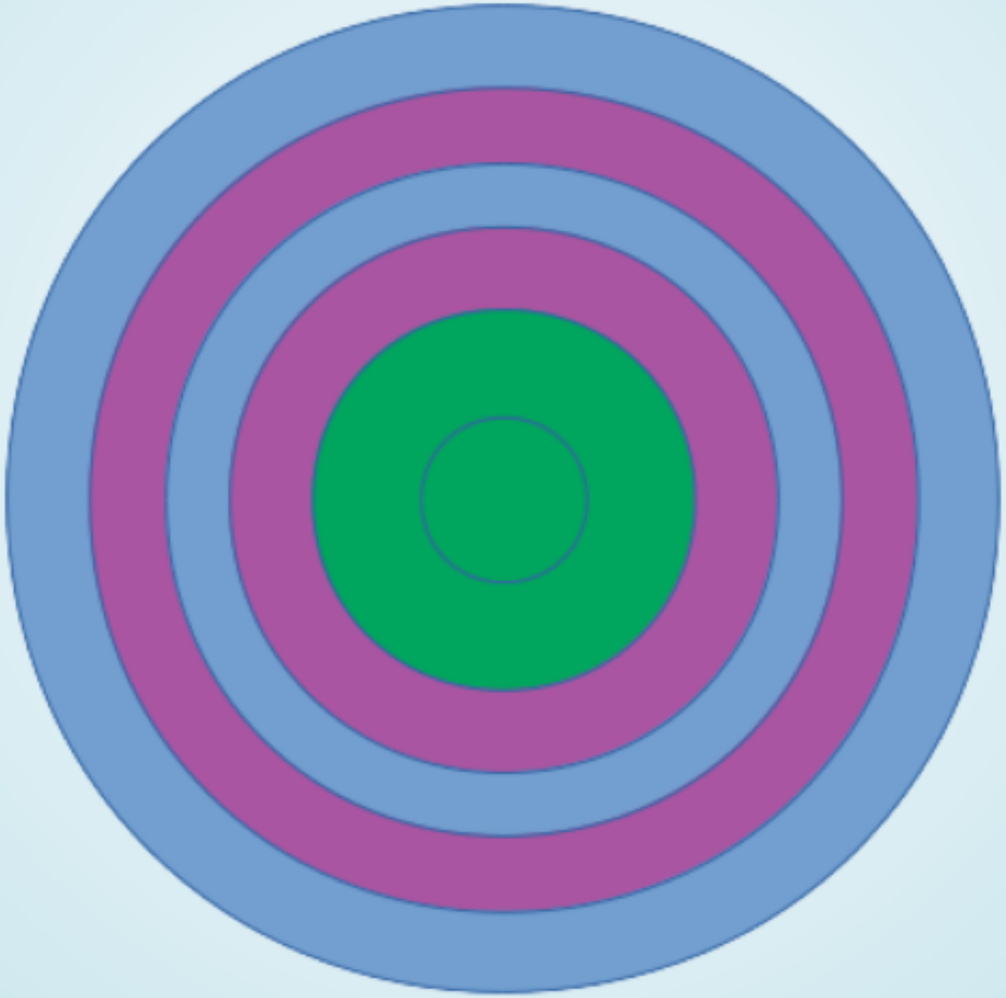
INSIDE OUT


Inside-Out
Inside-Out
GUI
Database / Event Queue
/ External System

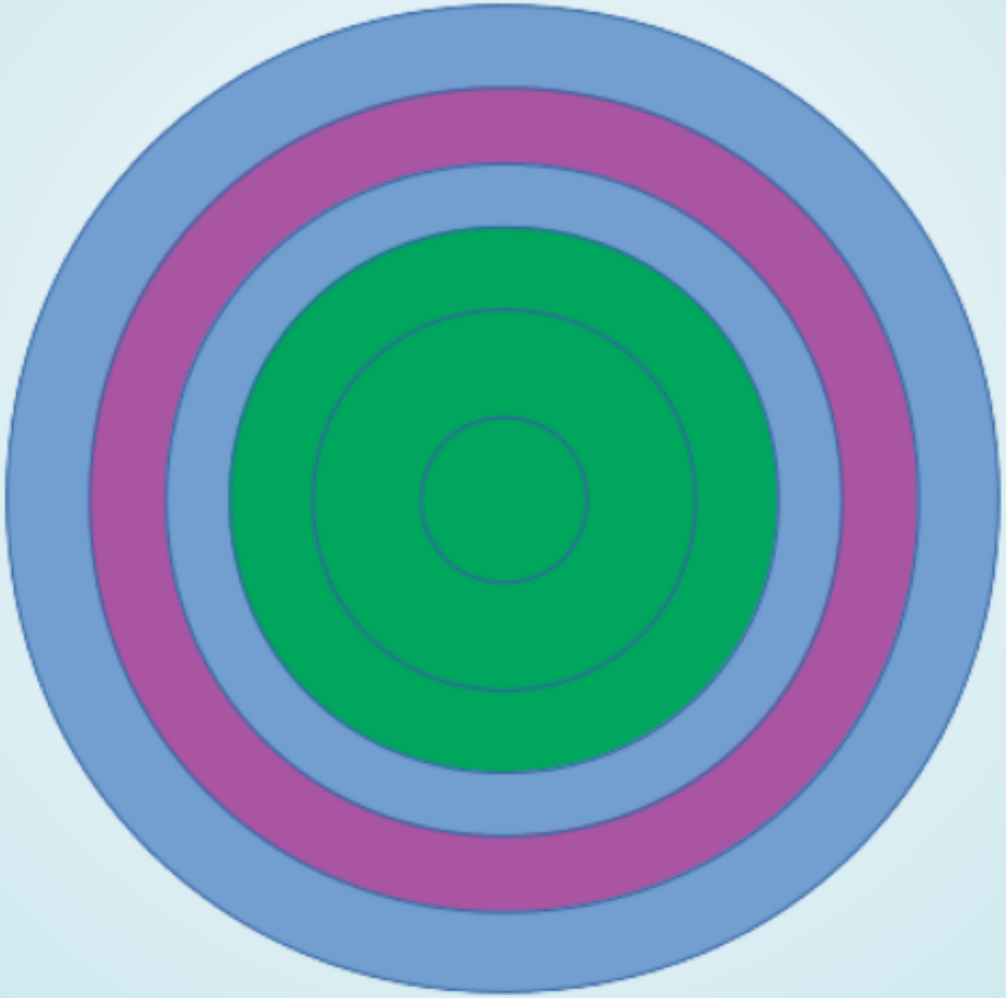
INSIDE OUT



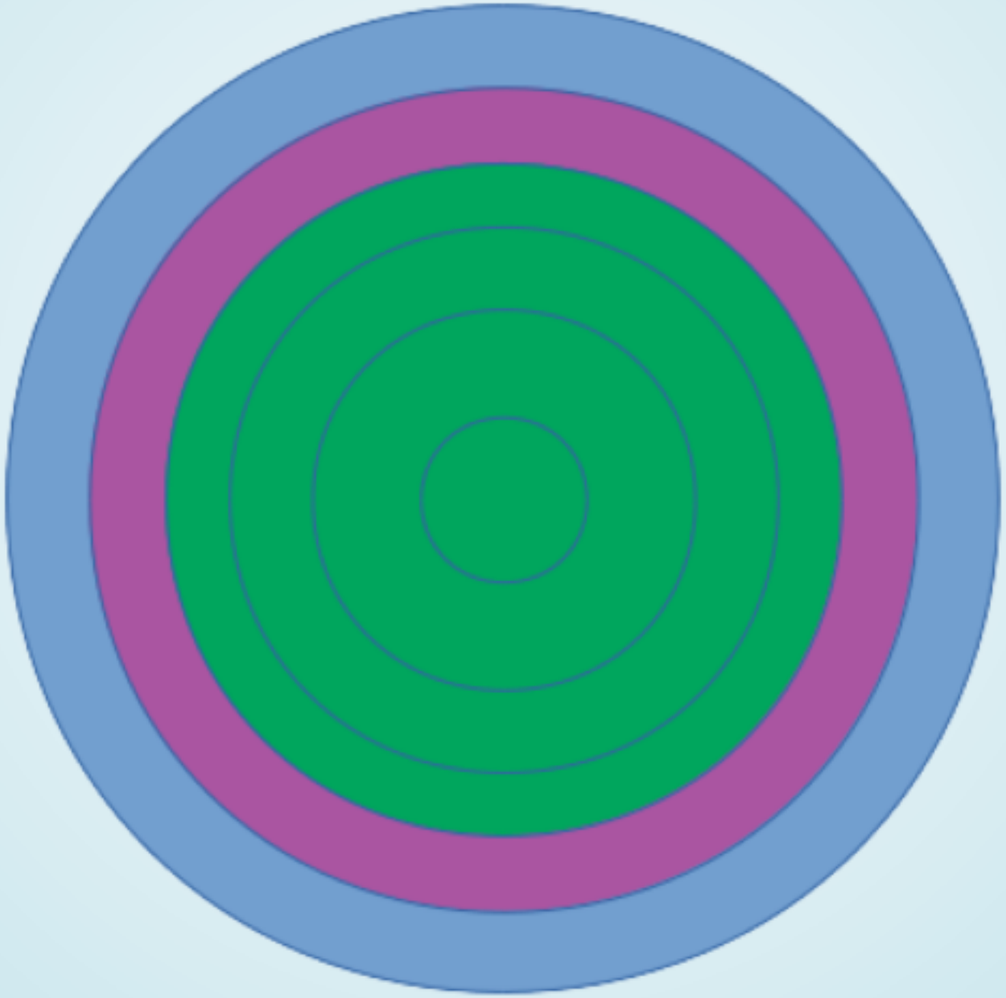
INSIDE OUT



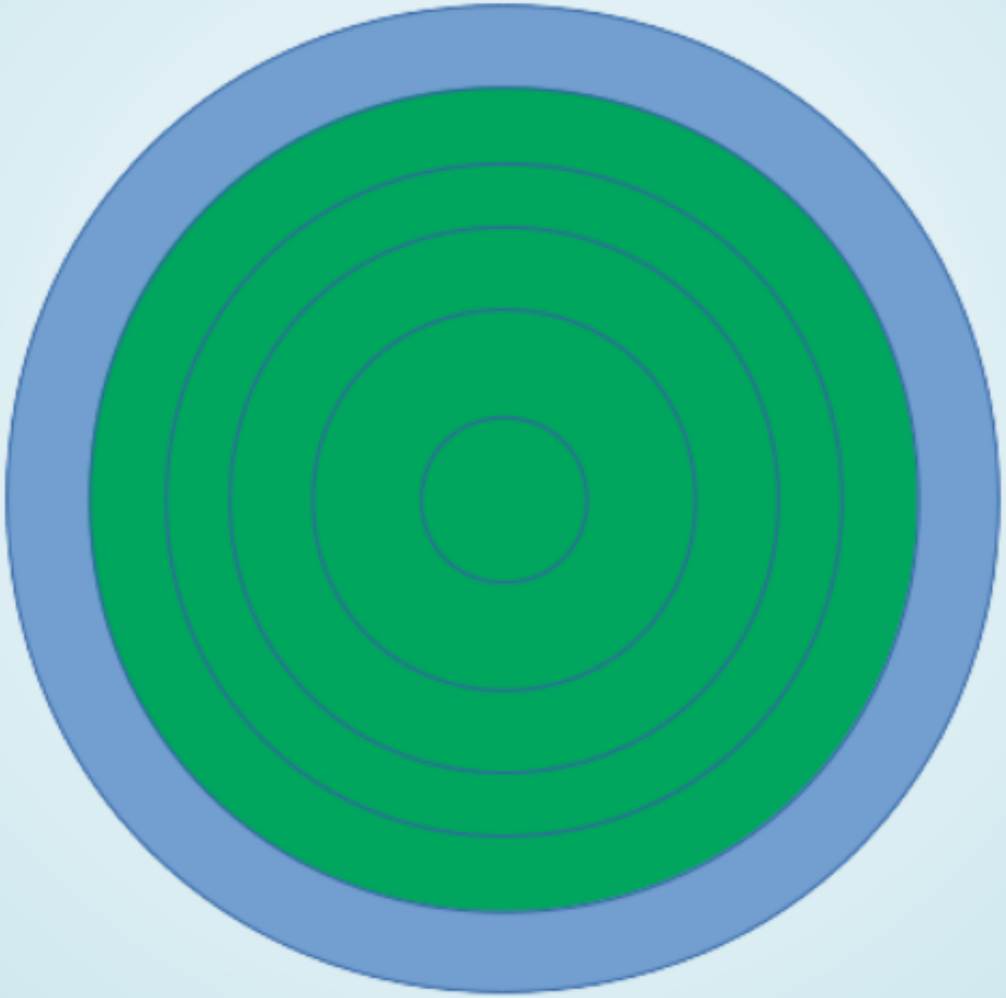
INSIDE OUT



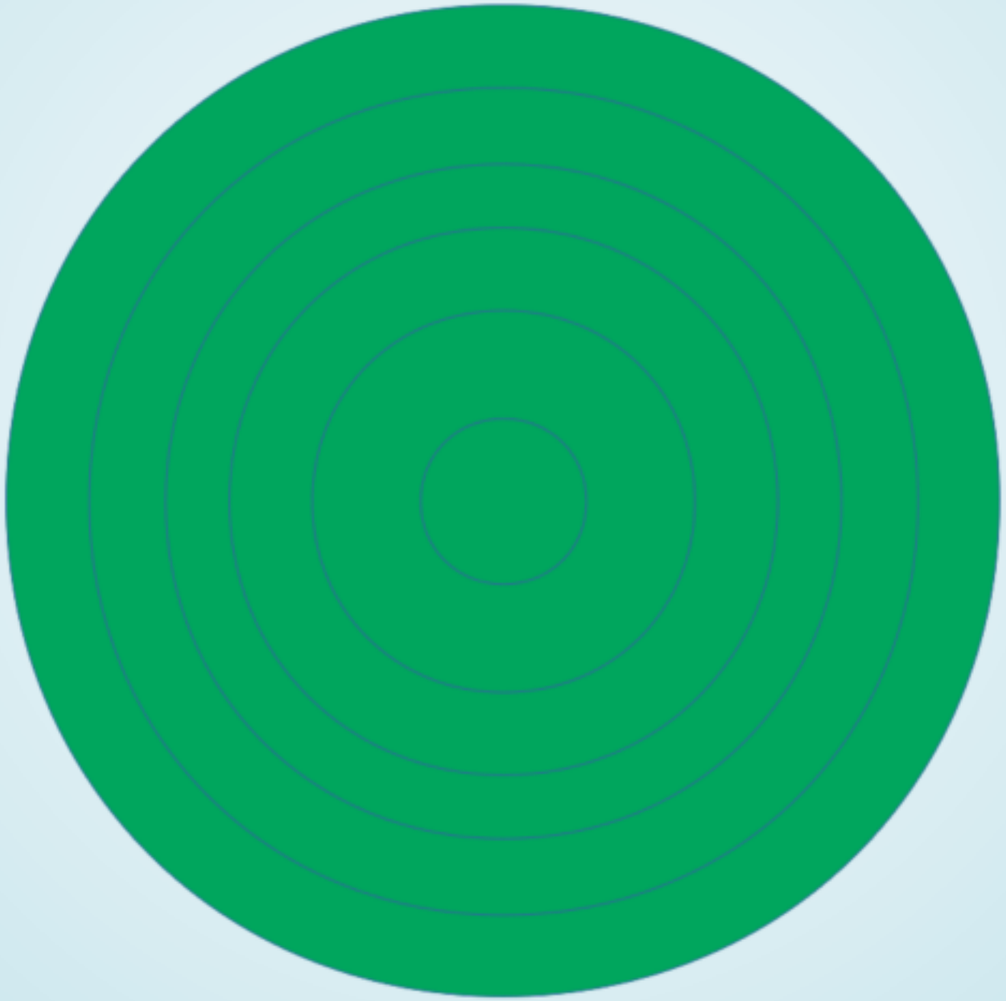
INSIDE OUT



INSIDE OUT

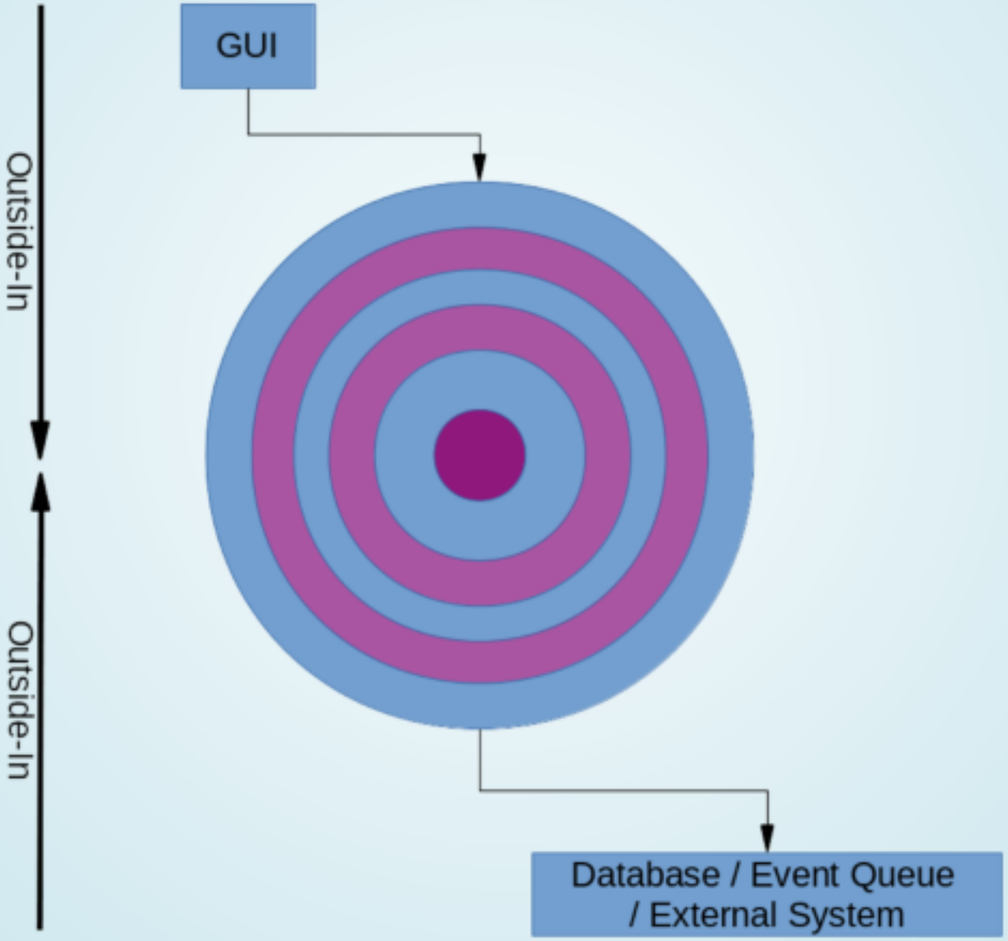


INSIDE OUT

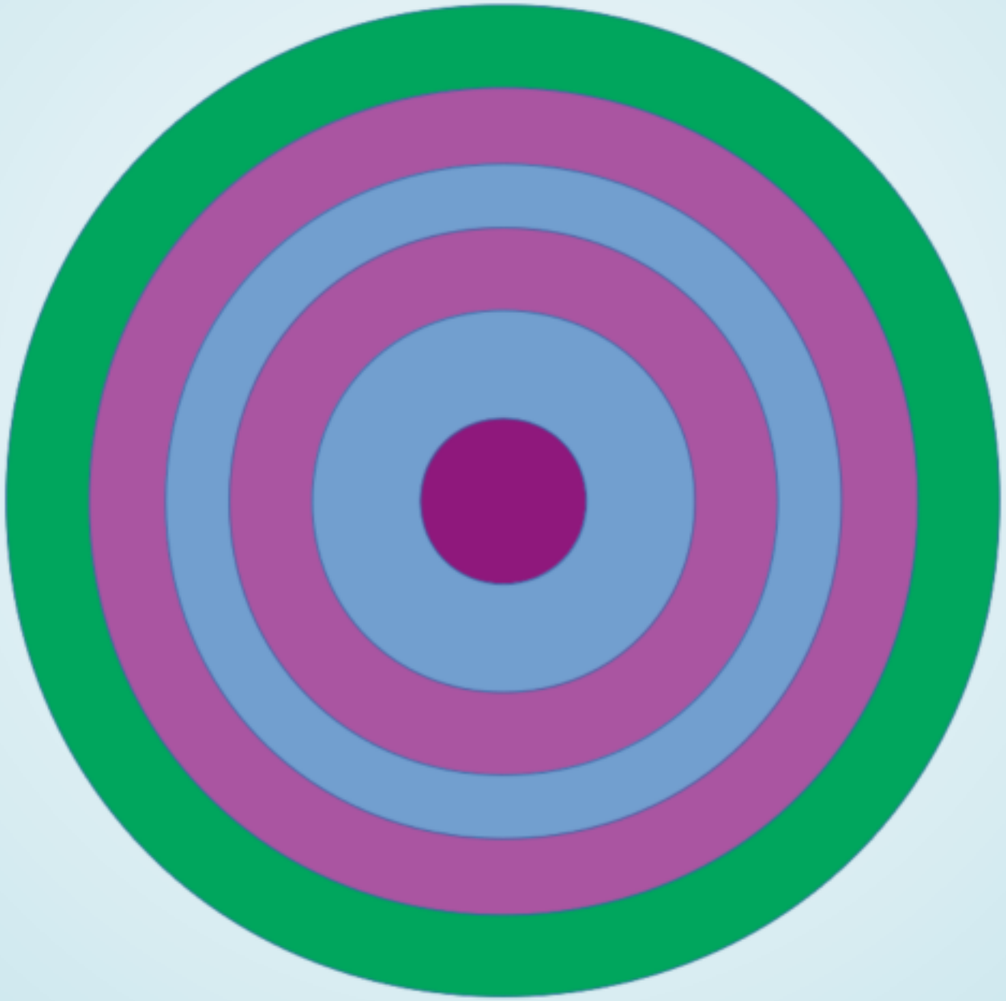


OUTSIDE IN

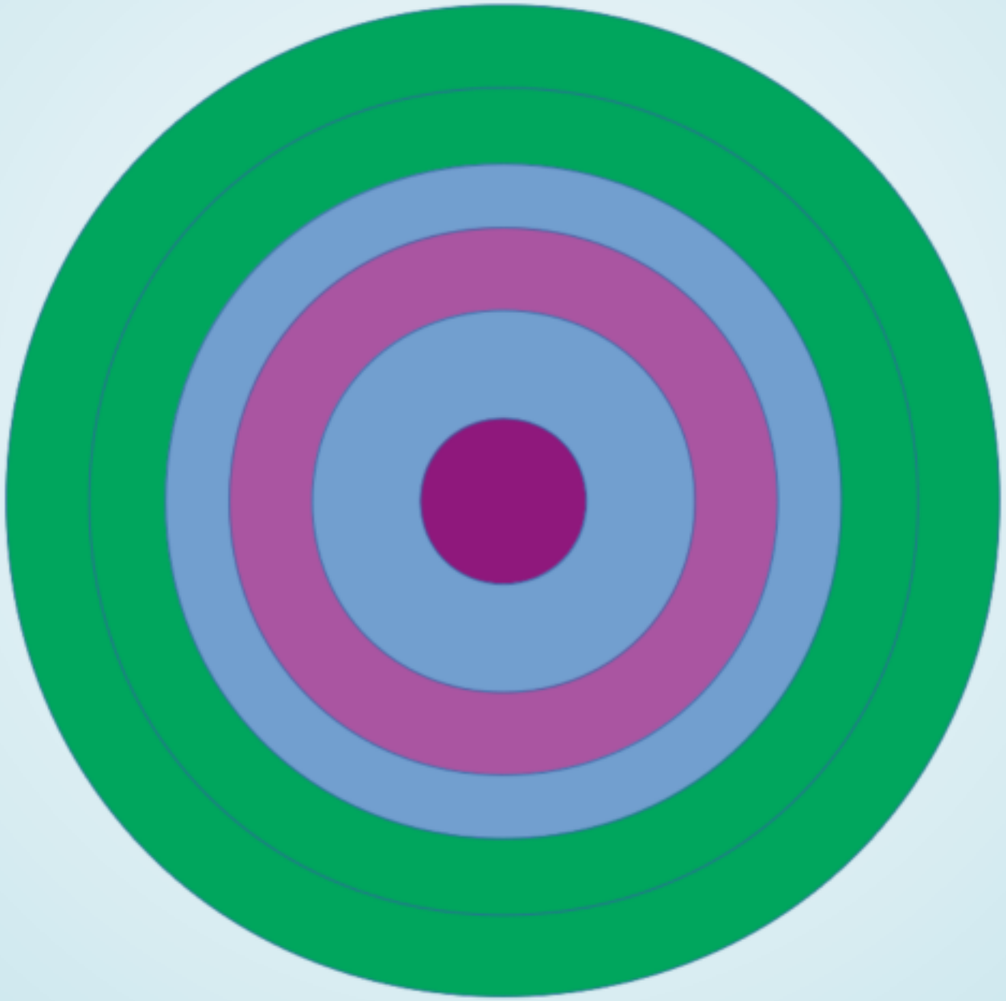
OUTSIDE IN


Outside-In
Outside-In
GUI
Database / Event Queue
/ External System

OUTSIDE IN



OUTSIDE IN



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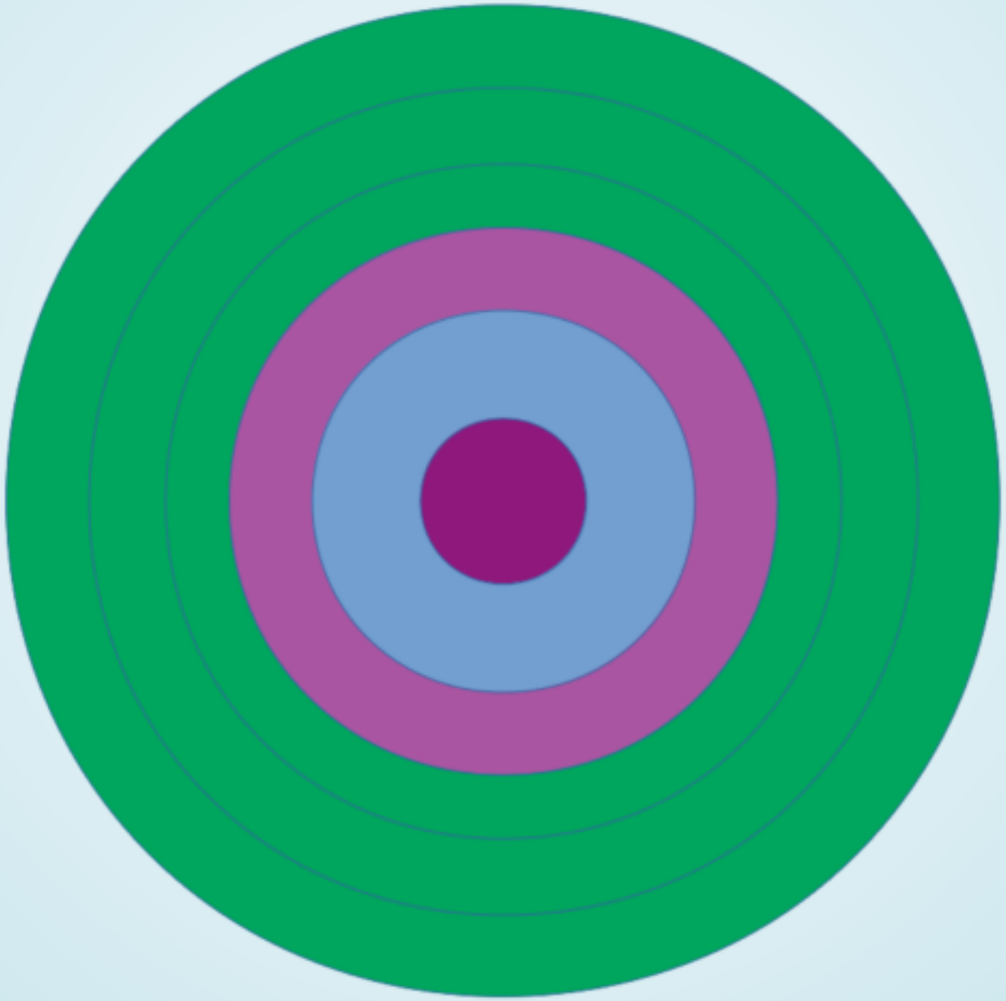
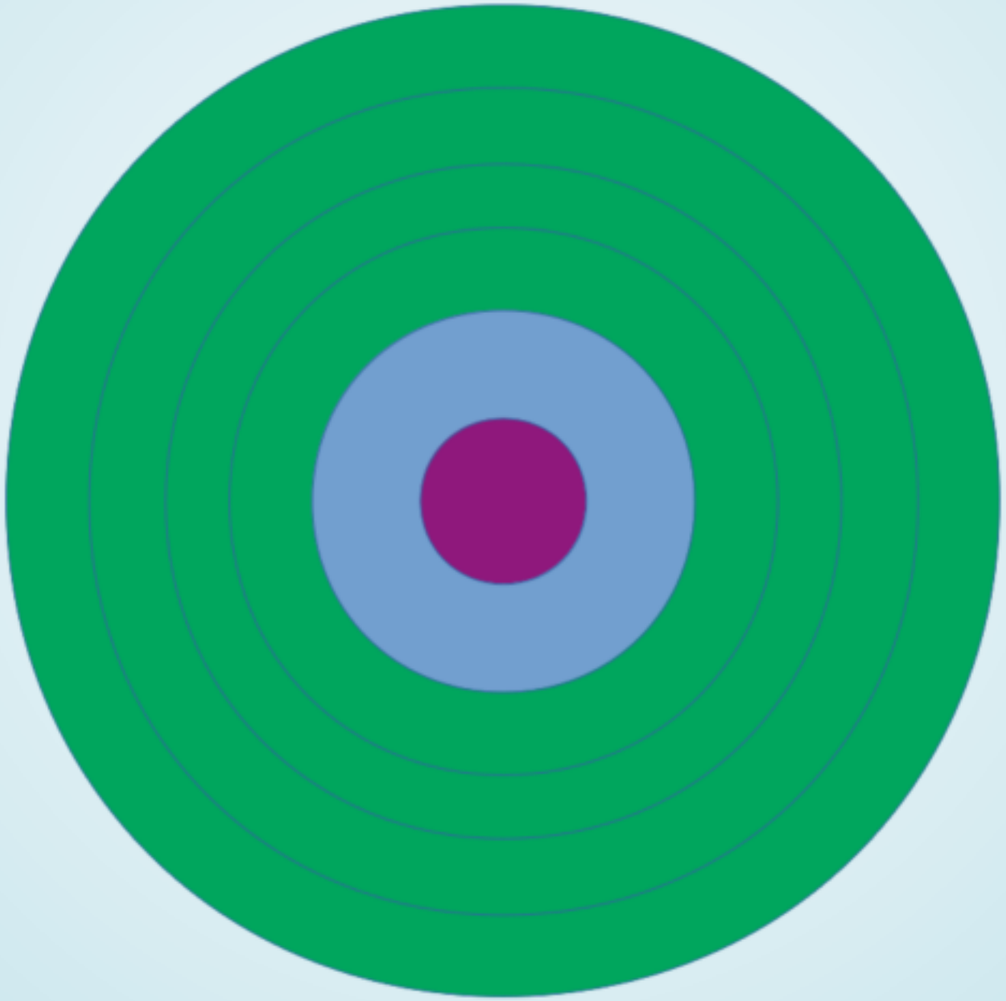
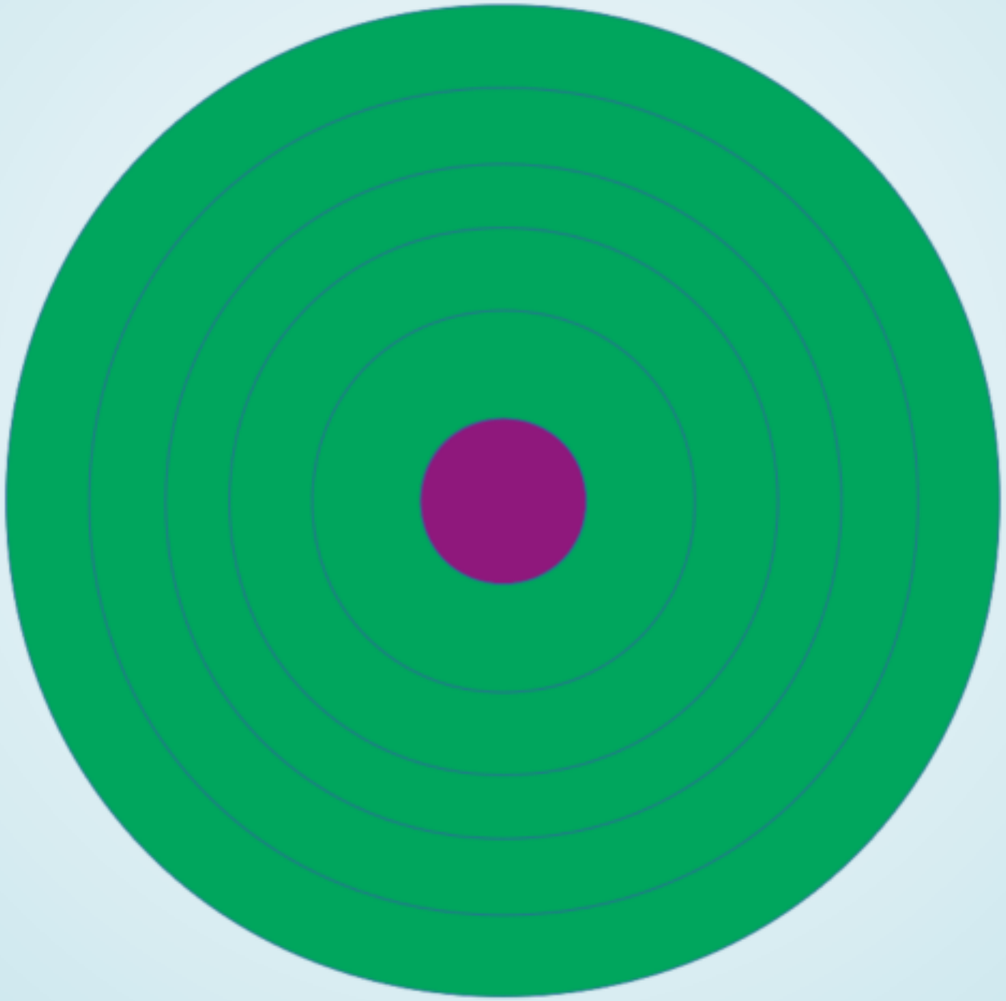


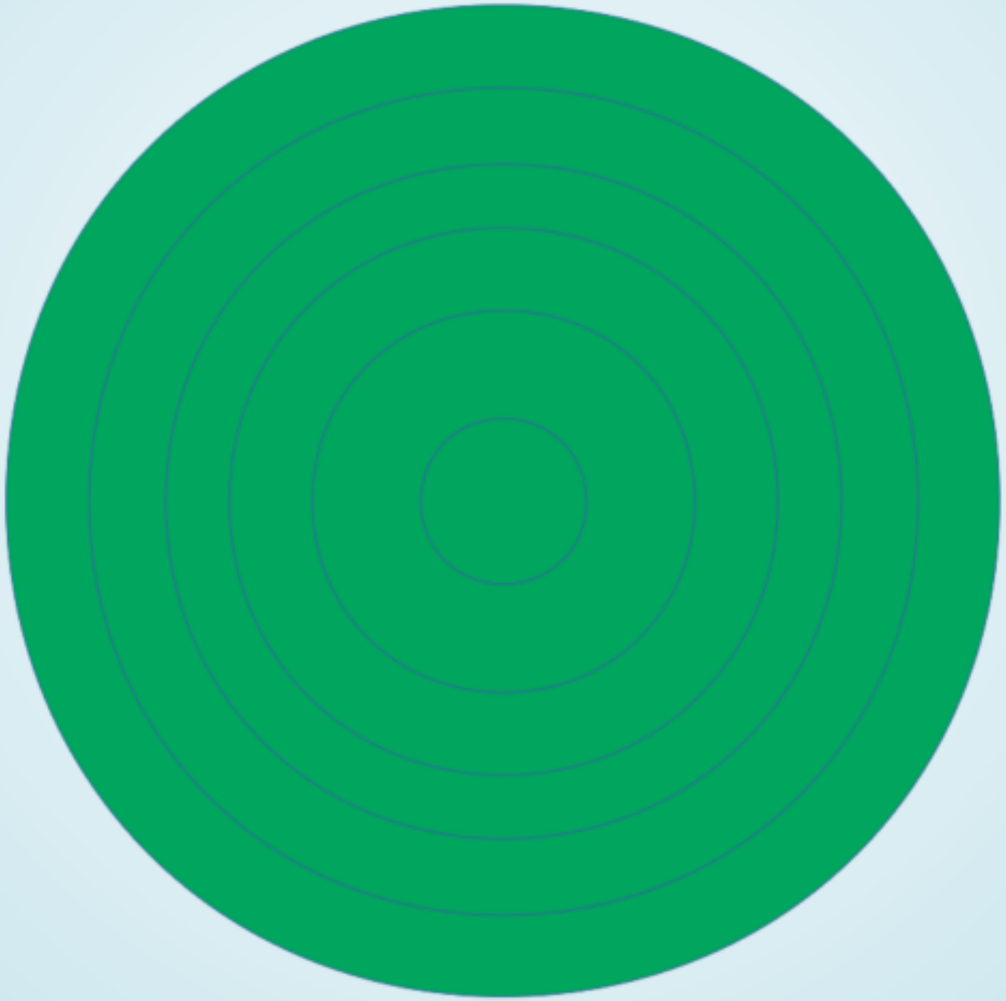
OUTSIDE IN



OUTSIDE IN



OUTSIDE IN



SCHOOLS

SCHOOLS

COMPARE?

EXAMPLE

BANK KATA

Feiges
FruchtChey
Feige mit Vodka
Likör
20ml e
Kobold

BANK KATA

```
account.deposit(1000);
account.deposit(2000);
account.withdraw(500);
account.printStatement()
```

```
Date        Amount Balance
14.01.2019 +1000  1000
15.01.2019 +2000  3000
16.01.2019 -500   2500
```

BANK KATA

- Original by Sandro Mancuso
  https://github.com/sandromancuso/Bank-kata
- Kata-Log by Egga Hartung
  (Softwerkskammer Berlin)
  http://kata-log.rocks/banking-kata

Kata-Log

All Topics

Choose Your Level

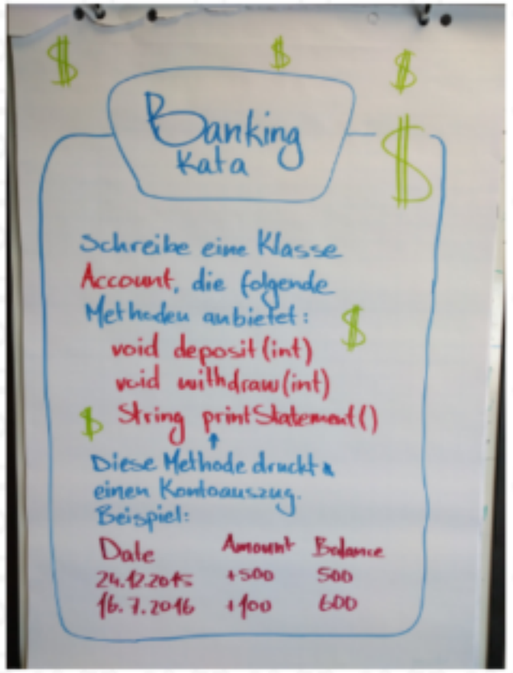
- Starter
- Experienced

Choose a Topic

- Agile
- BDD
- Golden Master
- Mocks
- Outside-In
- Pair-Programming
- Refactoring
- SOLID Principles
- Software-Design
- TDD

Choose a Constraint

Banking Kata



Credits

Inspired by Sandro Mancuso

Your Task

Your bank is tired of its mainframe COBOL accounting software and they hired both of you for a greenfield project in - what a happy coincidence

- your favorite programming language!

BIG UP FRONT DESIGN

VS

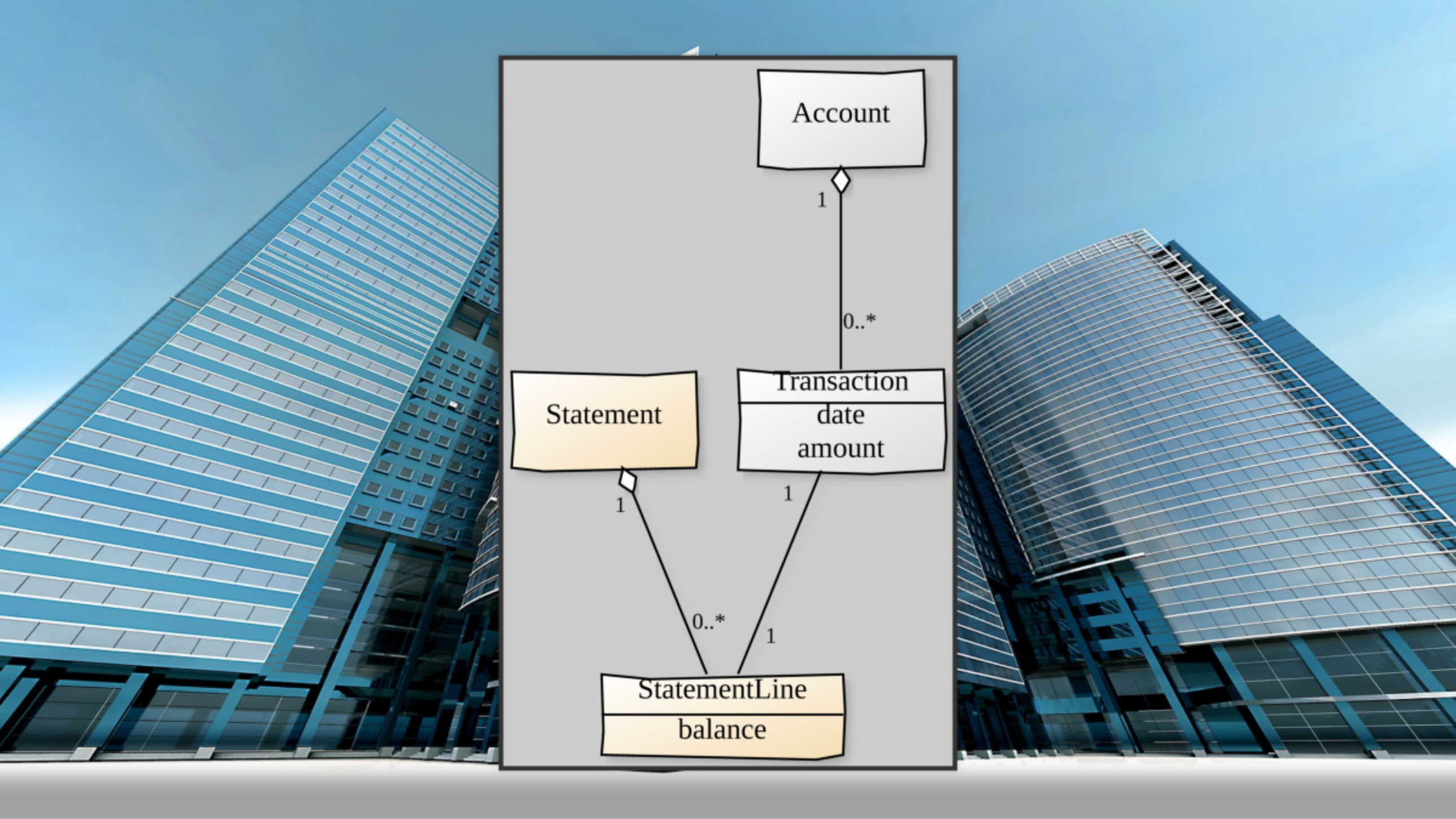
EMERGENT DESIGN

BDUF

EMERGENT DESIGN?

BRAIN-ON-MODE

THINK-AHEAD-BUT-NOT-TOO-MUCH-APPROACH


Account
1
0..*
Statement
Transaction
date
amount
1
1
0..*
1
StatementLine
balance

CHICAGO
(CLASSIC)

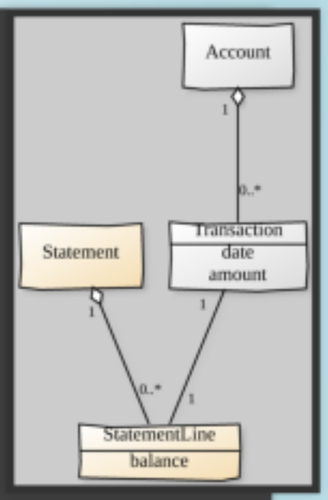
CHICAGO (CLASSIC)

- Inside-Out
- Integrated Tests
- TestDoubles only for Outside-Deps

DISCLAIMER

Transaction

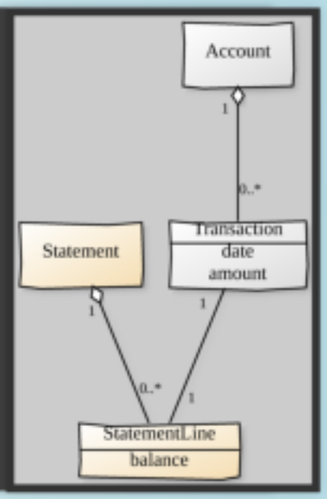
```
describe('Transaction', () => {
  it('should hold date & amount', () => {
    const date = new Date(2019, 0, 10);
    const amount = 1200;

    const transaction = new Transaction(date, amount);

    expect(transaction.date).toEqual(date);
    expect(transaction.amount).toEqual(amount);
  })
});
```




```
export class Transaction {
  constructor(date, amount) {
    this.date = date;
    this.amount = amount;
  }
}
```

formattedDate

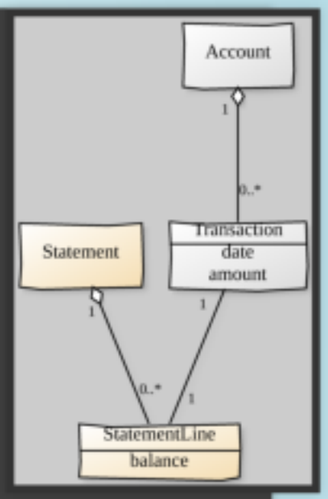
```
describe('formattedDate', () => {
  it('formats a string for a Date', () => {
    expect(
      formattedDate(new Date(2019, 0, 10))
    ).toEqual(
      "10.1.2019"
    );
  });
});
```




```
export const formattedDate = date =>
  `${date.getDate()}` +
  `.${date.getMonth() + 1}` +
  `.${date.getFullYear()}`;
```

StatementLine

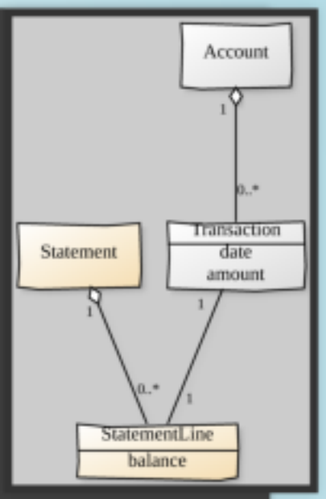
```
describe('StatementLine#toString', () => {
  it('should return a formatted string', () => {
    const transaction = new Transaction(new Date(2019, 0, 10), 1000);

    const statementLine = new StatementLine(transaction, 3000);

    expect( statementLine.toString() ).toEqual(
      "10.1.2019\t+1000\t3000"
    );
  });
});
```




```
export class StatementLine {
  toString() {
    return "10.1.2019\t+1000\t3000";
  }
}
```

Triangulation

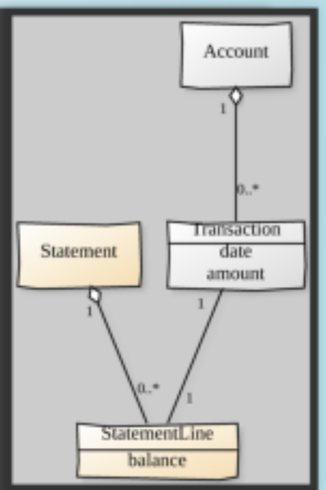
```
    ...
    expect( statementLine.toString() ).toEqual(
      "10.1.2019\t+1000\t3000"
    );
  });

  it('returns a formatted string for 2nd Transaction', () => {
    ...
    expect( statementLine.toString() ).toEqual(
      "14.1.2019\t+500\t2000"
  ...
```




```
import { formattedDate } from "./formattedDate";
export class StatementLine {
...
toString() {
    return `${formattedDate(this.transaction.date)}\t` +
           `+${this.transaction.amount}\t` +
           `${this.balance}`;
  }
}
```

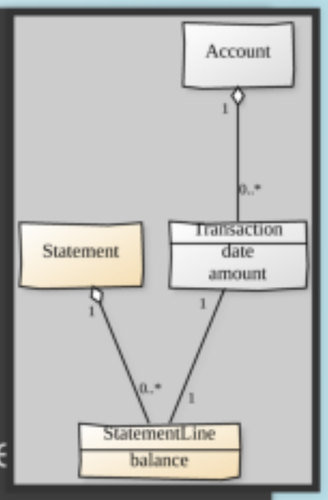
Statement - Spec

```
describe('Statement', () => {
  it('should print a blank Statement', () => {
...
  it('should print a Statement with 1 Transaction', () => {
...
  it('should print a Statement with 2 Transactions', () => {
    const account = new Account();
    account.deposit(new Date(2019, 0, 10), 1000);
    account.deposit(new Date(2019, 0, 13), 2000);
    const statement = new Statement(account);
    expect( statement.toString() ).toEqual(
      "Date\tAmount\tBalance\n" +
      "10.1.2019\t+1000\t1000\n" +
      "13.1.2019\t+2000\t3000"
    );
  })
```



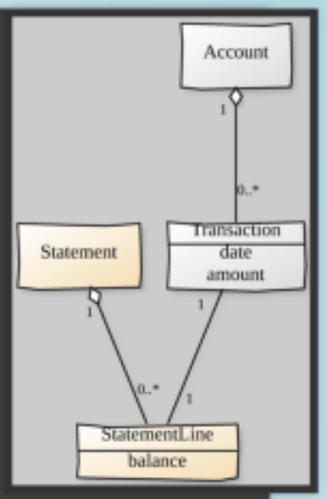
Statement - Implementation

```
import { StatementLine } from "./StatementLine";

export class Statement {
  constructor(account) { this.account = account; }
  toString() {
    return "Date\tAmount\tBalance\n" +
      this.account.transactions
        .reduce(
          (lines, t) => lines.concat(new StatementLine(t, this.balance
        ).map(sl => sl.toString()).join("\n");
  }

  balanceForLines(lines) {...
  lastLine(lines) {...
  areLinesEmpty(lines) {...
}
```



Account

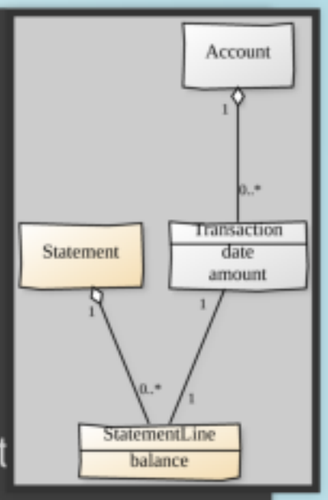
```
  it('should add new Transactions on Deposit', () => {...
  it('should add two new Transactions on two Deposits', () => {
    const account = new Account();

    account.deposit(new Date(2019, 0, 10), 2000);
    account.deposit(new Date(2019, 0, 14), 1000);

    expect( account.transactions ).toEqual( [
      new Transaction(new Date(2019, 0, 10), 2000),
      new Transaction(new Date(2019, 0, 14), 1000),
    ] );
  });
```




```
import { Transaction } from "./Transaction";

export class Account {
  constructor() { this.transactions = []; }

  deposit(date, amount) {
    this.transactions.push(new Transaction(date, amount));
  }
}
```

account.print()

```
describe('Account', () => {
  ...
  it('should print a Statement', () => {
    const printFn = jest.fn();
    const account = new Account();
    account.deposit(new Date(2019, 0, 10), 2000);
    account.deposit(new Date(2019, 0, 14), 1000);
    account.print(printFn);
    expect(printFn).toHaveBeenCalledWith((new Statement(account)).toSt
  });
});
```




```
import { Transaction } from "./Transaction";
import { Statement } from "./Statement";

export class Account {
  ...
  print(printFn) {
    const statement = new Statement(this);
    printFn(statement.toString());
  }
```

CONSEQUENCES OF CHICAGO CLASSIC

- - Can be fragile
- - Can be slow
- - Defect Localization is hard

CHICAGO
(MODERN)

CHICAGO (MODERN)

- J.B. Rainsberger
- Jay Fields
- Roy Osherove
- ...

CHICAGO (MODERN)

- Inside-Out
- Isolated Tests
- Lot of Stubs / Some Mocks

Spec for SUT: StatementLine
NOT SUT: Transaction, StatementLine

```
describe('StatementLine#toString', () => {
  it('should return a formatted string', () => {
    const transaction = new Transaction(new Date(2019, 0, 10), 1000);
    const statementLine = new StatementLine(transaction, 3000);
    expect( statementLine.toString() ).toEqual(
      "10.1.2019\t+1000\t3000"
    );
  });
```

```
import { formattedDate } from "./formattedDate";

export class StatementLine {
  constructor(transaction, balance) {
    this.transaction = transaction;
    this.balance = balance;
  }
  toString() {
    return `${formattedDate(this.transaction.date)}\t+${this.transaction.amount}
  }
}
```

SUT: StatementLine

```
it('should return a formatted string', () => {
  const transaction = new Transaction(new Date(2019, 0, 10), 1000);
  const statementLine = new StatementLine(transaction, 3000);
  ...
});
```

↓ Refactoring: replace Class with Stub

```
it('should return a formatted string', () => {
  const transaction = {date: new Date(2019, 0, 10), amount: 1000};
  const statementLine = new StatementLine(transaction, 3000);
  ...
});
```

SUT: StatementLine

```
export class StatementLine {
  ...
  toString() {
    return `${formattedDate(this.transaction.date)}\t+${this.transaction.amount}
  }
}
```

↓ Refactoring: Inject Function Dependency

```
export class StatementLine {
  ...
  toString(dateFormat) {
    return `${dateFormat(this.transaction.date)}\t+${this.transaction.amount}\t$
  }
}
```

```
it('should return a formatted string', () => {
  ...
  expect( statementLine.toString() ).toEqual(
    "10.1.2019\t+1000\t3000"
});
```

↓ Refactoring: Inject Function Dependency

StatementLine Spec (isolated)

```
it('should return a formatted string', () => {
  ...
  const germanDateFormat = jest.fn().mockReturnValue("10.1.2019");
  ...
  expect( statementLine.toString(germanDateFormat) ).toEqual(
    "10.1.2019\t+1000\t3000"
  );
});
```

Refactoring: Rename Function

formattedDate → germanDateFormat

```
import { germanDateFormat } from "./germanDateFormat";

describe('germanDateFormat', () => {
  it('should return a string for a Date formatted to the German standard', () =>
    expect(germanDateFormat(new Date(2019, 0, 10))).toEqual("10.1.2019");
  });
});
```

```
export const germanDateFormat = date =>
  `${date.getDate()}.${date.getMonth() + 1}.${date.getFullYear()}`;
```

CONSEQUENCES OF CHICAGO MODERN

- + ~~can be fragile~~ mostly stable
- + ~~Can be slow~~ blazing fast
- + Defect Localization is ~~hard~~ easy

GENERAL CHICAGO CONSEQUENCES

- + Useful for Emergent Design/Experimentation
- + Applicable in most situations
- + Easy to learn
- - Needs more Refactoring than London
- - Dead/useless code possible: YAGNI

OTHER CHICAGO VARIANTS

- TDD as if you meant it
- Emergent TDD
- ...

LONDON

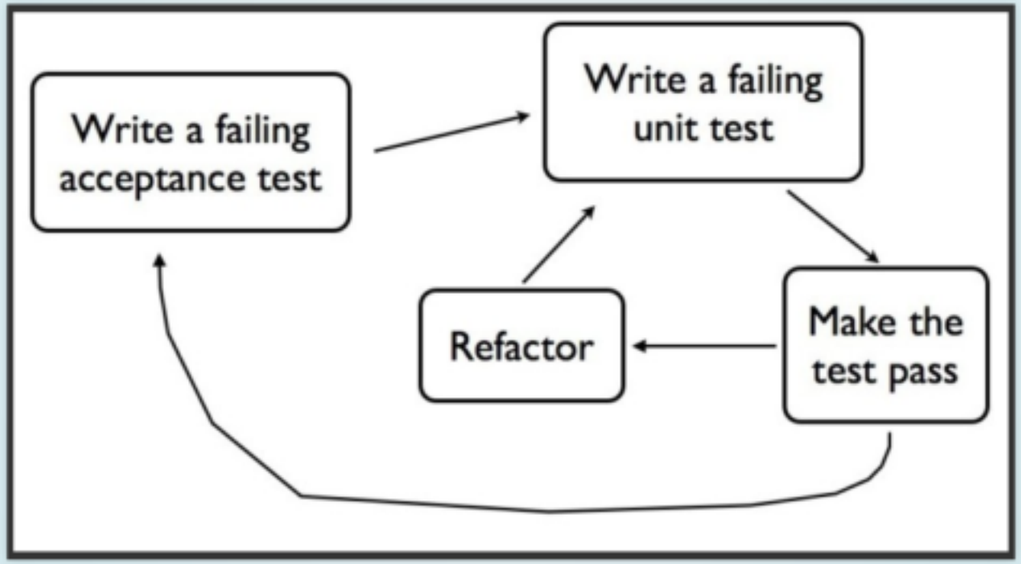
LONDON

=

OUTSIDE-IN WITH MOCKS

LONDON

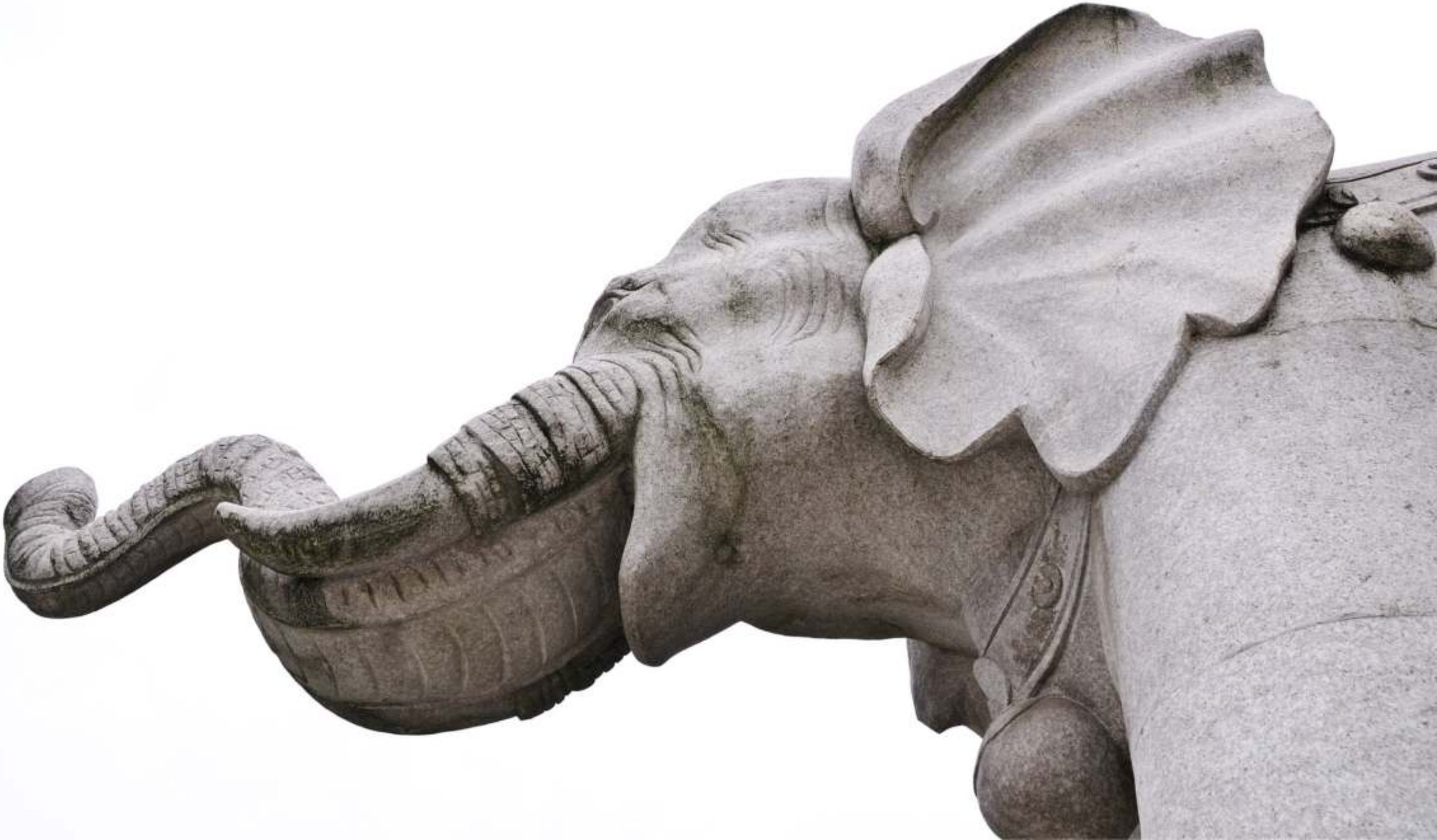
Double Loop ATDD



stolen from Emily Bache

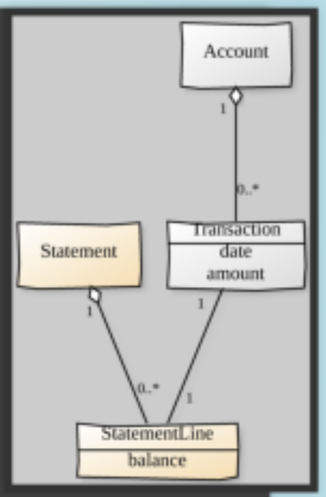
LONDON

- Double Loop ATDD
- Outside-In
- Mocks as main Verification Mechanism
- Less Refactoring



Acceptance Spec

```
describe('Banking Kata Acceptance Spec', () => {
  it('should print a Statement with two Deposits', () => {
    const printerFn = jest.fn();
    const account = new Account();
    account.deposit(Date(2012, 0, 10), 1000);
    account.deposit(Date(2012, 0, 13), 2000);

    account.print(printerFn);

    expect(printerFn).toHaveBeenCalledWith(
      "Date\tAmount\tBalance\n" +
      "10.1.2012\t+1000\t1000\n" +
      "13.1.2012\t+2000\t3000\n"
    );
  });
});
```

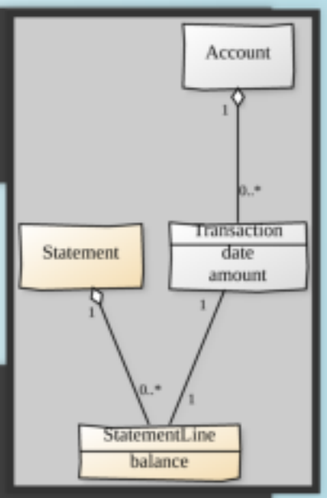


Acceptance Spec

```
describe('Banking Kata Acceptance Spec', () => {
  it('should print a Statement with two Deposits', () => {
  ...
```

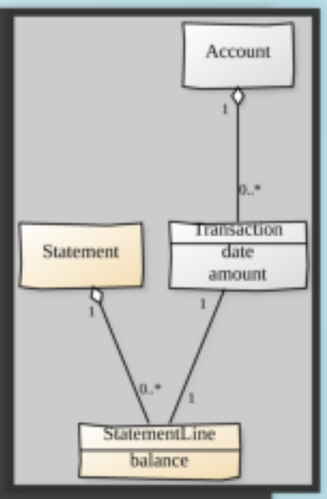
X-out

```
xdescribe('Banking Kata Acceptance Spec', () => {
  it('should print a Statement with two Deposits', () => {
  ...
```



Account Spec: deposit

```
describe('Account', () => {
  it('should add StatementLine of deposit to Statement', () => {
    const statement = {addLine: jest.fn()};
    const transaction = new Transaction(new Date(2012, 0, 13), 1000);
    const account = new Account(statement);

    account.deposit(new Date(2012, 0, 13), 1000);
    expect(statement.addLine).toHaveBeenCalledWith(
      transaction, 1000
    )
  });
```

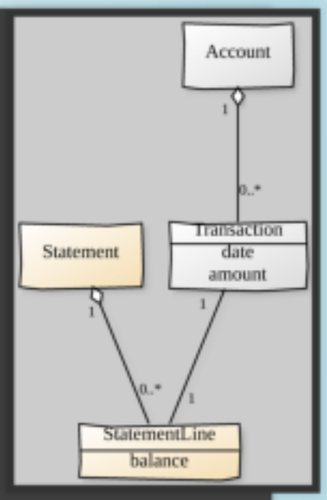


Account

```
class Account {
  constructor(statement) {
    this.statement = statement;
  }
  deposit(date, value) {
    this.statement.addLine(new Transaction(date, value), value);
  }
}
```

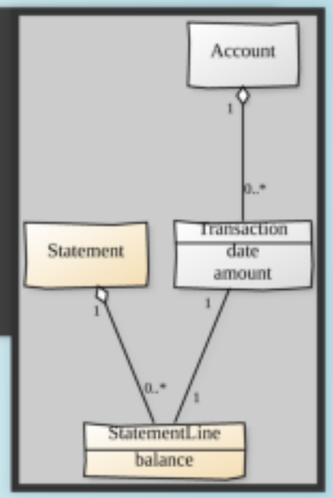
Account Spec: printStatement

```
describe('Account', () => {
  it('should add StatementLine of deposit to Statement', () => {
  ...

  it('should print Statement', () => {
    const statement = {print: jest.fn()};
    const account = new Account(statement);
    const printFn = jest.fn();
    account.printStatement(printFn);
    expect(statement.print).toHaveBeenCalledWith(printFn);
  });
});
```



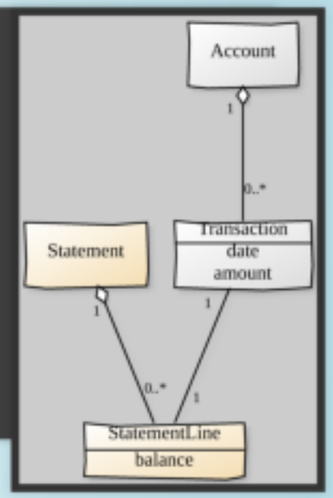
Account

```
class Account {
  ...
  printStatement(fn) {
    this.statement.print(fn);
  }
}
```



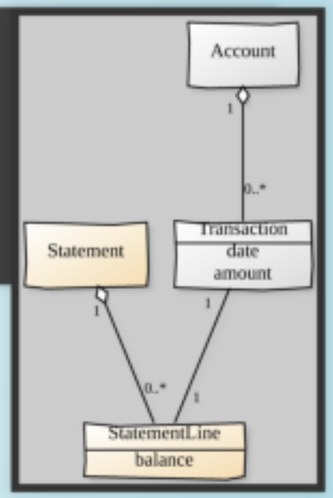
Statement

```
describe('Statement', () => {
  it('should print Header', () => {
    const printFn = jest.fn();
    const statement = new Statement()
    statement.print(printFn);
    expect(printFn).toHaveBeenCalledWith('Date\tAmount\tBalance');
  });
});
```



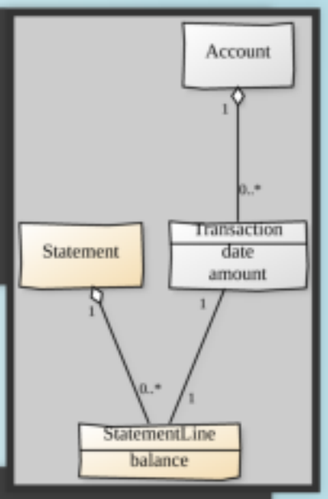
Statement

```
class Statement {
  print(printFn) {
    printFn('Date\tAmount\tBalance');
  }
}
```



Statement

```
class Statement {
  print(printFn) {
    printFn('Date\tAmount\tBalance');
  }
}
```

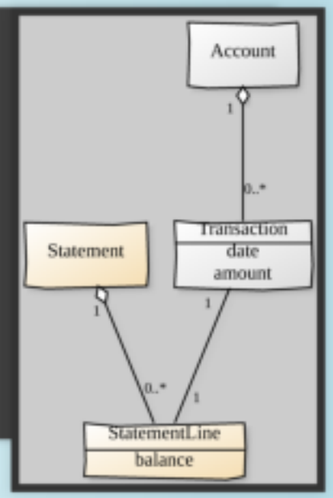


Refactoring: Extract Constant

```
class Statement {
  constructor() {
    this.STATEMENT_HEADER = 'Date\tAmount\tBalance';
  }

  print(printFn) {
    printFn(this.STATEMENT_HEADER);
  }
}
```

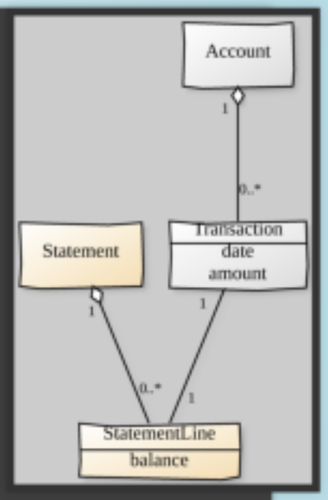
Statement Spec

```
describe('Statement', () => {
  it('should print Header', () => {
    const printFn = jest.fn();
    const statement = new Statement()
    statement.print(printFn);
    expect(printFn).toHaveBeenCalledWith(statement.STATEMENT_HEADER);
  });
});
```



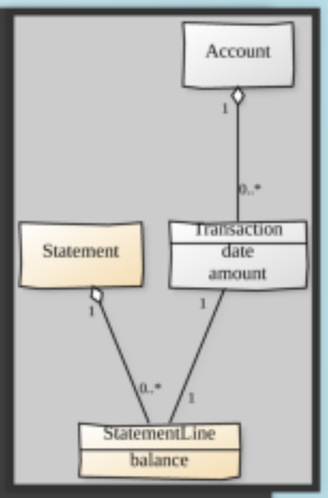
Statement Spec

```
...
  it('should print each line', () => {
    const printFn = jest.fn();
    const statementLine1 = {print: jest.fn()};
    const statementLine2 = {print: jest.fn()};

    const statement = new Statement()
    statement.addLine(statementLine1);
    statement.addLine(statementLine2);
    statement.print(printFn);

    expect(statementLine1.print).toHaveBeenCalledWith(printFn);
    expect(statementLine2.print).toHaveBeenCalledWith(printFn);
  });
});
```



Statement

```
class Statement {
  constructor() {
    this.STATEMENT_HEADER = 'Date\tAmount\tBalance';
    this.lines = [];
  }

  addLine(statementLine) {
    this.lines.push(statementLine);
  }

  print(printFn) {
    printFn(this.STATEMENT_HEADER);
    this.lines.forEach(l => l.print(printFn));
  }
}
```



LONDON CONSEQUENCES

LONDON CONSEQUENCES

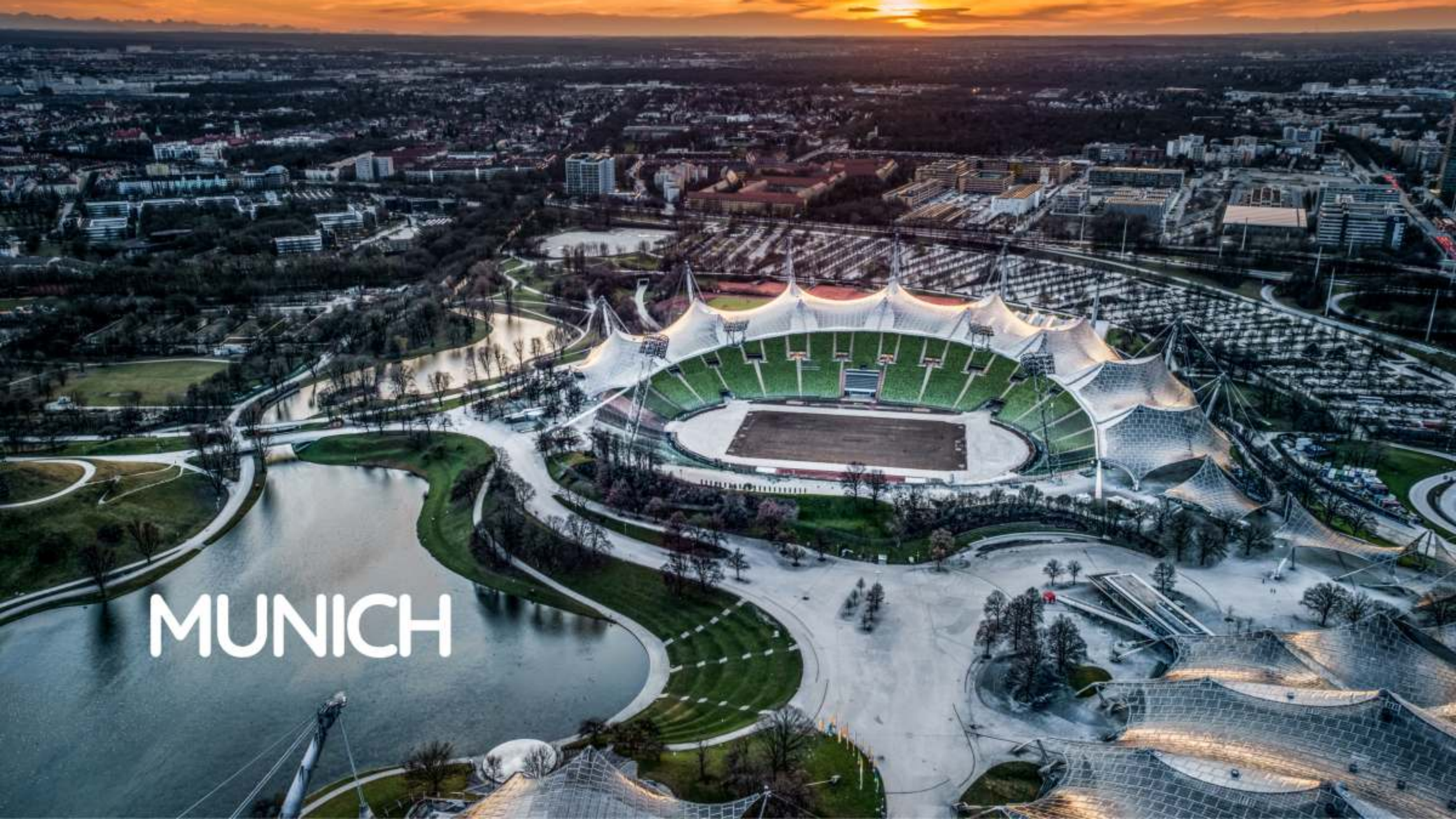
- + No YAGNI
- + Obvious next step
- Leads to "Tell Don't Ask"-design
- Easier for known designs
- - Design harder to refactor
- - Mocking is hard

TEST DOUBLES

MOCKS

156

BCCL


MUNICH

MUNICH

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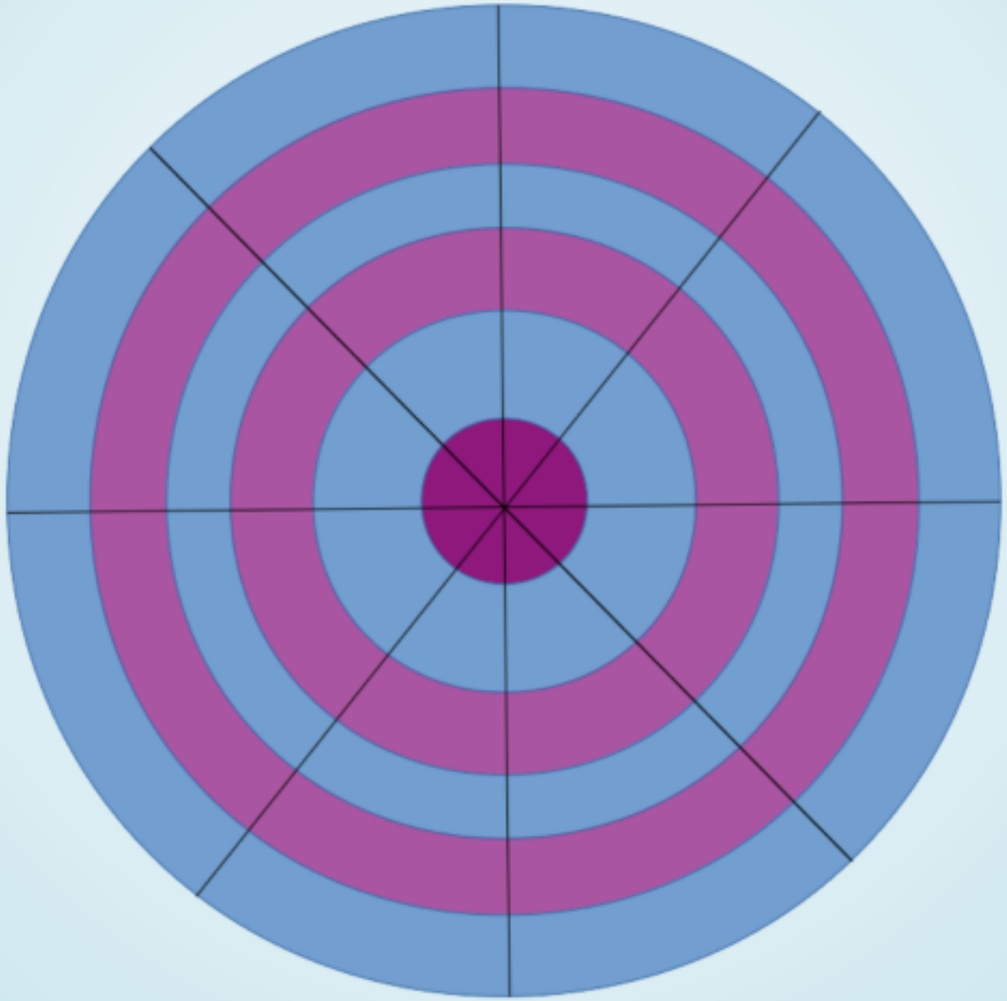
FAKE-IT OUTSIDE-IN

MUNICH

- Outside-In
- with or without Mocks
- Very Large Amount of Refactorings

MUNICH



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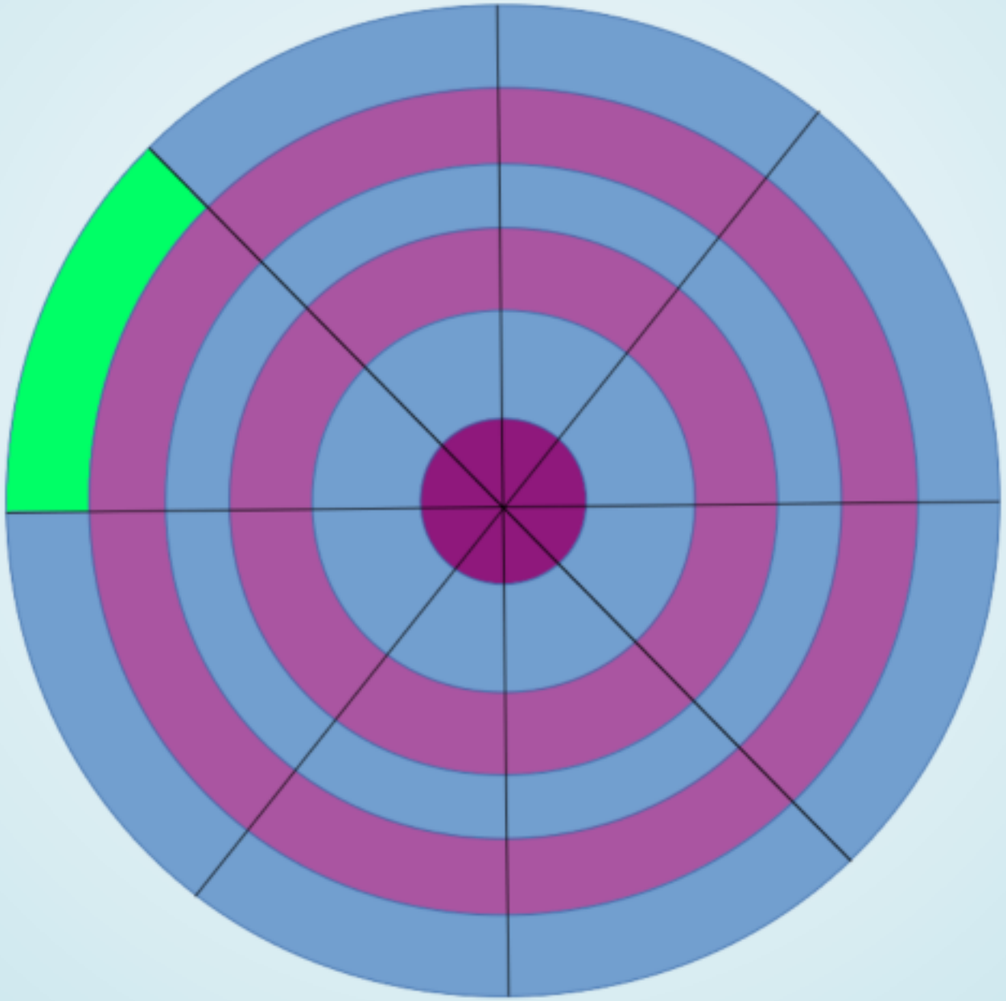

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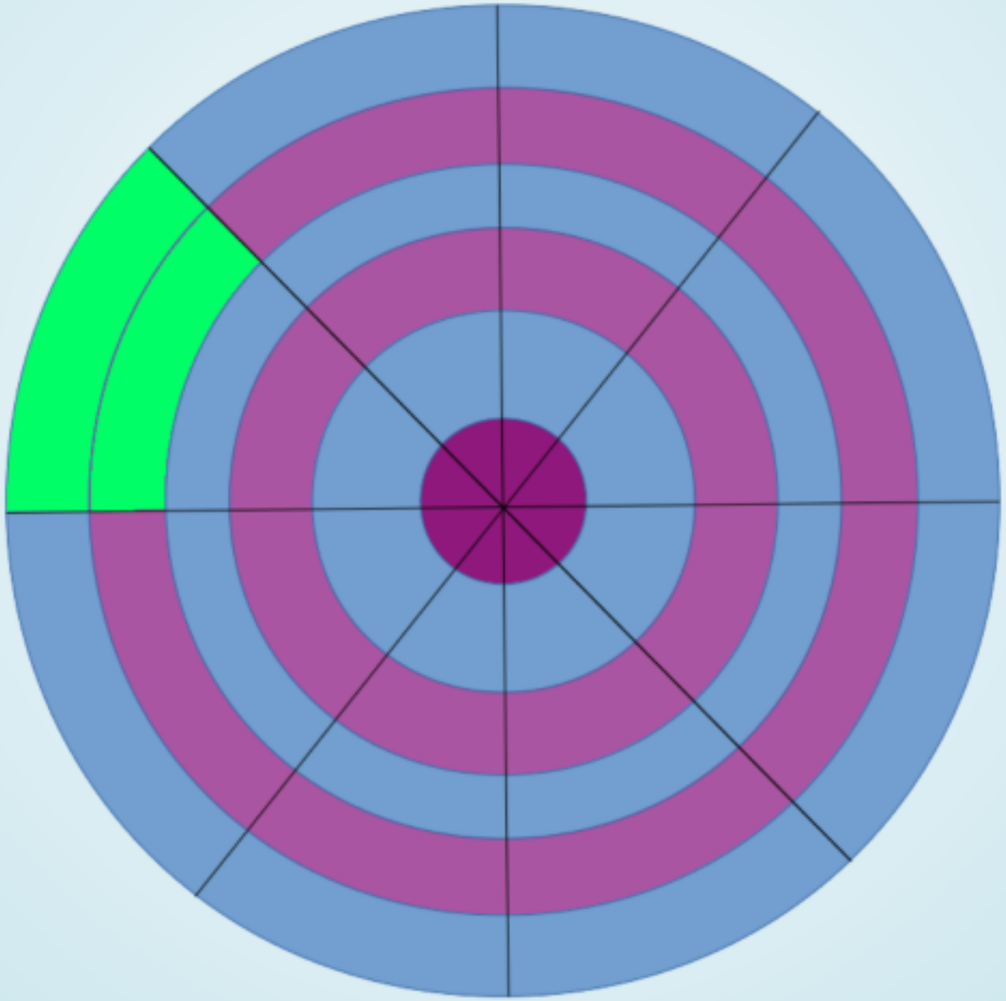

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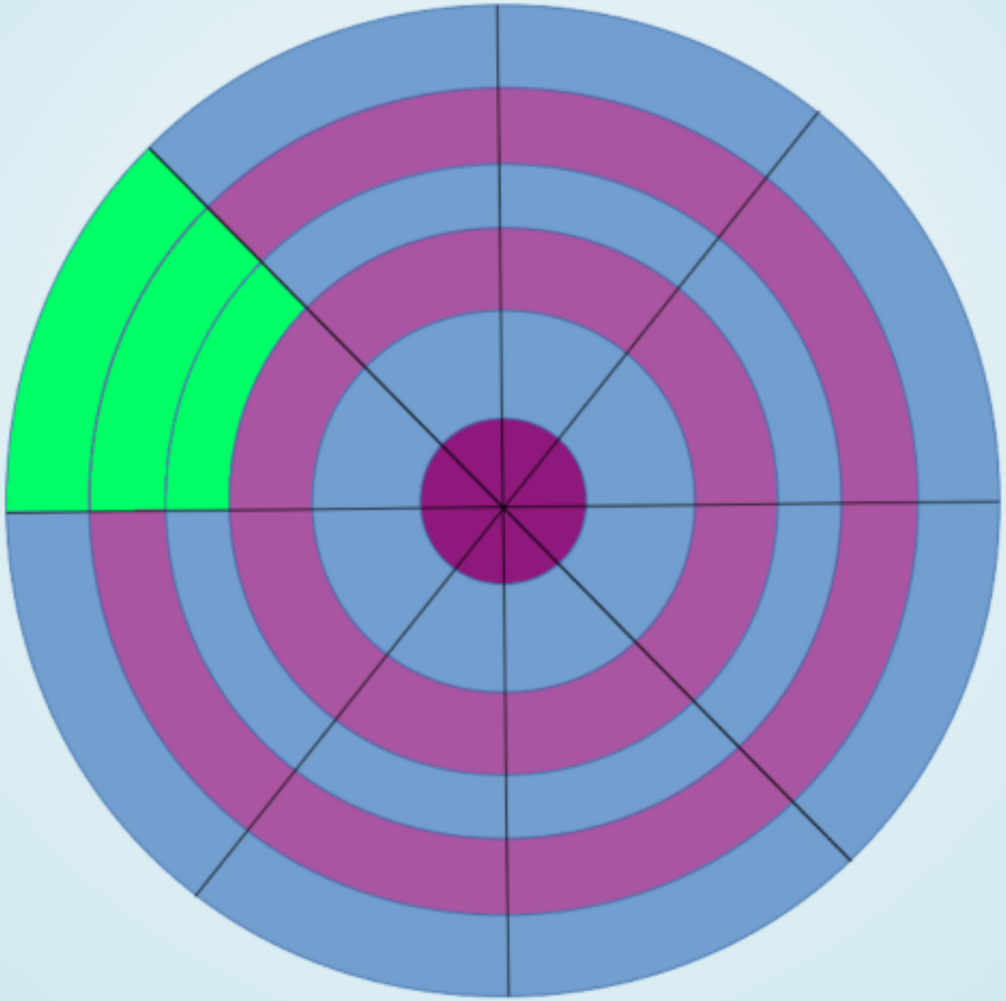

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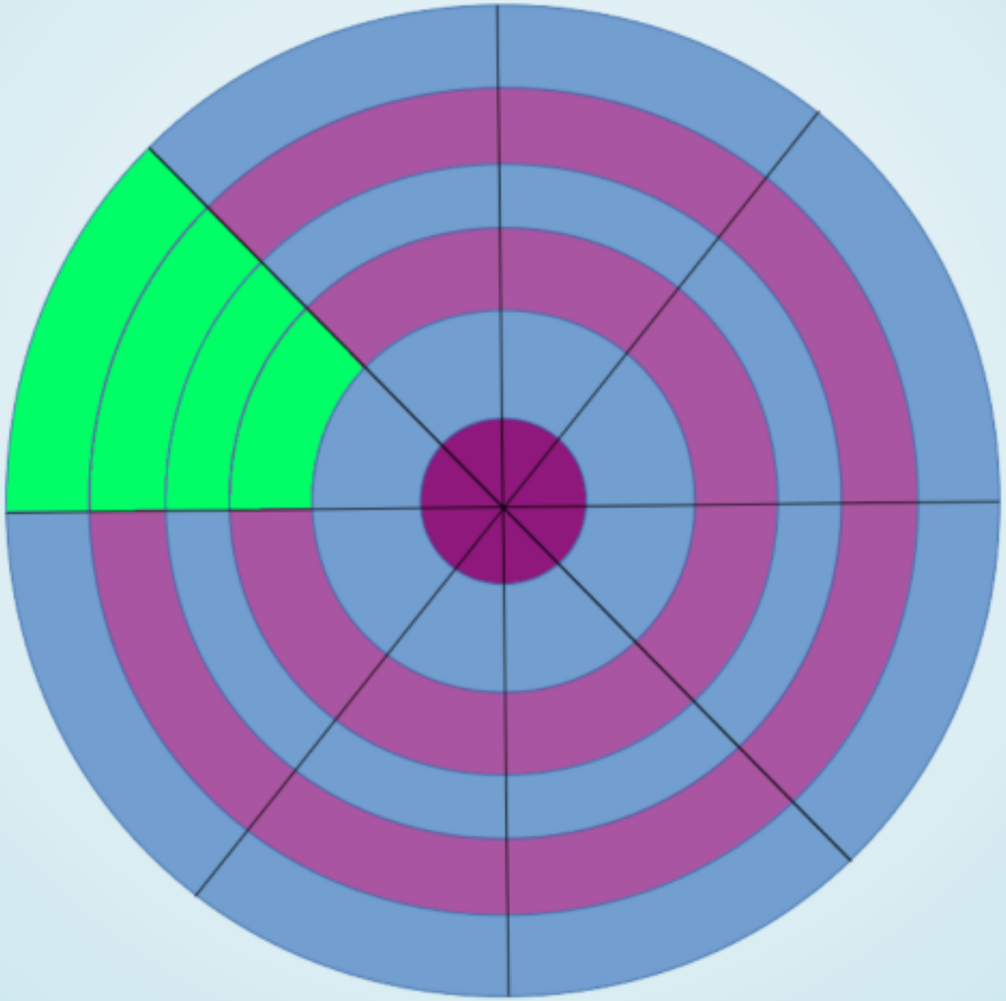

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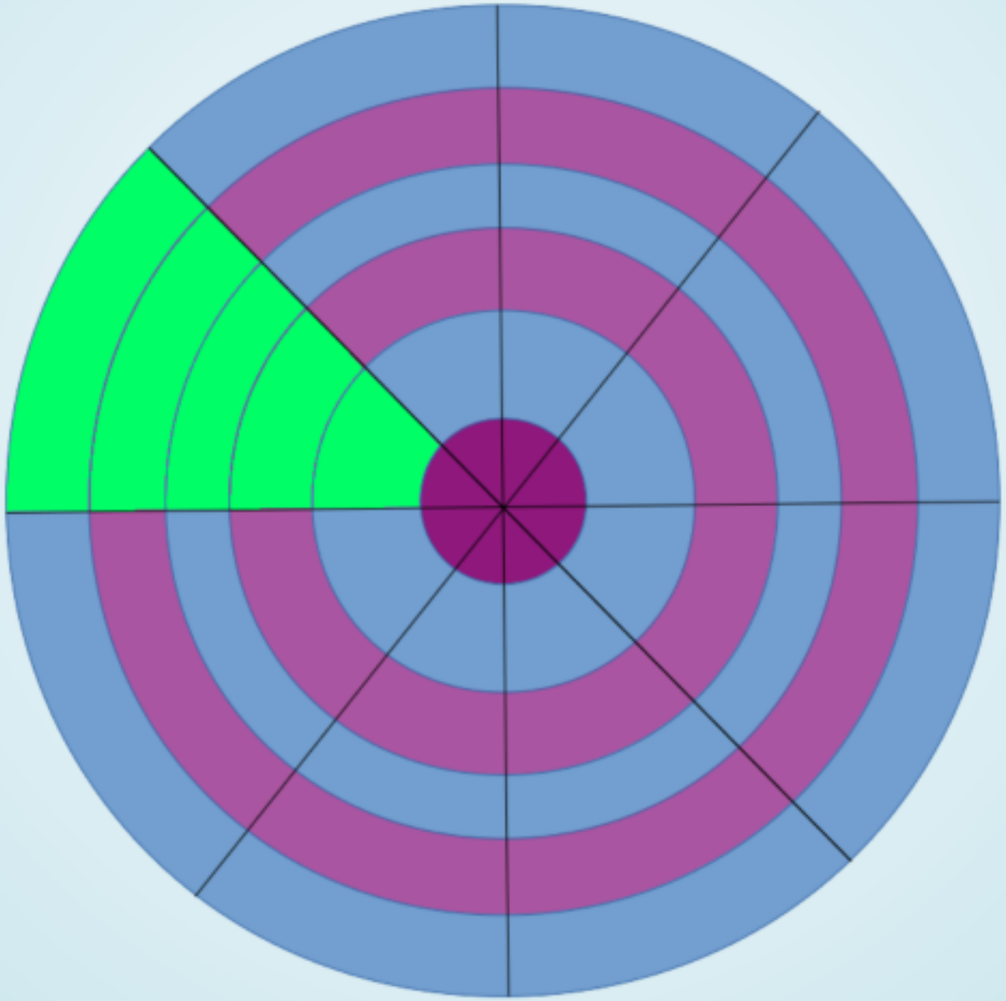

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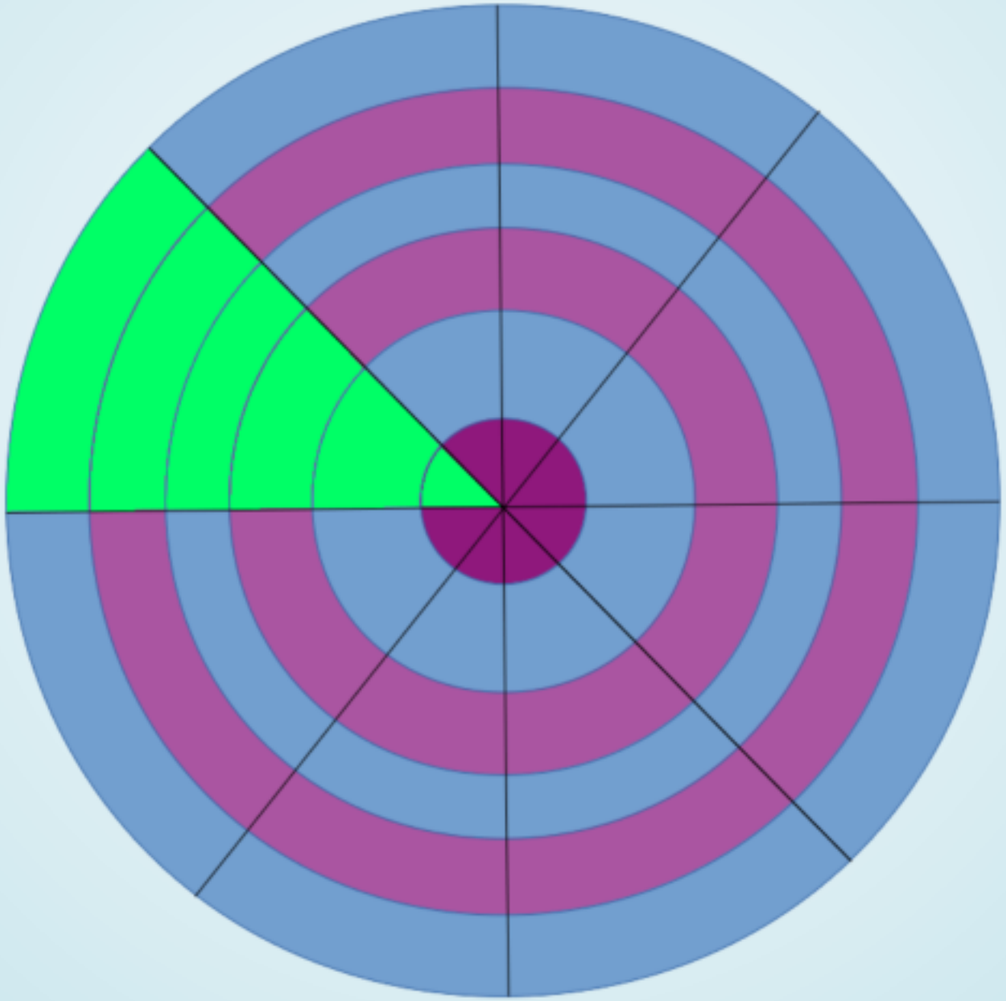

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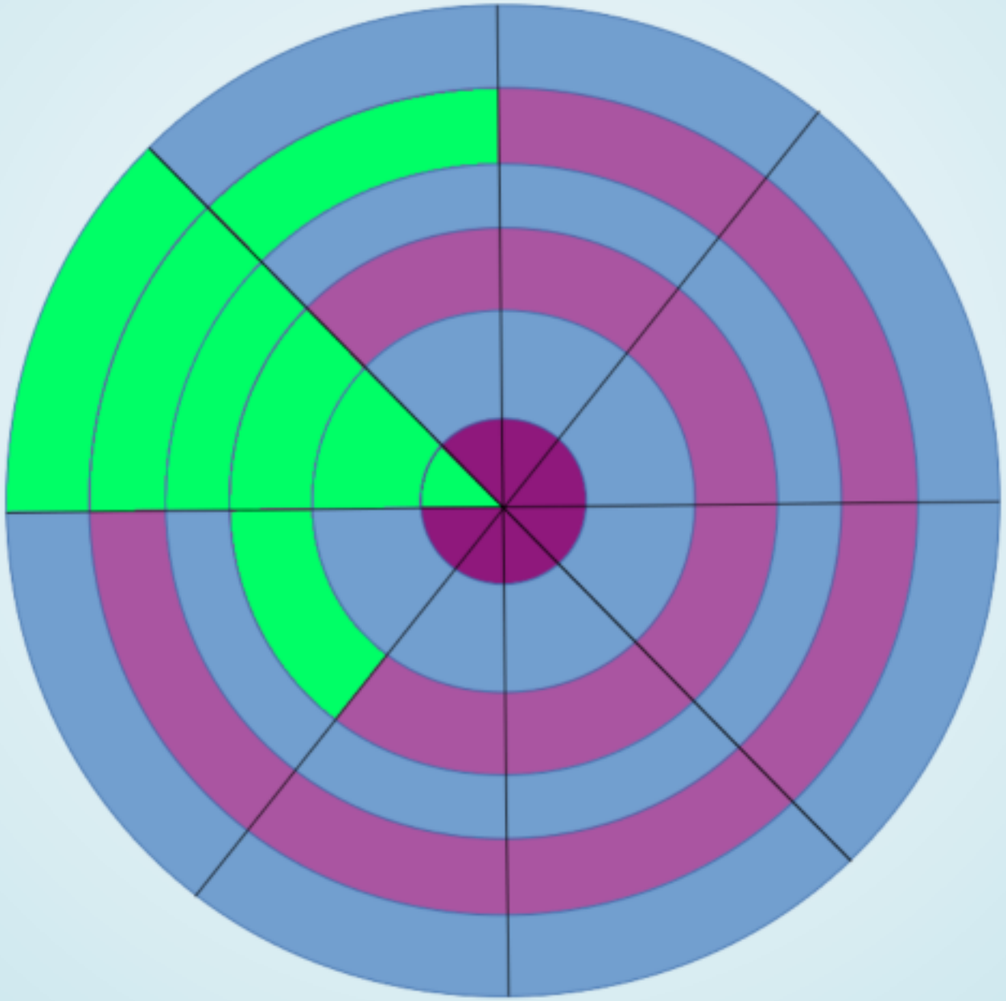

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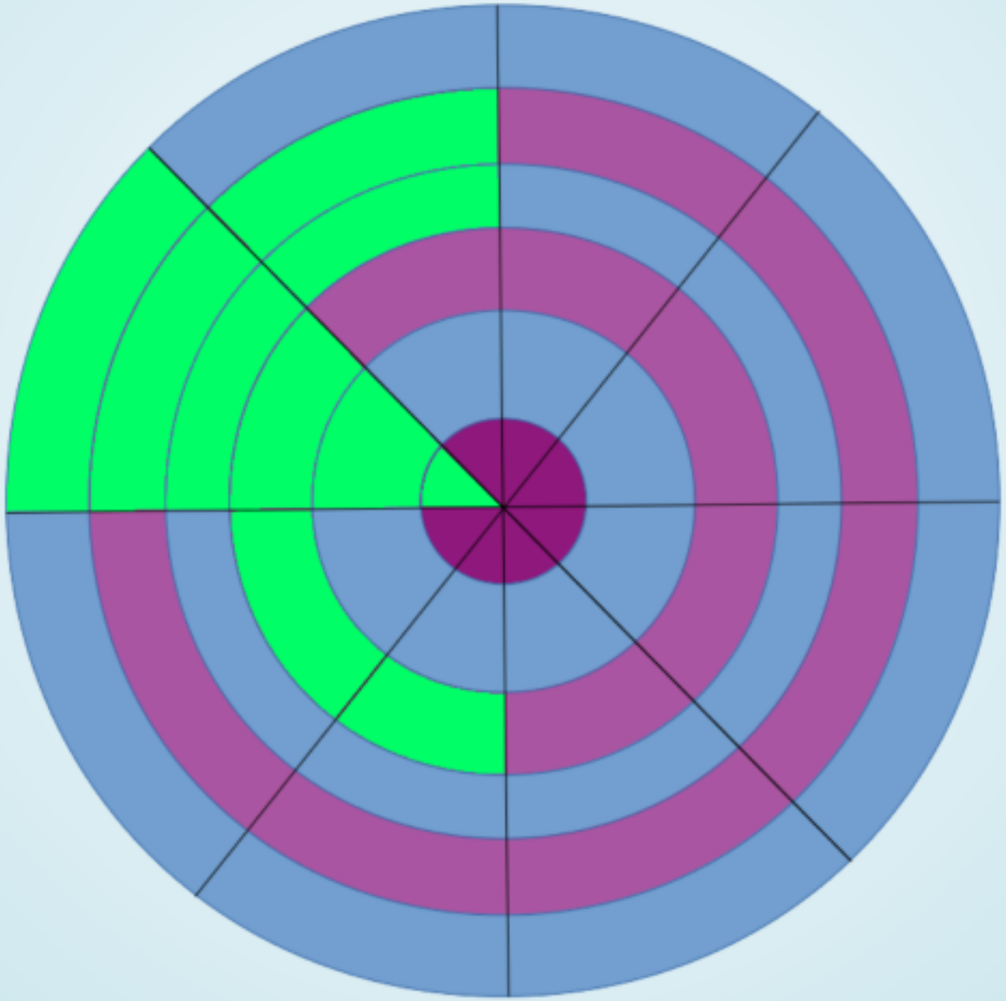

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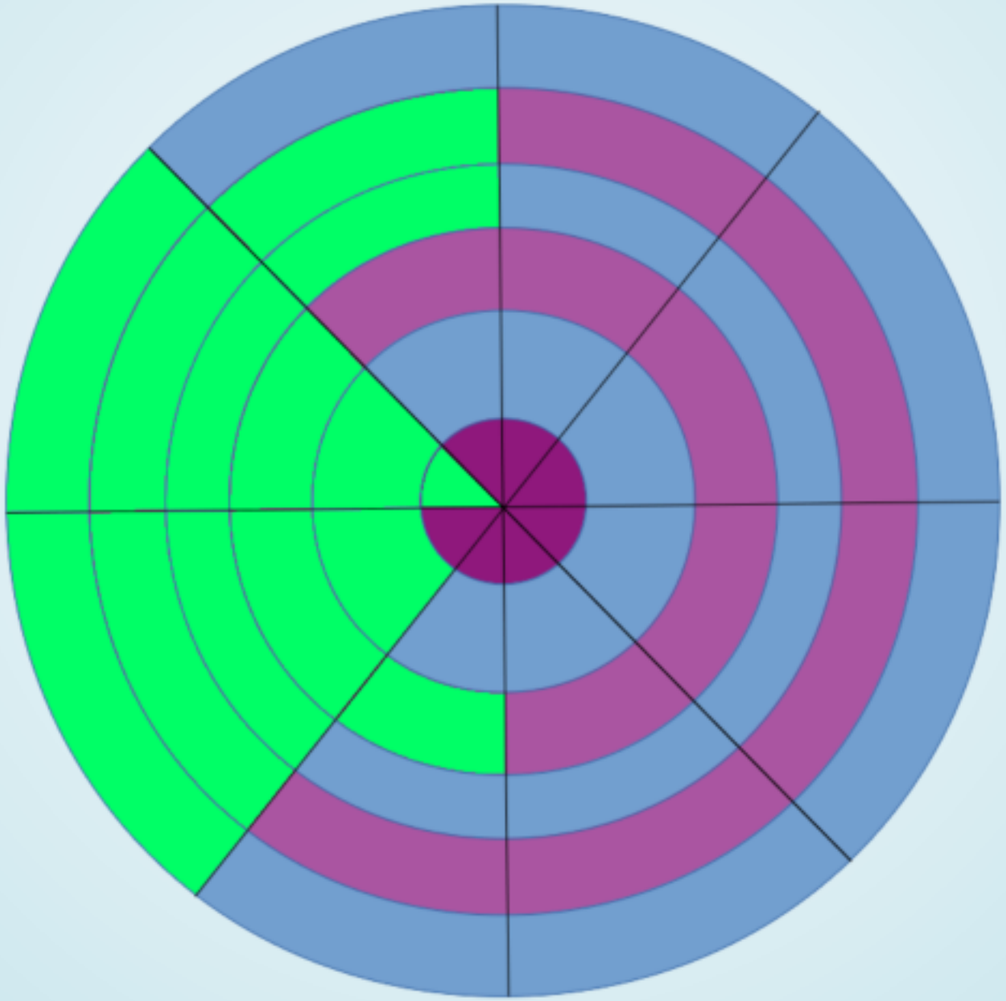

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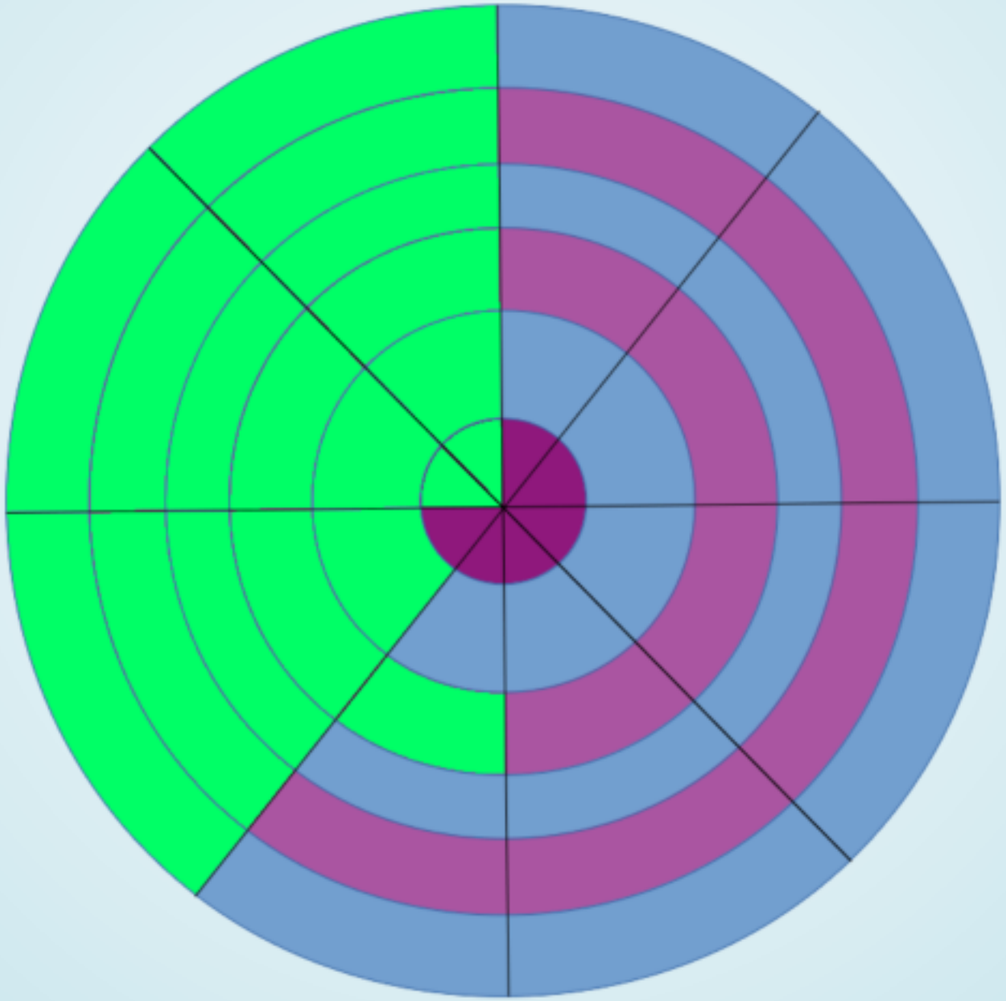

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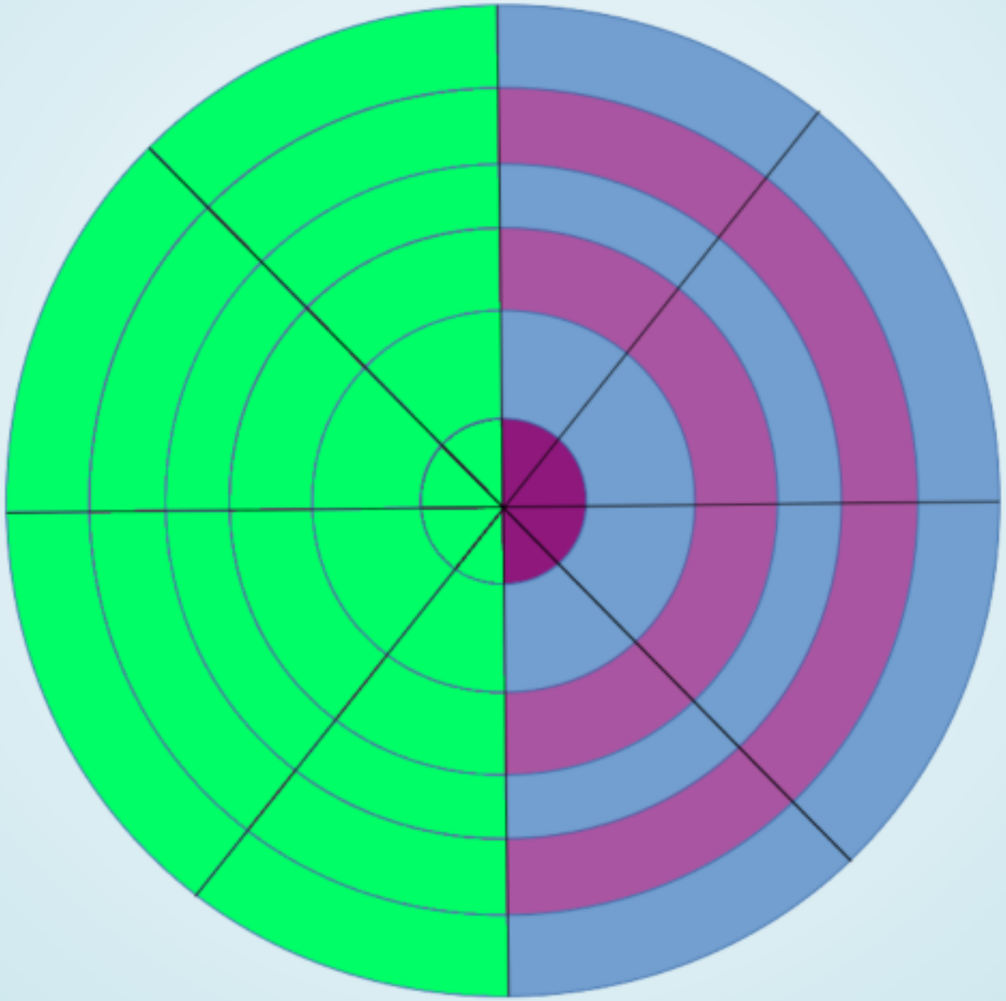

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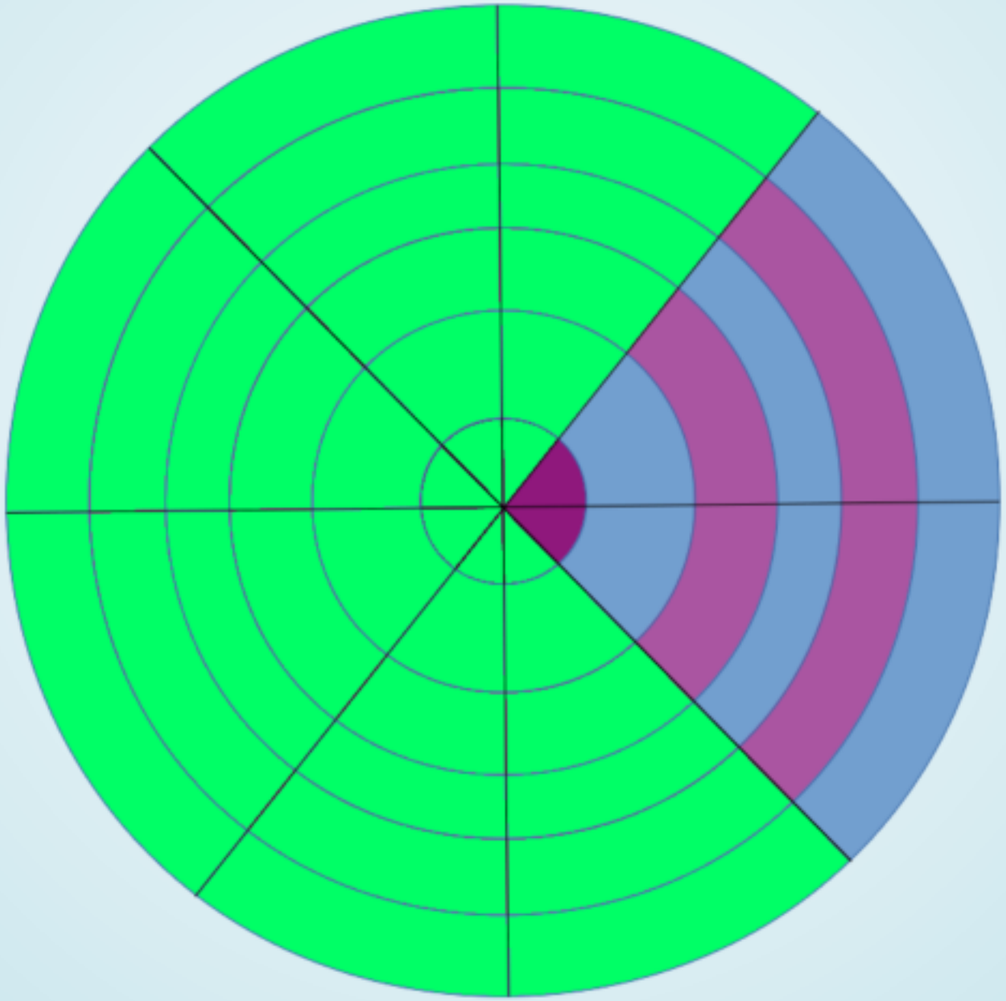

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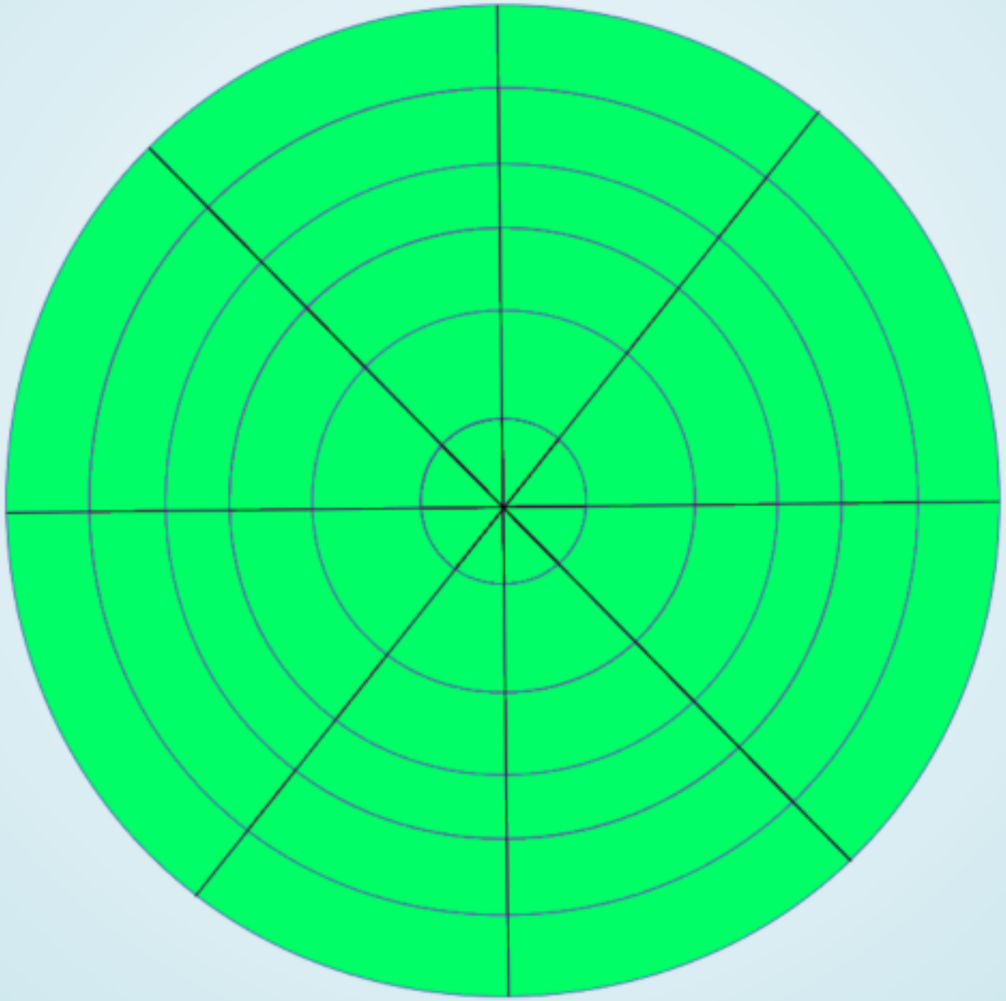

Outer Spec

```
describe('Account', () => {
  it('should print the correct statement after withdraws and deposits', () => {
    const account = new Account();
    account.deposit(new Date(2012, 0, 10), 1000);
    account.deposit(new Date(2012, 0, 13), 2000);

    expect(
      new Statement(account).toString()
    ).toEqual(
      "Date\tAmount\tBalance\n" +
      "10.1.2012\t+1000\t1000\n" +
      "13.1.2012\t+2000\t3000"
    );
  });
});
```

Fake-It

```
class Account {
  deposit(date, amount) {}
}

class Statement {
  constructor(account) {}

  toString() {
    return "Date\tAmount\tBalance\n" +
      "10.1.2012\t+1000\t1000\n" +
      "13.1.2012\t+2000\t3000";
  }
}
```

```
class Statement {
  constructor(account) {}

  toString() {
    return "Date\tAmount\tBalance\n" +
      "10.1.2012\t+1000\t1000\n" +
      "13.1.2012\t+2000\t3000";
  }
}
```

↓ Refactoring: String → Array ↓

```
class Statement {
  constructor(account) {}

  toString() {
    const statementLines = [
      "Date\tAmount\tBalance",
      "10.1.2012\t+1000\t1000",
      "13.1.2012\t+2000\t3000"];
    return statementLines.join('\n')
  }
}
```

```
toString() {
  const statementLines = [
    "Date\tAmount\tBalance",
    "10.1.2012\t+1000\t1000",
    "13.1.2012\t+2000\t3000"];
  return statementLines.join('\n')
}
```

↓ Refactoring: Introduce Constant / Instance Var ↓

```
toString() {
  this.STATEMENT_HEADER = "Date\tAmount\tBalance";
  this.statementLines = [
    "10.1.2012\t+1000\t1000",
    "13.1.2012\t+2000\t3000"
  ];
  const statementLines =
    [this.STATEMENT_HEADER].concat(this.statementLines);
  return statementLines.join('\n')
}
```

```
toString() {
  this.STATEMENT_HEADER = "Date\tAmount\tBalance";
  this.statementLines = [
    "10.1.2012\t+1000\t1000",
    "13.1.2012\t+2000\t3000"
  ];
  const statementLines =
    [this.STATEMENT_HEADER].concat(this.statementLines);
  return statementLines.join('\n')
}
```

↓ Refactoring: Move Assignment to Constructor ↓

```
constructor(account) {
  this.STATEMENT_HEADER = "Date\tAmount\tBalance";
  this.statementLines = [
    "10.1.2012\t+1000\t1000",
    "13.1.2012\t+2000\t3000"
  ]
}
toString() {
  const statementLines =
    [this.STATEMENT_HEADER].concat(this.statementLines);
  return statementLines.join('\n')
}
```

```
  toString() {
    const statementLines =
      [this.STATEMENT_HEADER].concat(this.statementLines);
    return statementLines.join('\n')
  }
```

↓ Refactoring: Inline Variable ↓

```
class Statement {
  ...
  toString() {
    return [this.STATEMENT_HEADER]
      .concat(this.statementLines)
      .join('\n');
  }
}
```

```
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = [
      "10.1.2012\t+1000\t1000",
      "13.1.2012\t+2000\t3000"
    ]
  }
```

↓ Refactoring: Introduce Class ↓

```
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = [
      new StatementLine("10.1.2012\t+1000\t1000"),
      new StatementLine("13.1.2012\t+2000\t3000")
    ]
  }
...

class StatementLine {
  constructor(line)  {this.line = line;}
  toString() {return this.line;}
}
```

INTERMEDIATE TESTS

```
describe('StatementLine#toString', () => {
  it('should return a tab-separated String', () => {
    const transaction = new Transaction("21.2.2012", "+1000");
    const statementLine = new StatementLine(transaction, 4000);
    expect( statementLine.toString() ).toEqual(
      "21.2.2012\t+1000\t4000"
    );
  });
});
```

```
class StatementLine {
  constructor(transaction, balance)  {
    this.transaction = transaction;
    this.balance = balance;
  }
  toString() {
    return [
      this.transaction.date,
      this.transaction.amount,
      this.balance
    ].join('\t');
  }
}
```

```
class Transaction {
  constructor(date, amount) {
    this.date = date;
    this.amount = amount;
  }
}
```

```
class Statement {
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = [
      new StatementLine("10.1.2012\t+1000\t1000"),
      new StatementLine("13.1.2012\t+2000\t3000")
    ]
  }
  ...
```

↓ Refactoring: Split Arguments ↓

```
class Statement {
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = [
      new StatementLine(new Transaction("10.1.2012", "+1000"), 1000),
      new StatementLine(new Transaction("13.1.2012", "+2000"), 3000)
    ]
  }
  ...
```

```
class Statement {
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = [
      new StatementLine(new Transaction("10.1.2012", "+1000"), 1000),
      new StatementLine(new Transaction("13.1.2012", "+2000"), 3000)
  ...
```

↓ Refactoring: Move Transactions to Account ↓

```
class Account {
  constructor()  {
    this.transactions = [
      new Transaction("10.1.2012", "+1000"),
      new Transaction("13.1.2012", "+2000")
...
class Statement {
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = [
      new StatementLine(account.transactions[0], 1000),
      new StatementLine(account.transactions[1], 3000)
    ]
  }
```

```
class Account {
  constructor()  {
    this.transactions = [
      new Transaction("10.1.2012", "+1000"),
      new Transaction("13.1.2012", "+2000")
...
```

↓ Refactoring: Replace Fake Value ↓

```
class Account {
  constructor()  {
    this.transactions = []
  }
  deposit(date, amount) {
    this.transactions.push(new Transaction(formattedDate(date), "+" + amount))
  }
}
```

```
class Statement {
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = [
      new StatementLine(account.transactions[0], 1000),
      new StatementLine(account.transactions[1], 3000)
    ]
  }
  ...
```

↓ Refactoring: Replace Fixed Index with map ↓

```
class Statement {
  constructor(account) {
    this.STATEMENT_HEADER = "Date\tAmount\tBalance";
    this.statementLines = account.transactions.map(
      (t, i, ts) => new StatementLine(t, balance(ts, i))
    );
  }
```

MUNICH CONSEQUENCES

- + No YAGNI
- + Obvious next step
- + ...from many choices
- - ...from many choices
- + No Mocks needed!!!
- Higher Amount of Time in Green
- Emergent Design Outside-In!

BEST SCHOOL?

> *It depends™*
>
> — any Consultant ever

CHOOSE BEST TOOL FOR THE JOB

DEPENDS ON WHAT?

QUESTIONS ???

FP OR OOP?

DESIGN?

QUERY VS COMMANDS

DISTRIBUTED?

EXPERIMENTAL

OR

KNOWN DESIGN?

DEGREE OF CERTAINTY

VS.

AMOUNT OF REFACTORING

WILL IT BLEND?

REFERENCES: GENERAL

- Interview with Kent Beck
- Martin Fowler: Mocks aren't Stubs
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REFERENCES: CHICAGO

- J.B. Rainsberger: Integrated Tests are a Scam
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- Emily Bache: Double-Loop TDD
- Book: Growing Object Oriented Software Guided by Tests by Steve Freeman & Nat Price

REFERENCES: MUNICH

- David Völkel: Fake-it Outside-In
- David Völkel: Screencasts (Youtube)

David Völkel

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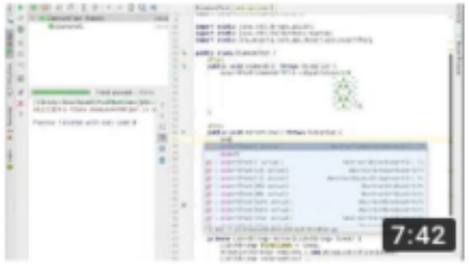

Fake it Outside-In TDD

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Preparatory Refactorings with TDD

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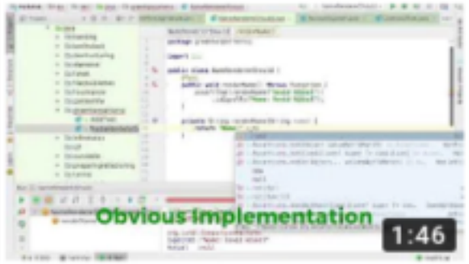

Kent Beck's Greenbar Patterns

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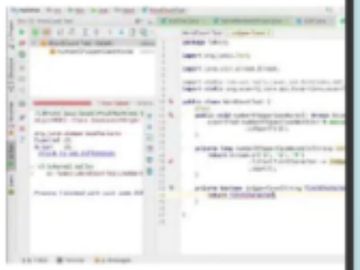

Fake it TDD: Working backwards from an...

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Brown Paper Bag Lunches

codecentric

https://www.codecentric.de/leistungen/loesungen/brown-paper-bag-lunches

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THX

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