

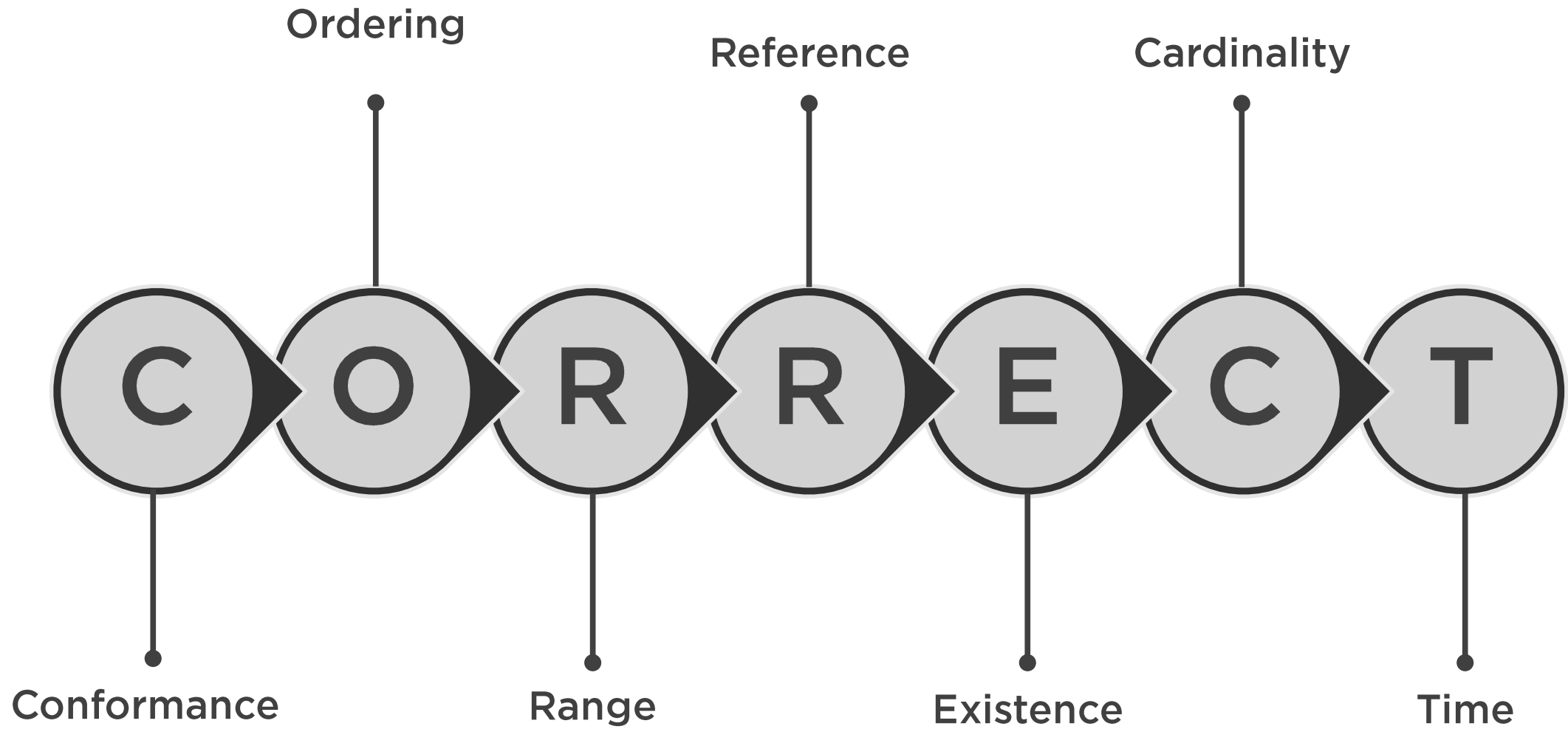
Making Tests CORRECT



Andrejs Doronins

TEST AUTOMATION ENGINEER





Conform

To act or be in accordance with some specified standard.



Things Affected by Conformance



Strings

Numbers

Time formats

Things Affected by Conformance



Any structured entity

Data containers

A message typically contains a header and body:

- Can the header be empty? If not – min. required data?
- Can the body be empty? If not – what is the min. required?

Name: Surname:

Email:

Phone:

John Smith
de la Torres?
van der Meer?
O'Reilly?

{ @mail.com
john@
johnmail.com }



@DataProvider

```
Object[][] nameProvider() {  
    return new Object[][] {  
        {"John Smith"},  
        {"Jose de la Torres"},  
        {"Chris O'Reilly"}  
    };  
}
```

```
@Test(dataProvider="nameProvider")  
public void verifyX(String s){  
    parseName(s);  
}
```



Number Conformance



Range

Rounding

Format

@DataProvider

```
Object[][] numberProvider() {  
    return new Object[][] {  
        {"4 294 967 295,000"},  
        {"4 294 967.295,000"},  
        {"4,294,967,295.00"}  
    };  
}
```

```
@Test(dataProvider="numberProvider")  
public void verifyX(String n){  
    parseNumber(n);  
}
```



6th of March? 3rd of June?

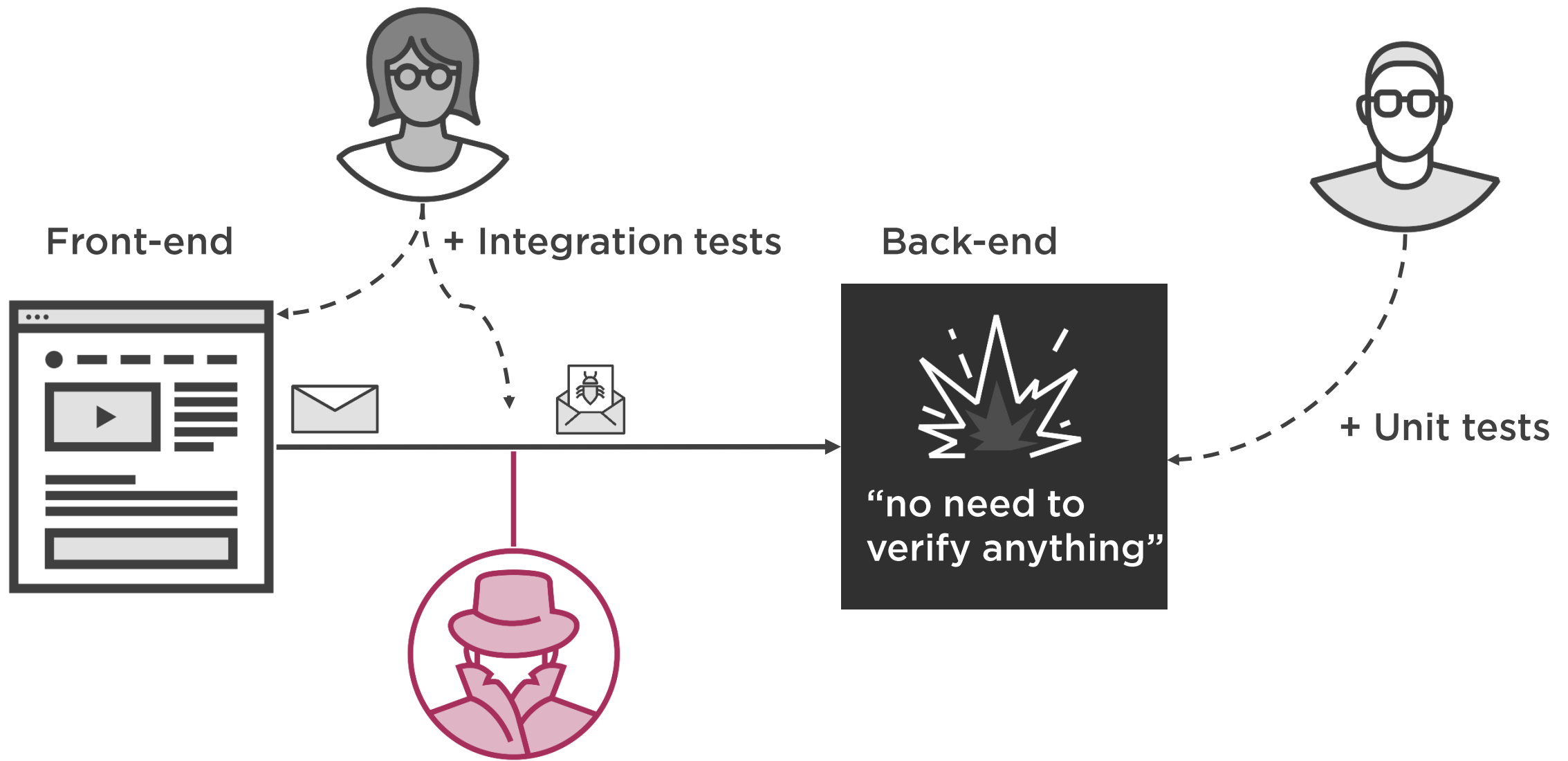
06 / 03 / 2020

21 / 03 / 2020

21 / 3 / 2020

21 / 3 / 20





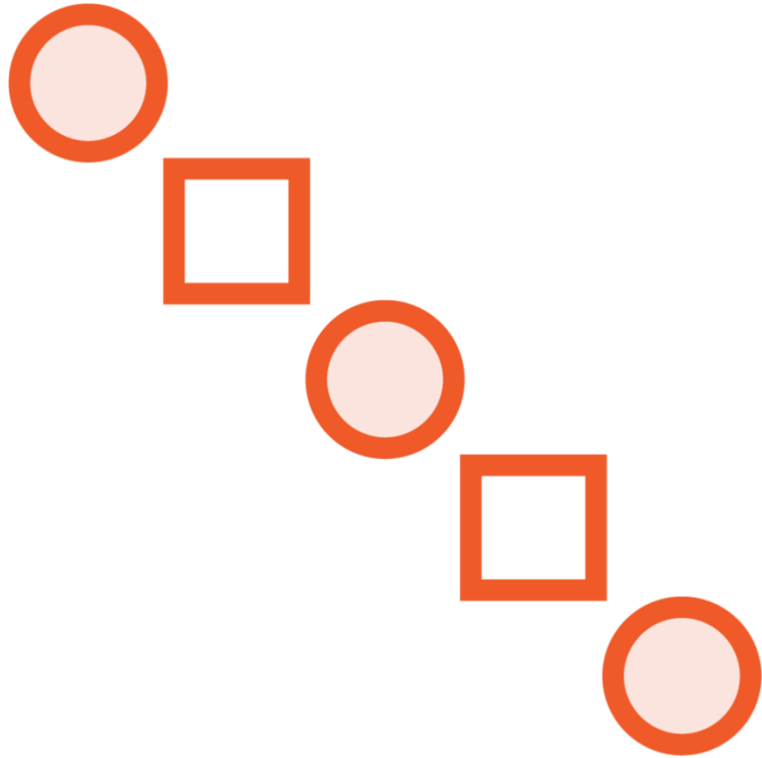
Demo



Conformance of strings and dates



Ordering

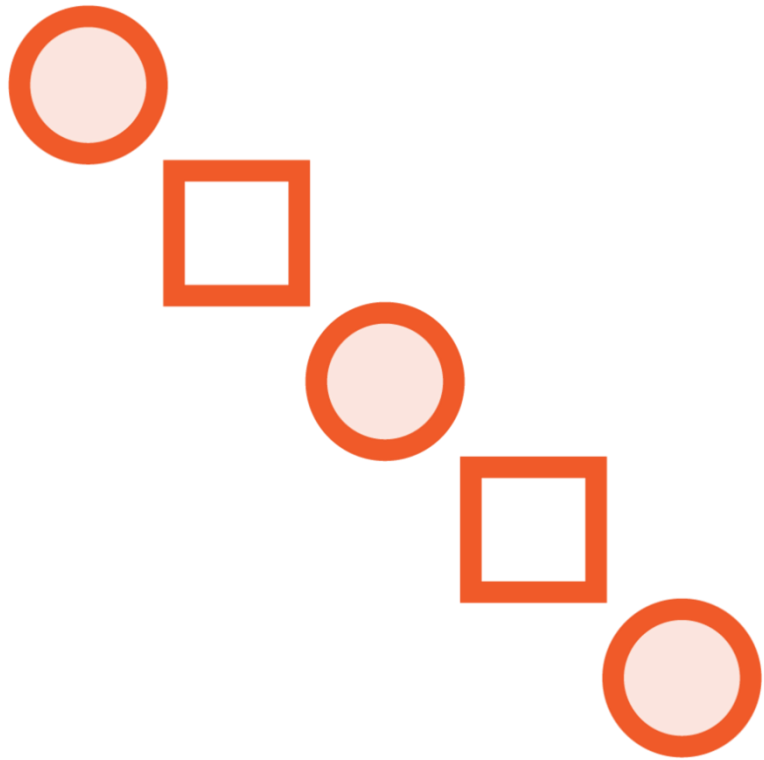


Lists & Collections

Items in data structures (e.g. XML or JSON)

UI tables





Ordering

Is the order correct?

Ascending or descending?

Sensible default?

Human-friendly?

- 1,2 [...], 11, 12
- 1, 11, 12, 2

Duplicates allowed?

- How to order duplicates?

1) Fetch once



Programming Languages

Java

JavaScript

C#

Python

...

2) Verify:

- Sorted correctly?
- Duplicates?
- etc...

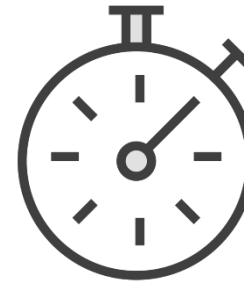
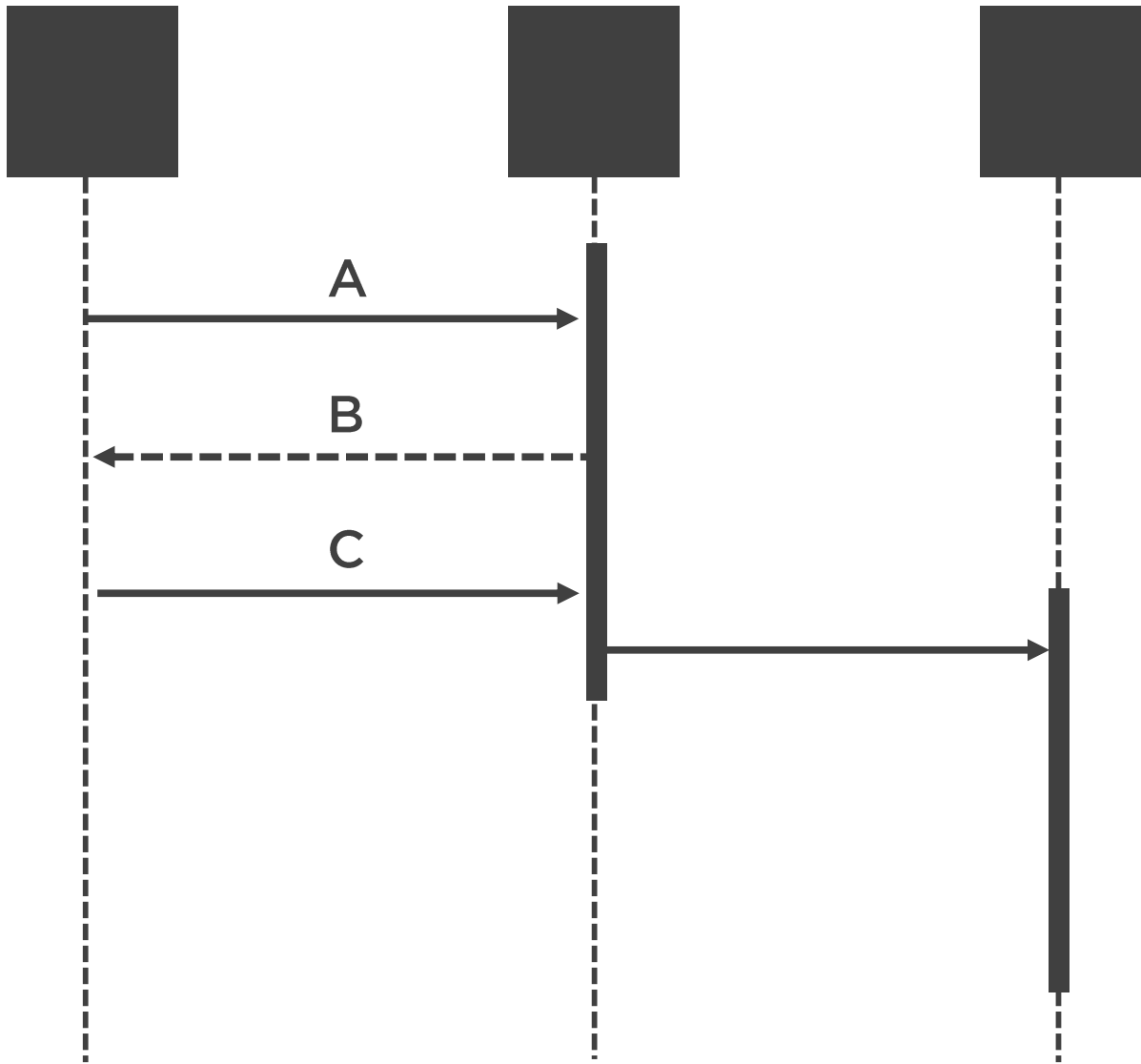


Ordering

Element
vs.
Event

Single moment
vs.
Across time





Chronological ordering:

- Does sequence matter?
- What if events happen out of order?





Ordering may occur in both
time and space



Range

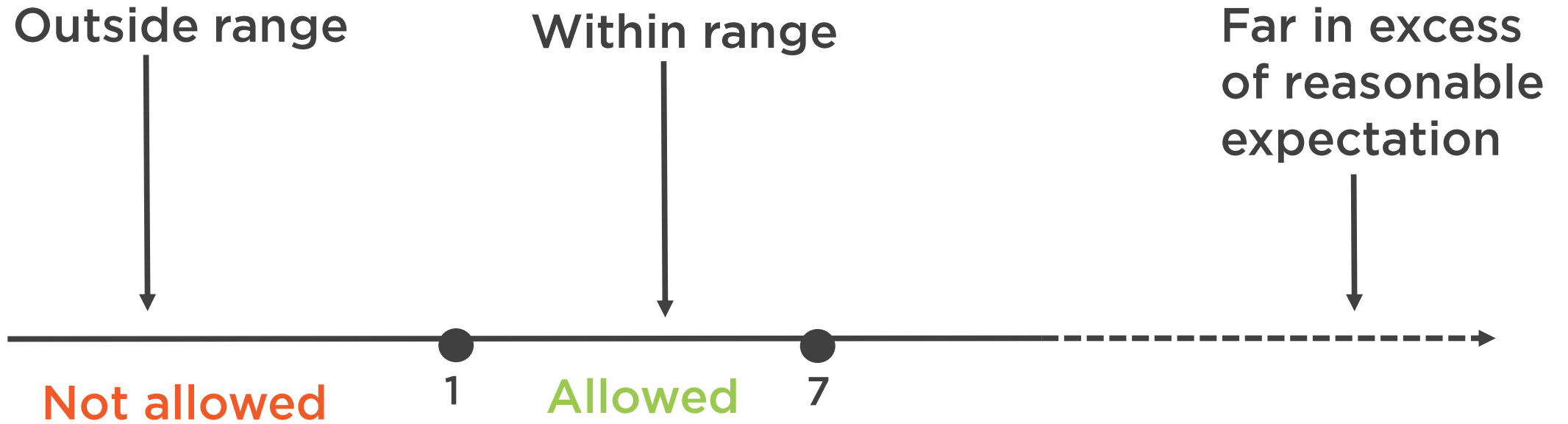


Within/Outside Range?

Far in excess of reasonable expectations?

Cases specific to types:

- Strings, Numbers, Dates



Strings



No single definition of “reasonable expectation”

When loading a file or receiving a message:

- Will it be OK if the size of it was 10 Gb?

Numbers



Two perspectives:

- Business
- Technical

Edges: inclusive or exclusive?

“Off by one?”
“ \leq ” instead of “ $<$ ”



OBO or OB1

Off-by-one: a logic error involving the discrete equivalent of a boundary condition





From X to Y

Should X be included?



Numbers

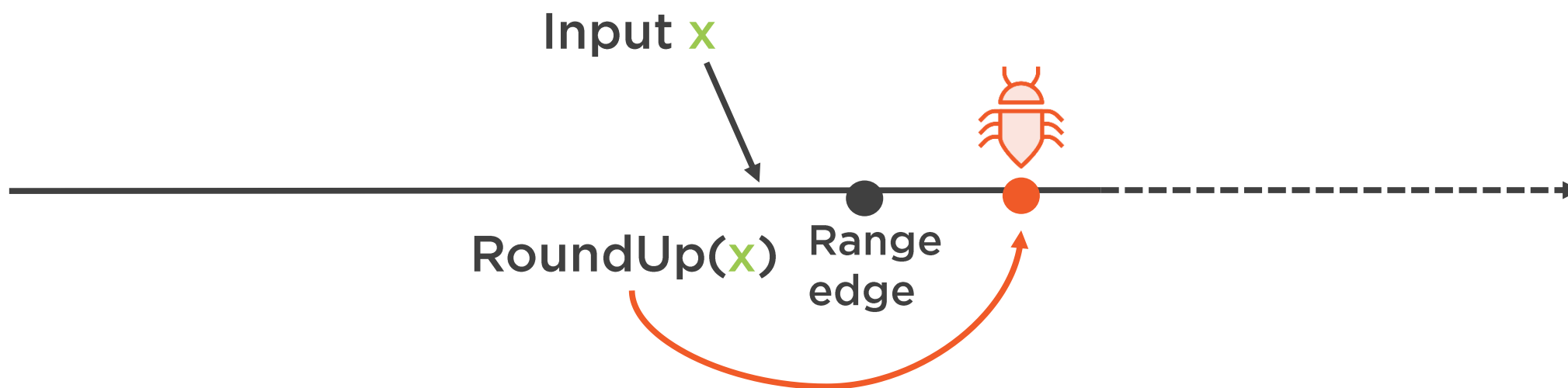


Technical perspective:

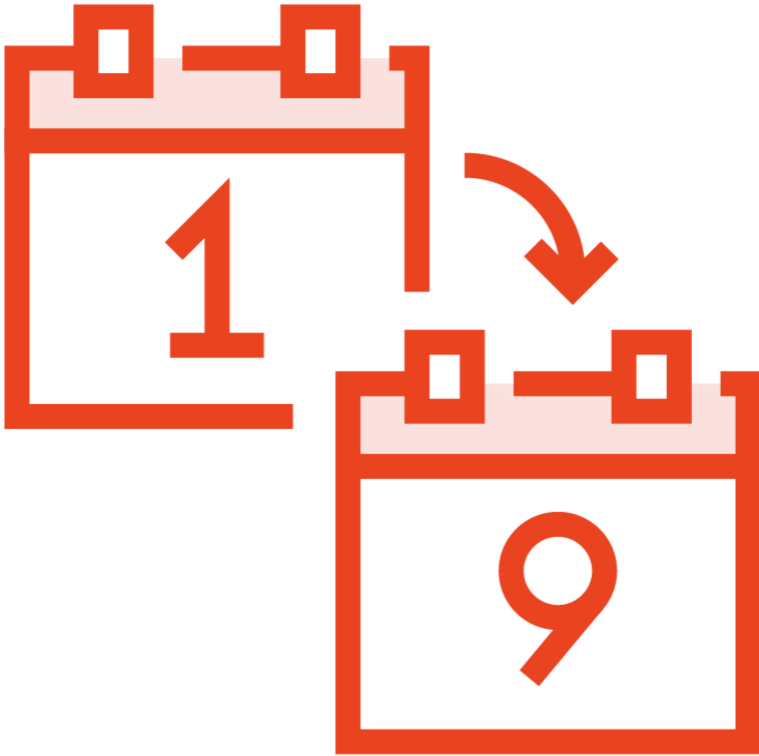
- Number too big for the type?
- Number with decimals where int expected?

Reject? Round quietly?

Edge Case Scenario



Dates



Also susceptible to OBO

Requirement: “display all items dated from 15th to the last day of current month”

- Including or excluding?
- Rephrase to “On or after __ but before __”
- Works for different months? (30 vs. 31)
- February? (28 days)
- Leap year February? (29 days)



Time Zones



Frequent sources of bugs

Time shifting (DST)

Happen in both tests and SUT

```
int someVar = 5;  
double calculate(double x) {  
    double y = x / someVar;  
    // ...  
    return z;  
}  
statefulObj;
```

The diagram illustrates a side effect in the code. A blue arrow points from the variable `someVar` in the first line to its use in the third line. A red arrow points from the `return z;` statement to the `statefulObj;` statement, with the label **set (side-effect)** indicating that the function call has a side effect of updating a stateful object.

```
car.pullHandBreak(); // also resets speed to 0
```




```
void someMethod() {
```

```
@Test → precondition(s)
```

```
@Test → // main functionality
```

```
@Test → postcondition(s)
```

```
}
```

Existence



Strings: null, empty, only whitespace

Collection: null or empty

Files

Primitive number (int): 0

Wrapper number (Integer): null, 0

- Division by 0

Handling non-existences is an inseparable part of programming

“Pay attention to zeroes. If there is a zero, someone will divide by it.”

devrant.com



Cardinality

The number of elements in a set or other grouping, as a property of that grouping.

$A = \{2, 4\}$ – cardinality of 2

$A = \{2, 4, 6\}$ – cardinality of 3



Cardinality



A specialized subset of Existence

ZOM: Zero-One-Many, a.k.a. 0-1-n rule

- Zero (non-existence) often happens
- One of something is often important
- N: If we can handle 2, then we should handle 5, 10 or 1000...

null, 0 or 1 element?

odd and even # of elements?

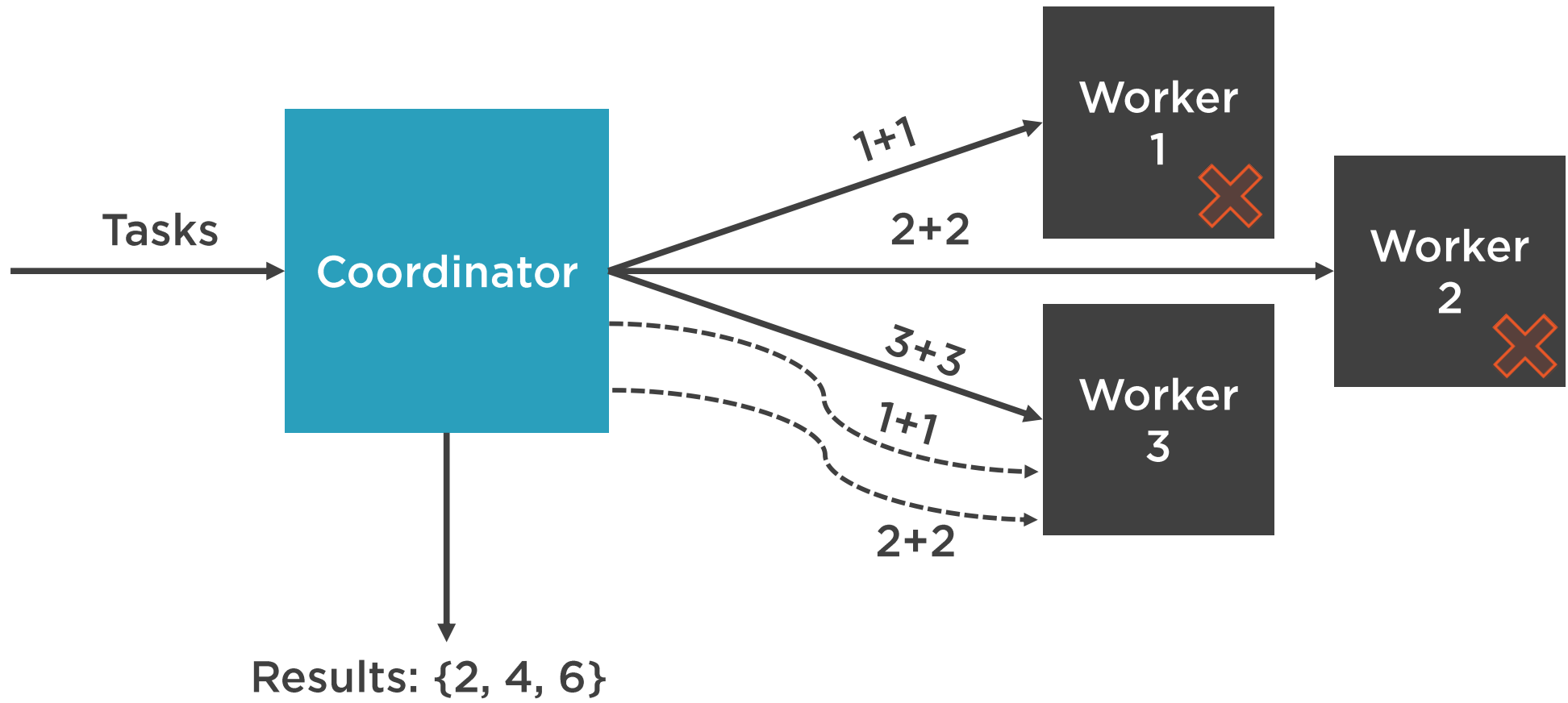
`extract(x);`

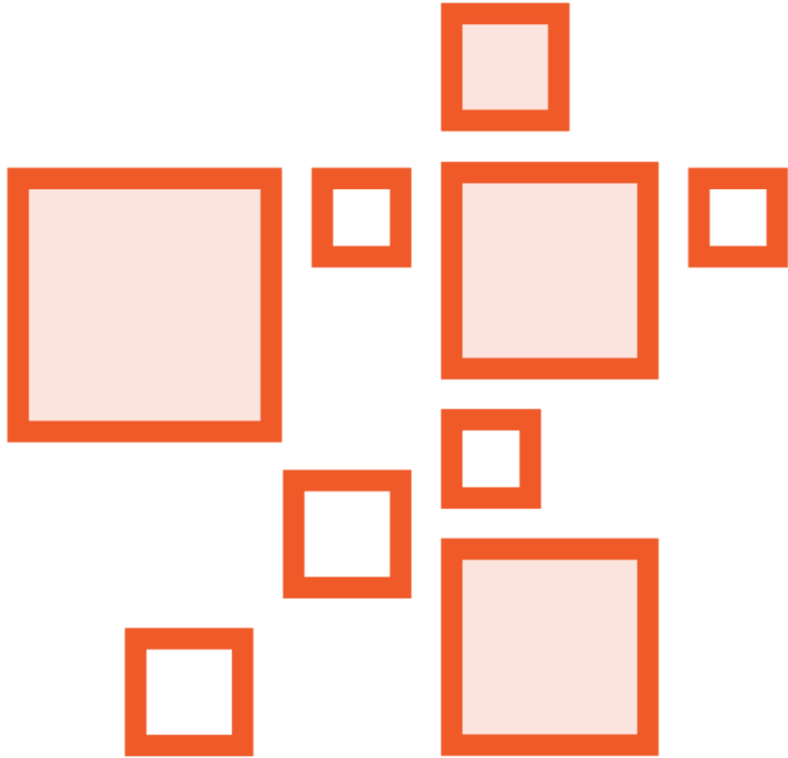
`split(x);`

`reduce(x);`

`merge(x);`







Apply 0-1-n

Extend the rule if necessary

Sensible logical minimum will catch most bugs

Additional elements are unlikely to add value



FIRST vs. CORRECT

FIRST{T}

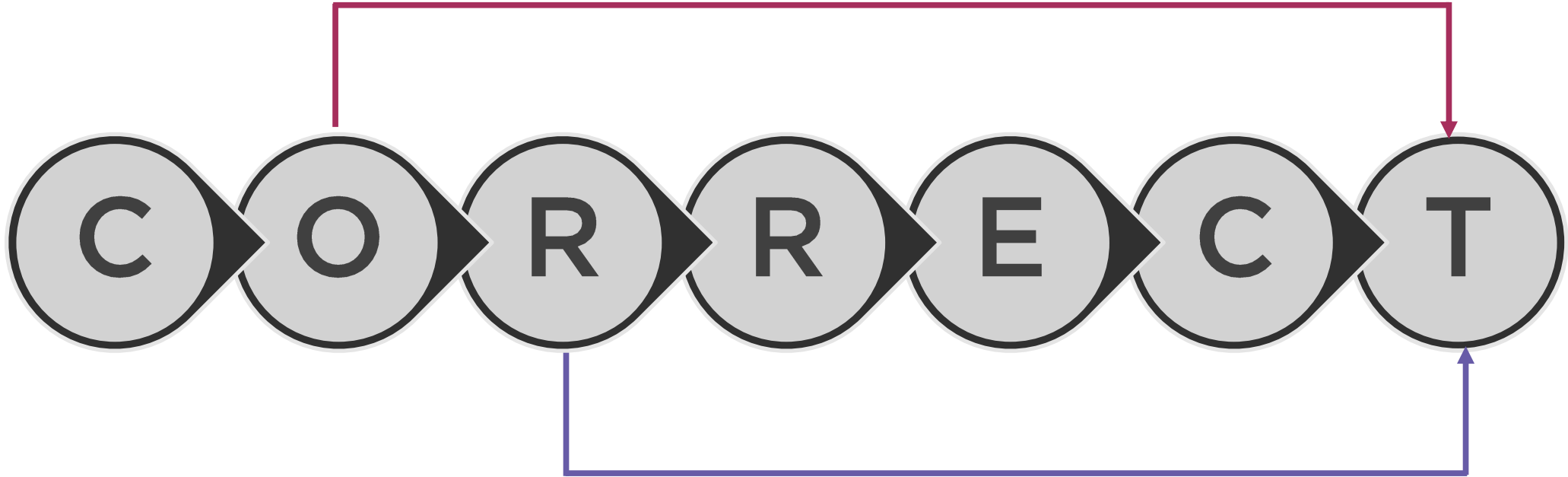
Timely: writing tests as soon
as possible

CORRECT{T}

Time-related bugs in the SUT

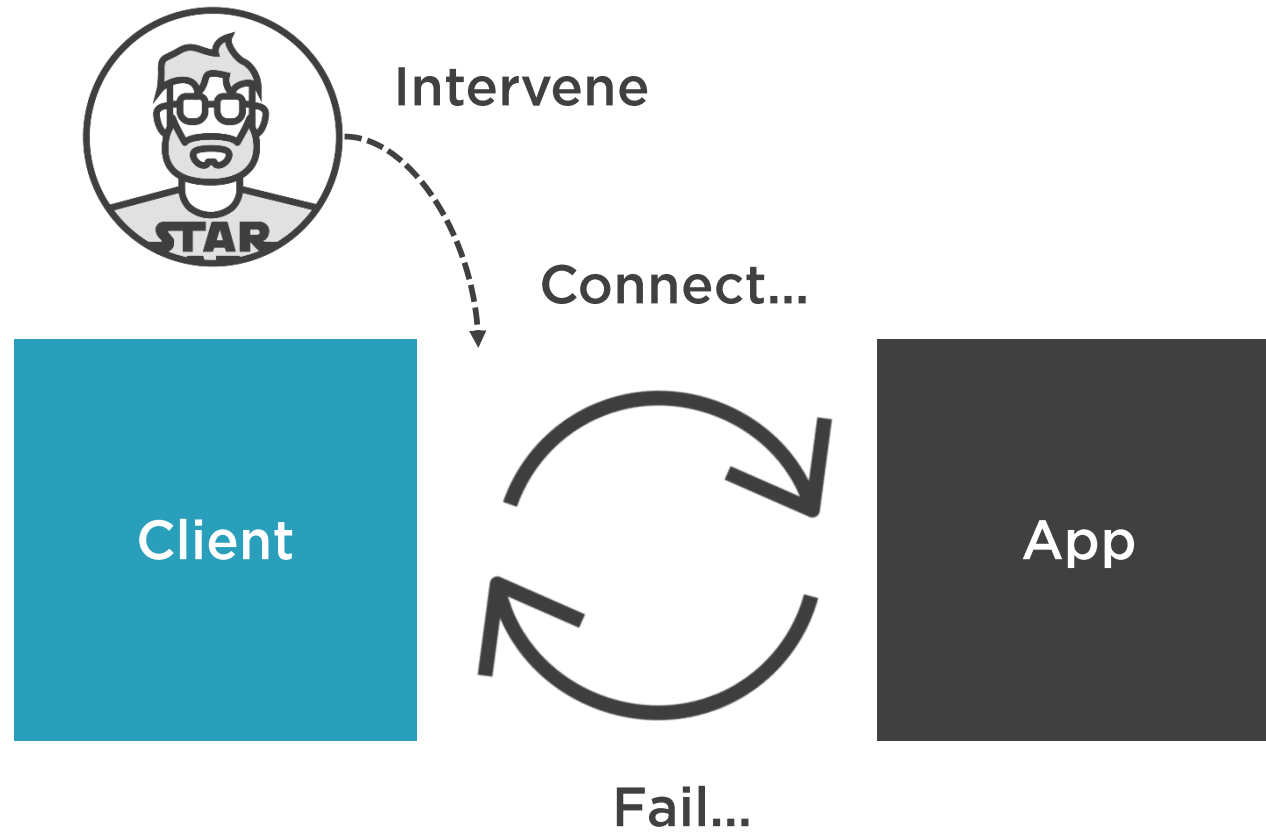


Ordering of actions
and events in time



Range: OBO, leap years,
time zones, etc.





Concurrency and Multithreading



Problems and bugs:

- Race condition
- Deadlocks
- Phantom reads

At least an understanding is desirable

Summary



Strings and numbers: check for conformance, existence and cardinality

Collections: ordering, existence and cardinality

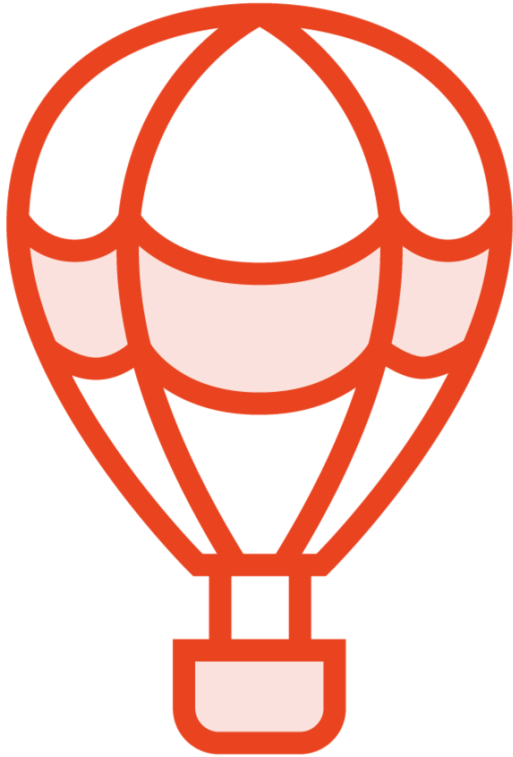
All other: reference and time (additionally)

CORRECT tests are no guarantee for 100% coverage

Don't stop at FIRST, BICEP,
and CORRECT



A-TRIP



Meaning:

- Automatic
- Thorough
- Repeatable
- Independent
- Professional

Thorough and Professional are vague enough to include almost anything

ZOMBIES



Blog by James Grenning

Meaning:

- Zero
- One
- Many
- Boundary behaviors
- Interface definition
- Exceptional behavior
- Simple scenarios – simple solutions

Up Next: Anti-patterns

