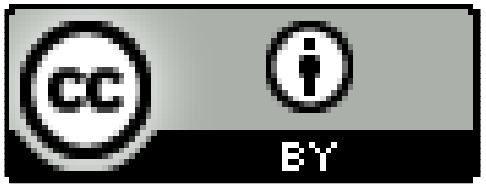
Testing

Introduction



Nobody enjoys testing

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- you like being inefficient

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So you can skip this lecture *if*

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The more you invest in quality, the less total time it takes to build working software

Testing tells you:

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- what the program actually *is* supposed to do

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Tests are runnable specifications

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Tests are runnable specifications

- Less likely to fall out of sync with the program than documentation

Quality is *not* just testing

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Trying to improve the quality of software by doing more testing is like trying to lose weight by weighing yourself more often.

– Steve McConnell

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Good tests localize problems to speed up debugging

Testing comparison of 7-digit phone numbers

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...and then you start testing the next function

How do you know that your tests are correct?

"All" testing can do is show that

there *might* be a problem

"It might work in practice,

but it'll never work in theory."

If testing isn't easy, people won't do it

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Must be easy to:

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Must be easy to:

- add or change tests

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- understand existing tests

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Must be easy to:

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- run tests

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Must be easy to:

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- understand test results

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And test results must be reliable

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Must be easy to:

- add or change tests
- understand existing tests
- run tests
- understand test results

And test results must be reliable

- No false positives or false negatives

A *unit test* tests one component in a program

A *unit test* tests one component in a program

fixture

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fixture

What the test is run on

A *unit test* tests one component in a program

fixture

action

A *unit test* tests one component in a program

fixture

action

What's done to the fixture

A *unit test* tests one component in a program

fixture

action

expected result

A *unit test* tests one component in a program

fixture

action

expected result

What *should* happen

A *unit test* tests one component in a program

fixture

action

expected result

---

actual result

A *unit test* tests one component in a program

fixture

action

expected result

---

actual result

What *actually* happened

A *unit test* tests one component in a program

fixture

action

expected result

---

actual result

report

A *unit test* tests one component in a program

fixture

action

expected result

---

actual result

report

Summary

Test `dna_starts_with`

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`True` if second argument is a prefix of the first

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```
dna_starts_with('actggt', 'act') => True
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Test `dna_starts_with`

`True` if second argument is a prefix of the first

`False` otherwise

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dna_starts_with('actggt', 'act') => True
```

```
dna_starts_with('actggt', 'ctg') => False
```

Test `dna_starts_with`

`True` if second argument is a prefix of the first

`False` otherwise

```
dna_starts_with('actggt', 'act') => True
```

```
dna_starts_with('actggt', 'agt') => False
```

Do this one from scratch to show ideas

Test `dna_starts_with`

`True` if second argument is a prefix of the first

`False` otherwise

```
dna_starts_with('actggt', 'act') => True
```

```
dna_starts_with('actggt', 'agt') => False
```

Do this one from scratch to show ideas

Then introduce a library that can take care of the repetitive bits

```
# Test directly
assert dna_starts_with('a', 'a')
assert dna_starts_with('at', 'a')
assert dna_starts_with('at', 'at')
assert not dna_starts_with('at', 't')
```

```
# Test directly
assert dna_starts_with('a', 'a')
assert dna_starts_with('at', 'a')
assert dna_starts_with('at', 'at')
assert not dna_starts_with('at', 't')
```

This works...

```
# Test directly
assert dna_starts_with('a', 'a')
assert dna_starts_with('at', 'a')
assert dna_starts_with('at', 'at')
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This works...

...but there's a lot of repeated code...

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# Test directly
assert dna_starts_with('a', 'a')
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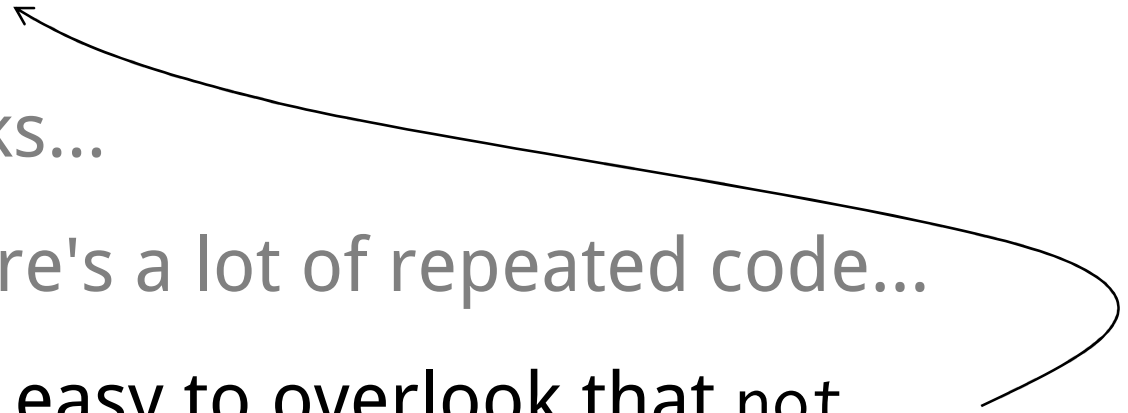

This works...

...but there's a lot of repeated code...

...and it's easy to overlook that `not`...

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# Test directly
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assert not dna_starts_with('at', 't')
```

This works...

...but there's a lot of repeated code...

...and it's easy to overlook that `not`...

...and it only tests up to the first failure

```
# Tests in table
# Sequence   Prefix   Expected
Tests = [
  ['a',      'a',     True],
  ['at',     'a',     True],
  ['at',     'at',    True],
  ['at,      't',     False]
]
```

```
# Tests in table
# Sequence   Prefix   Expected
Tests = [
  ['a',      'a',     True],
  ['at',     'a',     True],
  ['at',     'at',    True],
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]
```

Easy to read

```
# Tests in table
# Sequence   Prefix   Expected
Tests = [
  ['a',      'a',     True],
  ['at',     'a',     True],
  ['at',     'at',    True],
  ['at,      't',     False]
]
```

Easy to read

Easy to add new tests

```
# Run and report
passes = 0
for (seq, prefix, expected) in Tests:
  if dna_starts_with(seq, prefix) == expected:
    passes += 1
print '%d/%d tests passed' % (passes, len(Tests))
```

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# Run and report
passes = 0
for (seq, prefix, expected) in Tests:
  if dna_starts_with(seq, prefix) == expected:
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No runnable code is copied when adding tests

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```

No runnable code is copied when adding tests

But when tests fail, we don't know which ones

```
# Run and report
passes = 0
for (i, (seq, prefix, expected)) in enumerate(Tests):
  if dna_starts_with(seq, prefix) == expected:
    passes += 1
  else:
    print 'test %d failed' % i
print '%d/%d tests passed' % (passes, len(Tests))
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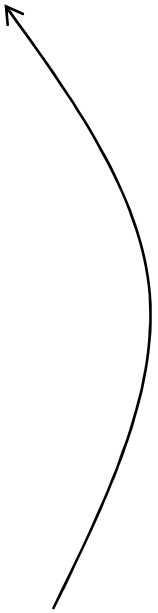

Produces (index, element)

for each element of list

```
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for (i, (seq, prefix, expected)) in enumerate(Tests):
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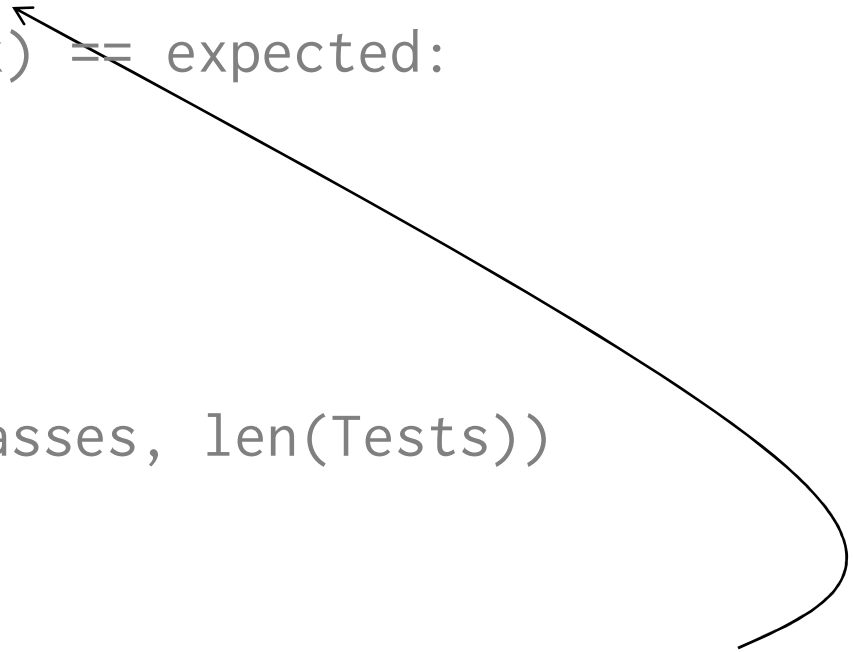

Decompose into variables

by matching structure

```
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passes = 0
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```

Test passes as before

```
# Run and report
passes = 0
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    print 'test %d failed' % i
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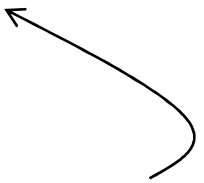
```



Summarize results that don't need attention

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# Run and report
passes = 0
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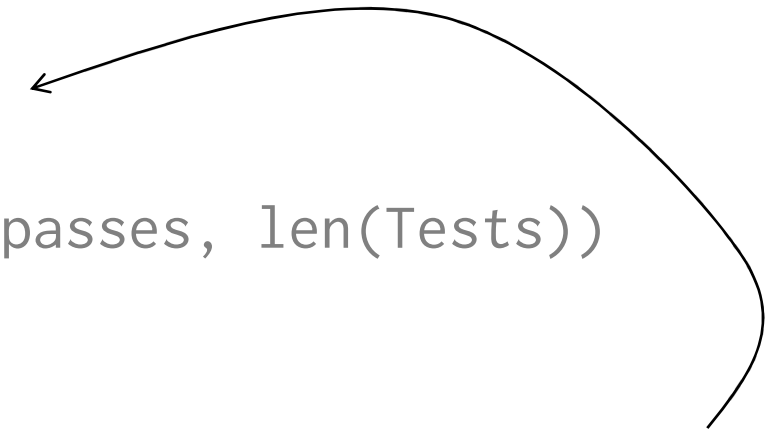

Report each result that needs attention separately

This pattern is used for testing over and over

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Many libraries to support it in many languages

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We'll look at one that comes with Python

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Many libraries to support it in many languages

We'll look at one that comes with Python

But first, we'll look at how to handle errors

in programs systematically

created by

Greg Wilson

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