

# Building Automated Tests for Python Toolbox Tools

(Making My Life Easier)

```
def a_story_about_testing():
```

### Mailing address

Country\*

United States

Company

Address line 1\*

Address line 2

City\*

Portland

State/province\*

Oregon

The zip code does not match the city entered. Please verify and make changes if necessary, then click Join Now.

Zip/postal code\*

97239

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def a_story_about_testing():
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The screenshot shows a web application titled "Look Up a ZIP Code™". It features two tabs: "ZIP Code™ By Address" (selected) and "Cities by ZIP Code™". Under the selected tab, the text "You entered:" is followed by two redacted address lines and "PORTLAND OR". To the right, there are two links: "Look up another ZIP Code™ >" and "Edit and Search Again >". Below this, a message states "Here's the full address, using standard abbreviations and formatting." This is followed by a redacted address line and "PORTLAND OR 97239-4742". At the bottom, there is a link "Show Mailing Industry Details" with a blue checkmark icon.

Look Up a ZIP Code™

Still Ha  
Brows

ZIP Code™ By Address Cities by ZIP Code™

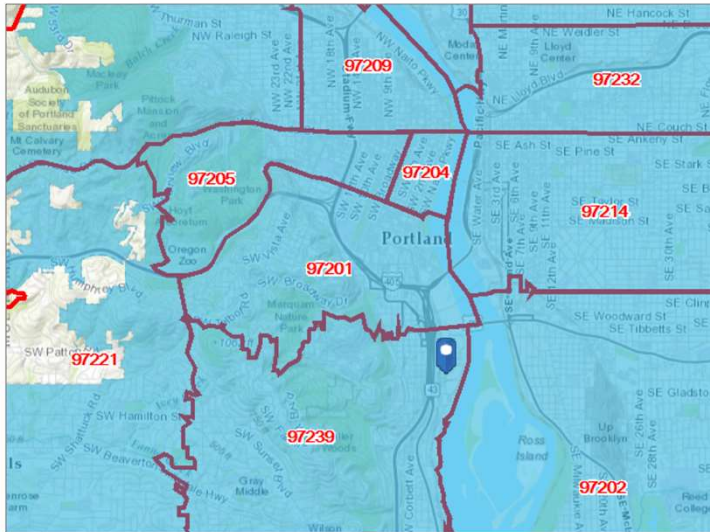
You entered:

Look up another ZIP Code™ >  
Edit and Search Again >

Here's the full address, using standard abbreviations and formatting.

Show Mailing Industry Details ✓

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Metro Data Resource Center | MRLC, Bureau of Land Management, State of Oregon, State of Oregon DOT, State of Oregon GEO, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, NGA, EPA, USDA, U.S. Forest Service

## Look Up a ZIP Code™

ZIP Code™ By Address

Cities by ZIP Code™

You entered:

██████████  
██████████  
PORTLAND OR

[Look up another ZIP Code™](#)  
[Edit and Search Again](#)

Here's the full address, using standard abbreviations and formatting.

██████████  
PORTLAND OR 97239-4742

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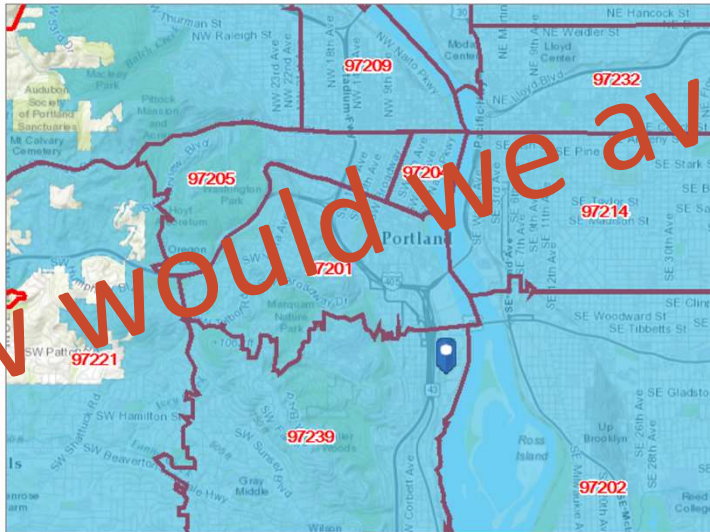
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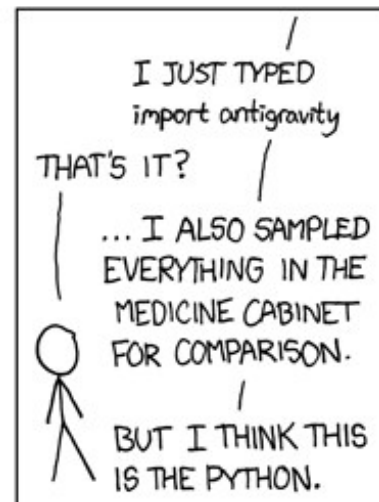
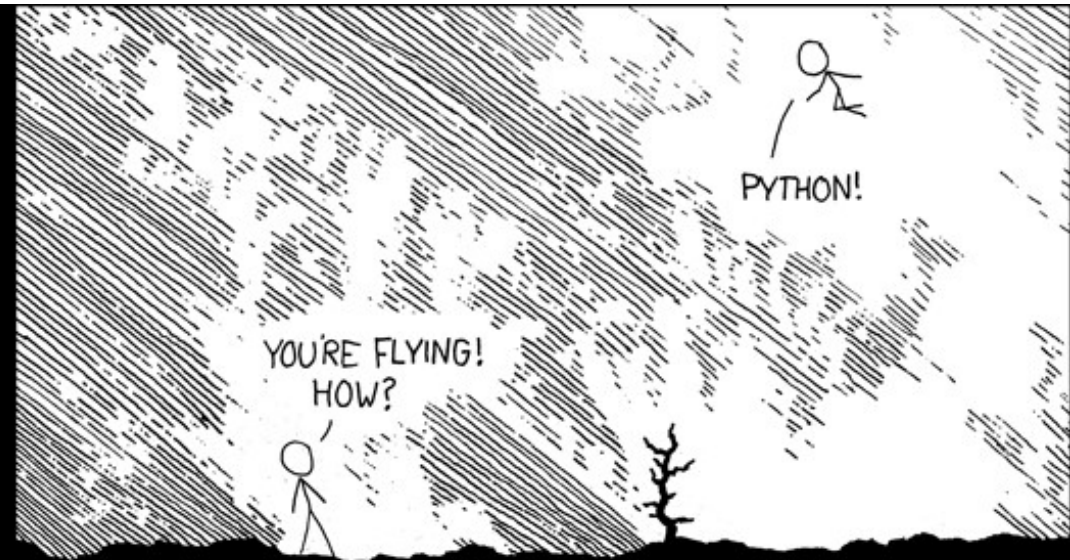
97239

# class SimpleTool

- Example ToolBox tool (PYT) for testing
- Inputs:
  - Point Layer with a “Type” column
  - Polygon Layer
- Output:
  - Copy of Polygon Layer with a Count of each Type (only two: RED, BLUE)
- Process:
  - Select Points for a type
  - Do a spatial join
  - Repeat
  - Make output

# Show Code

<https://xkcd.com/353/>



# What are “Tests?”

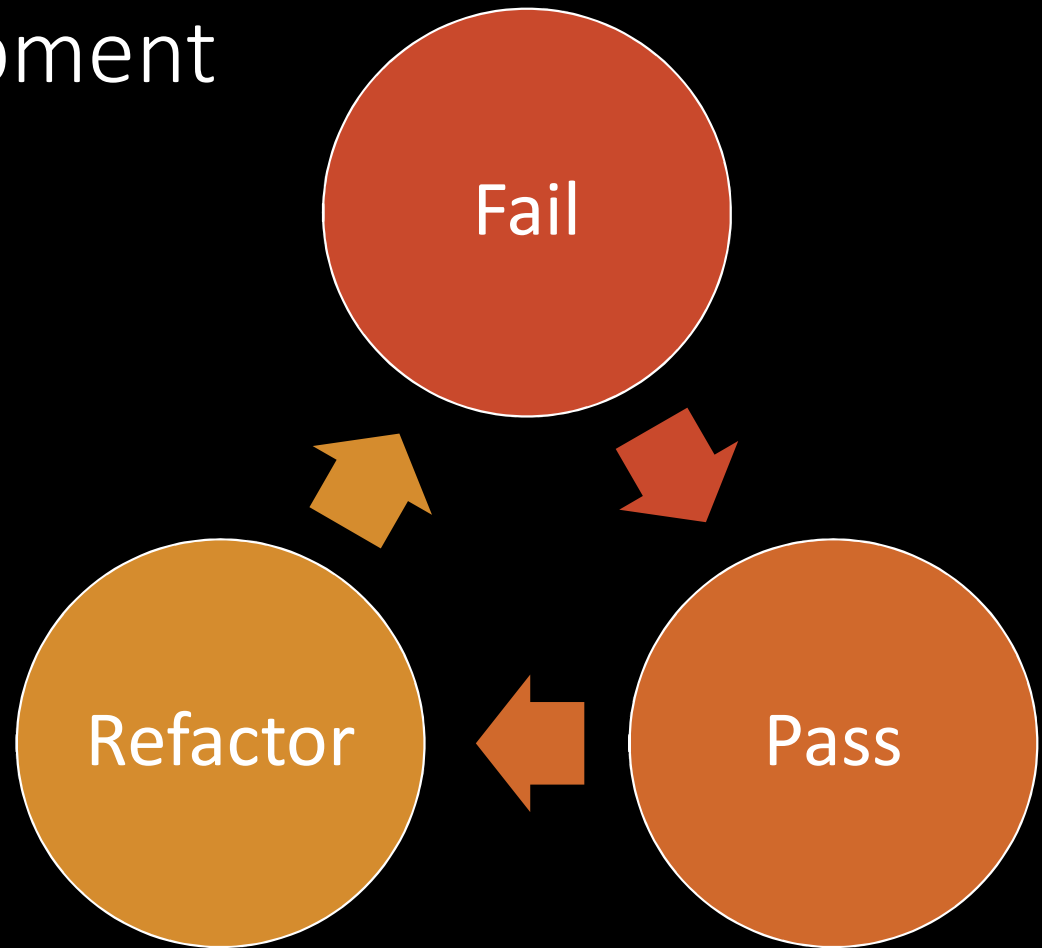
- The process of verifying that software functions as intended. The software should meet the design criteria of functionality, performance and interactivity.
- Types of Tests:
  - Conformance – Does it work the way it is supposed to?
  - Interoperability – Does it work with other things?
  - Performance – Does it work fast enough? (or with less memory, etc.)

<https://www.nist.gov/sites/default/files/documents/director/planning/report02-3.pdf>



# Test Driven Development

- Building tests before you build software
- Build Failing Tests before you fix an issue



# Test Coverage vs Code Coverage

## Test Coverage

- Amount of testing done by a test
- Do the tests cover all of the “paths” in our code?
- Functions, Methods, Classes, Branches, Loops, Exceptions

## Code Coverage

- How much of your code is exercised by a test
- Do the tests cover the use cases in our code?
- Documented test cases

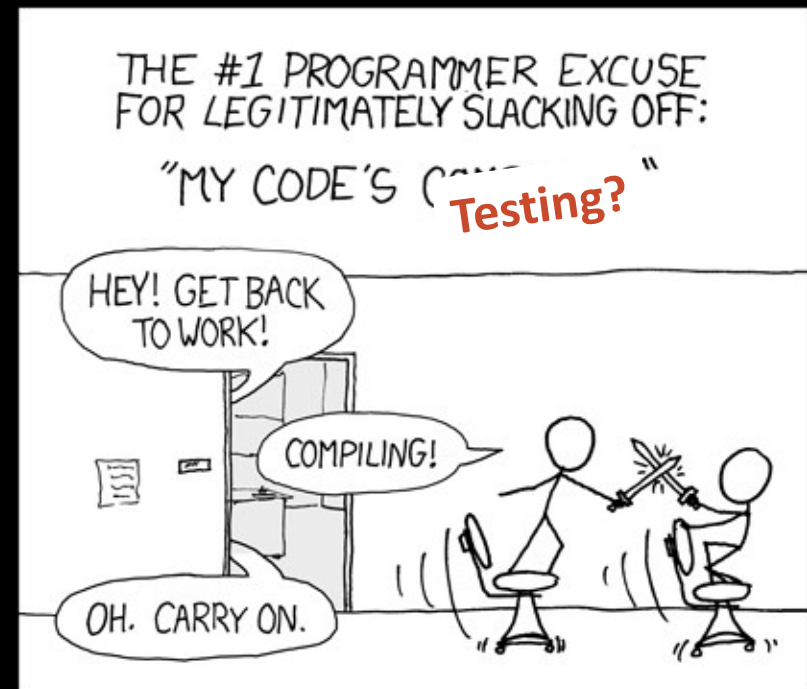
100 %  
Coverage

# 100% Coverage – A Myth?

- No
- Very hard to do, especially in complex software
- Point of diminishing return – eventually the cost (either in dollars or just plain boredom) is no longer worth the return
- “Tested By Relation”
  - One input, which is supposed to test one thing tends to test multiple things
  - Increases “Coverage”
  - Not measurable, except by “gut feel”
  - This can haunt you if it actually hides an issue...

# Why bother?

- Pride in my own work
- My sanity
- Preventing Bugs (or at least knowing them)
- Figuring stuff out you haven't touched in years
- Examples
- Being Lazy



<https://xkcd.com/303/>

# My Common Sense Approach

- Test “Core Code” as much as you can stand – strive for 100% coverage
- Test *all* common workflows
- Test edge cases
  - You may be able to group edge cases together
  - Consider alternate paths through code when testing edge cases
- Don’t test (at least not too much) what should already be tested
- Make better error messages

# Testing Toolboxes

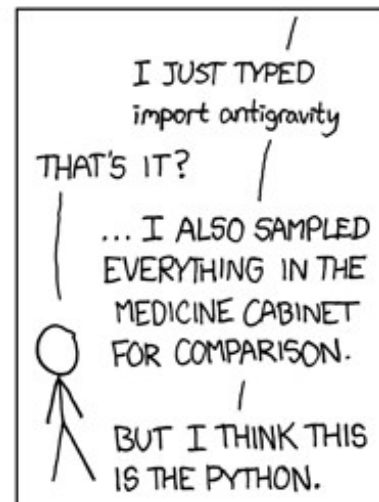
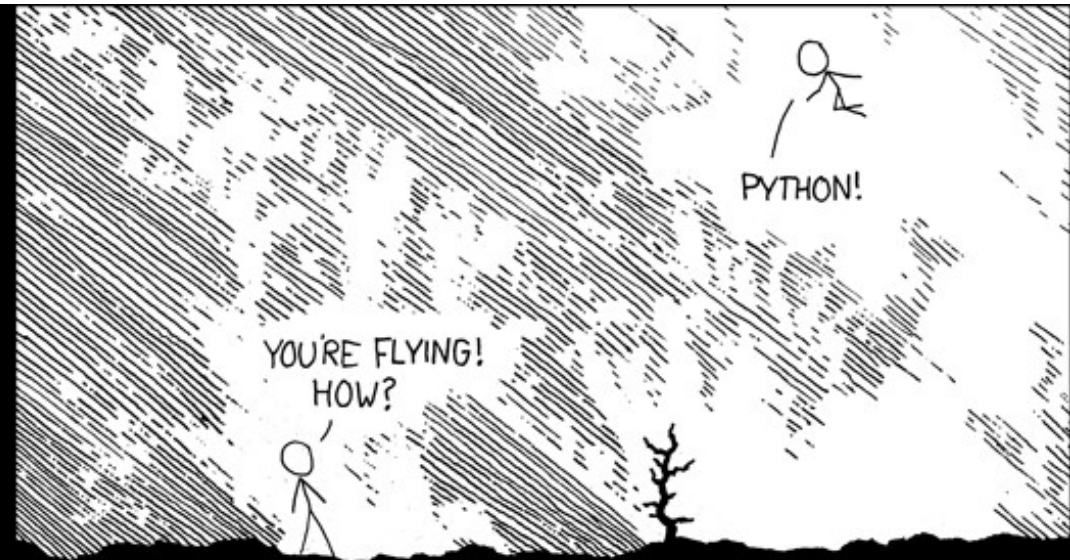
- Leverage Python unittest library
- Keep tests simple
  - Be able to read and understand the test
  - Test only one thing
- Toolboxes take in data and output data
  - Compare Table => `assertTablesEqual`
  - Compare Feature Class => `assertFeatureClassesEqual`
- Organize Test Data
- Check Test Data into repository?
- Testing to verify Errors
- Test on real data
- Reuse data where you can, but don't if it doesn't work, close enough isn't good enough
- Record Order!

# Test Structure

- Gather Data
  - Input
  - A place to put the output (scratch GDB)
  - The answer
- Execute the Tool
- Assert that the answer is equal to the output
- Clean up

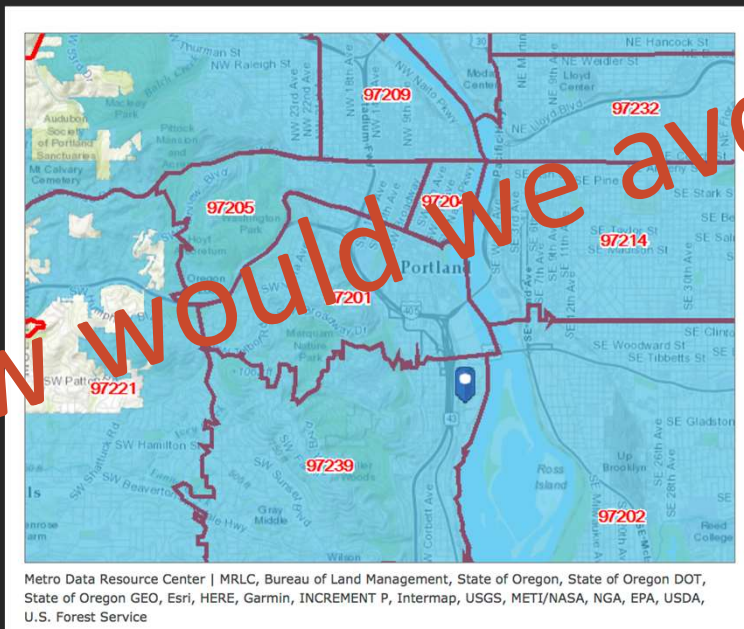
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# Going Forward

- Python can run in Pro, Desktop and Server
- Use tests to verify functionality in Pro, Desktop and Server
- Run tests often – Continuous Integration (You can do this with a bat file too)
- Use tests to verify or QC data (i.e. making sure cities and zip-codes are spatially accurate)
- NASA's 10 rules for developing safety-critical code - <http://sdtimes.com/nasas-10-rules-developing-safety-critical-code/>

# Christopher Moravec

Moravec Labs, LLC

Source: <https://github.com/MoravecLabs/ArcpyTestExample>

Resources: <https://goo.gl/BHSmNz>

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[www.MoravecLabs.com](http://www.MoravecLabs.com)

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