Week 4: debugging | testing

NRSC 7657 Workshop in Advanced Programming for Neuroscientists

course business

- Projects: started?
- Syllabus update

Debugging


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Debugging

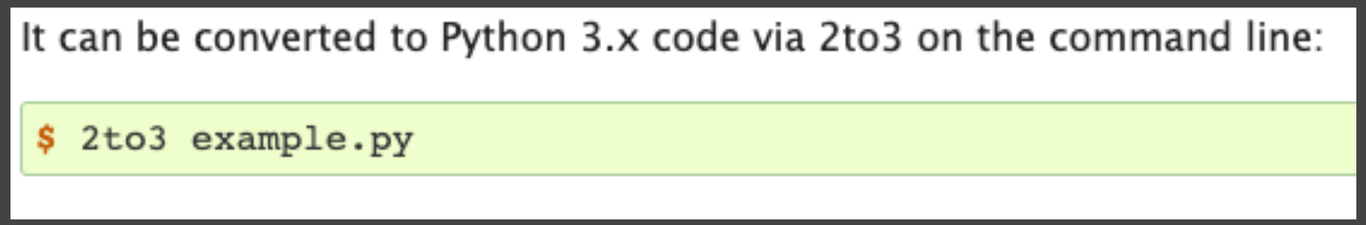
- The first step in debugging: `print("something")`

Debugging

- The first step in debugging: `print("something")`

  - Aside: you may see `print "something"` sometimes in older code, this is a relic of python 2. Change it to `print("something")`

    - https://docs.python.org/3/library/2to3.html


It can be converted to Python 3.x code via 2to3 on the command line:

```
$ 2to3 example.py
```

Debugging

Types of bugs: syntax errors

- Tracebacks

```
a = 2
print(2 + a)
b = a + c
```

```
4
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-1-0b5043da75c2> in <module>
      1 a = 2
      2 print(2 + a)
----> 3 b = a + c

NameError: name 'c' is not defined
```

Debugging

Types of bugs: syntax errors

- Tracebacks

```
[116]: rez = loadmat('rez.mat')
```

```
---------------------------------------------------------------------------
NotImplementedError                       Traceback (most recent call last)
<ipython-input-116-852d7d6a9435> in <module>
----> 1 rez = loadmat('rez.mat')

~/opt/anaconda3/envs/NRSC7657/lib/python3.8/site-packages/scipy/io/matlab/mio.py in loadmat(file_name, mdict,
appendmat, **kwargs)
    223     variable_names = kwargs.pop('variable_names', None)
    224     with _open_file_context(file_name, appendmat) as f:
--> 225         MR, _ = mat_reader_factory(f, **kwargs)
    226         matfile_dict = MR.get_variables(variable_names)
    227

~/opt/anaconda3/envs/NRSC7657/lib/python3.8/site-packages/scipy/io/matlab/mio.py in mat_reader_factory(file_n
ame, appendmat, **kwargs)
     78         return MatFile5Reader(byte_stream, **kwargs), file_opened
     79     elif mjv == 2:
---> 80         raise NotImplementedError('Please use HDF reader for matlab v7.3 files')
     81     else:
     82         raise TypeError('Did not recognize version %s' % mjv)

NotImplementedError: Please use HDF reader for matlab v7.3 files
```

Debugging

Types of bugs: semantic errors

- No `Traceback`, but…something didn’t work like you thought it would.

Debugging

Types of bugs: syntax and semantic errors

- The first step in debugging: `print(“something”)`

Debugging

Types of bugs: syntax and semantic errors

- The first step in debugging: `print("something")`
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Debugging

Types of bugs: you can fix both with print statements

- The first step in debugging: `print("something")`
  - Aside: you may see `print "something"` sometimes in older code, this is a relic of python 2. Change it to `print("something")`
    - https://docs.python.org/3/library/2to3.html

Debugging
Python standard debugger

import pdb

Go through this with `djd` in a minute

```
import pdb

x = 3
y = 4
pdb.set_trace()

total = x + y
pdb.set_trace()
```

We have inserted a few breakpoints in this program. The program will pause at each breakpoint (**pdb.set_trace()**). To view a variables contents simply type the variable name:

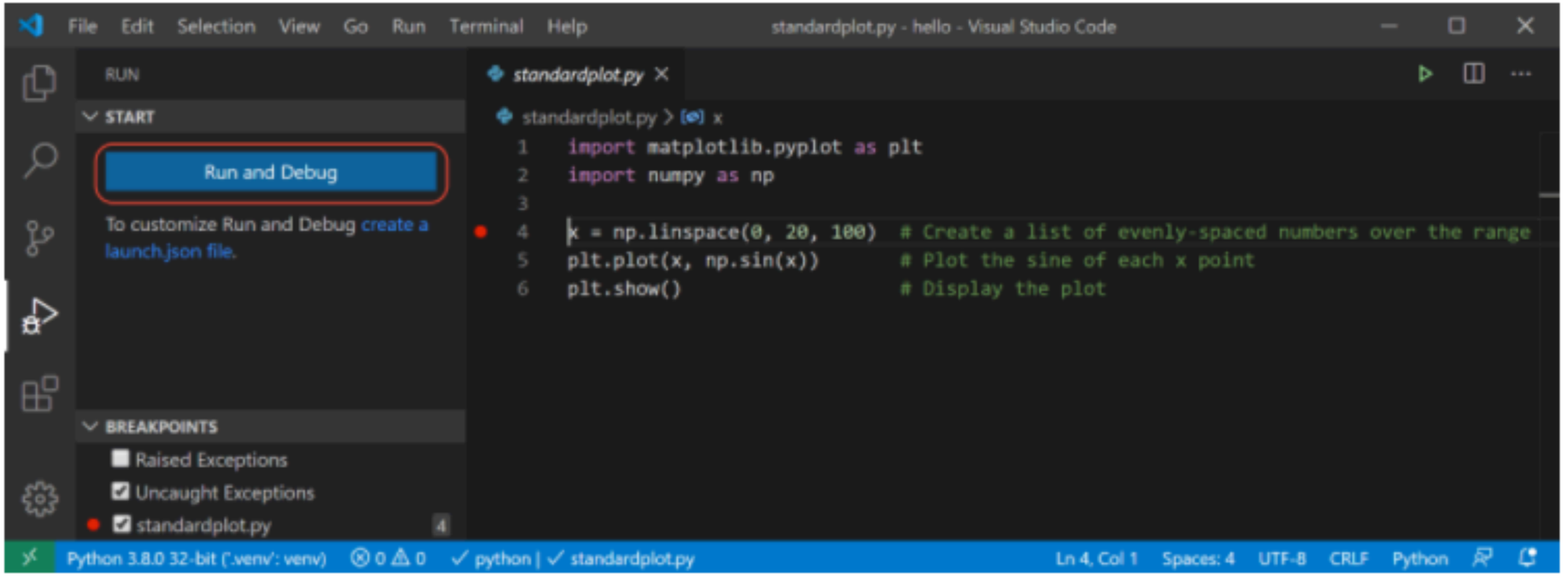
```
$ python3 program.py
(Pdb) x
3
(Pdb) y
4
(Pdb) total
*** NameError: name 'total' is not defined
(Pdb)
```

Debugging

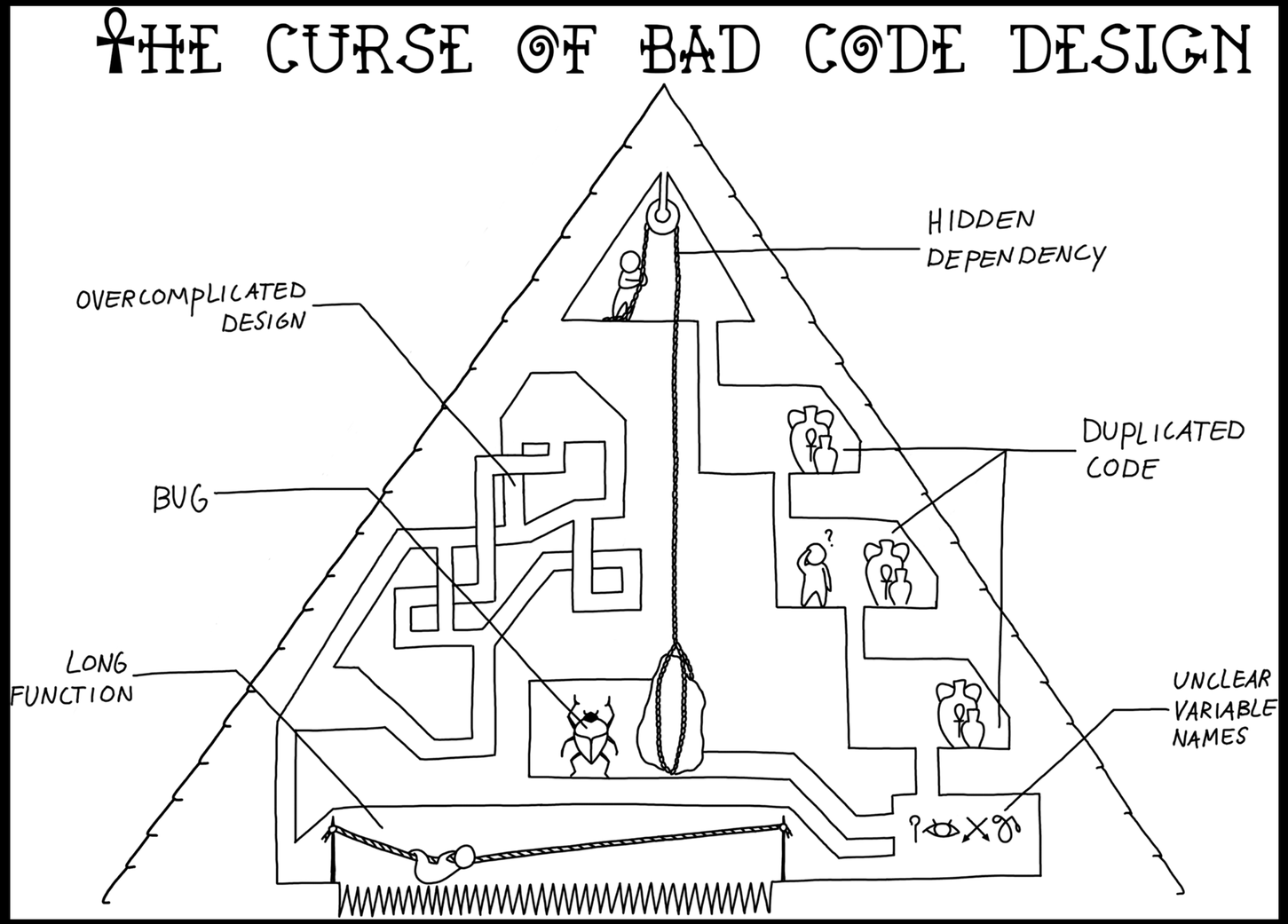
VSCode Run and Debug mode, for scripts

Basic debugging

The simplest way to begin debugging a Python file is to use the **Run** view and click the **Run and Debug** button. When no configuration has been previously set, you will be presented with a list of debugging options. Select the appropriate option to quickly begin debugging your code.



Debugging
Code architecture



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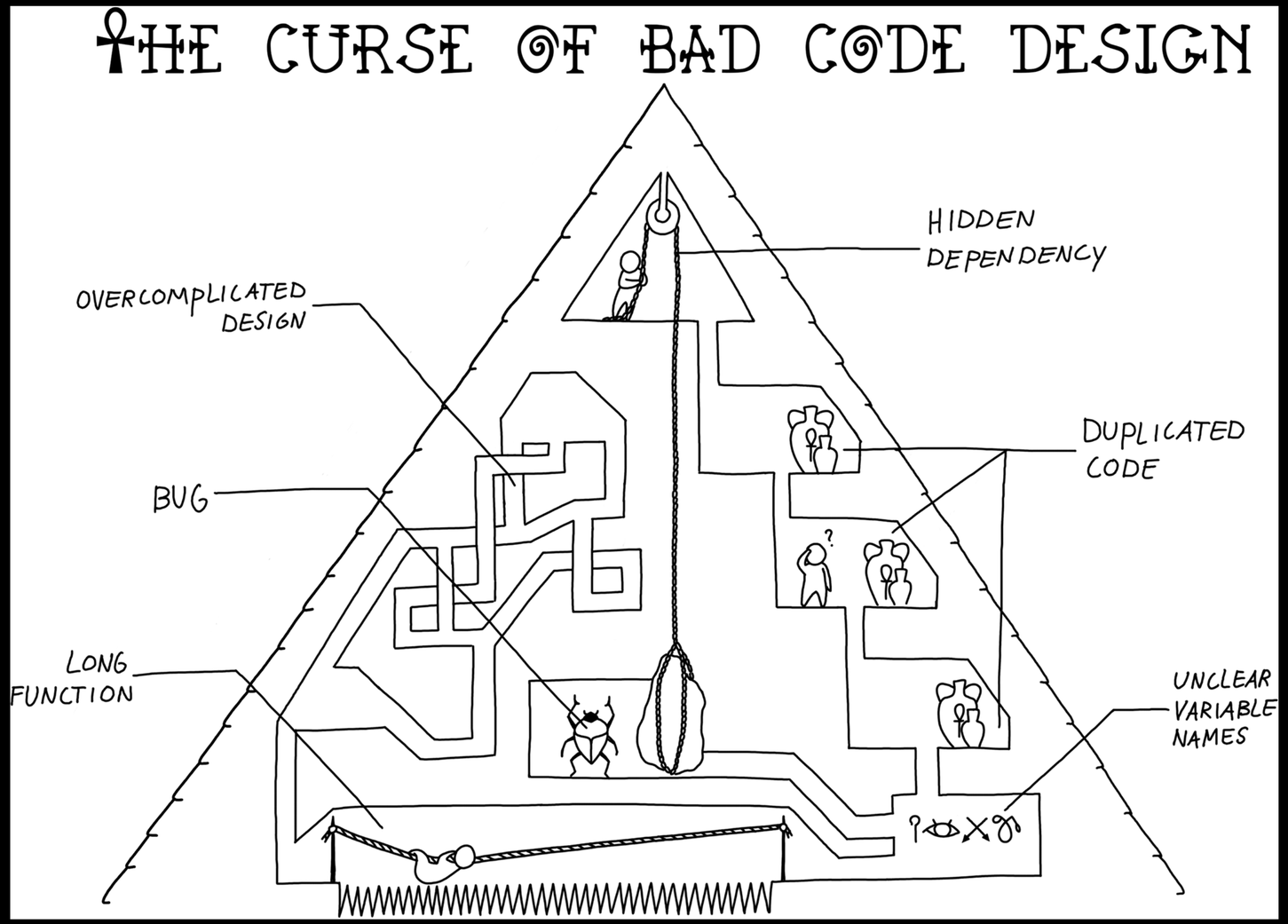

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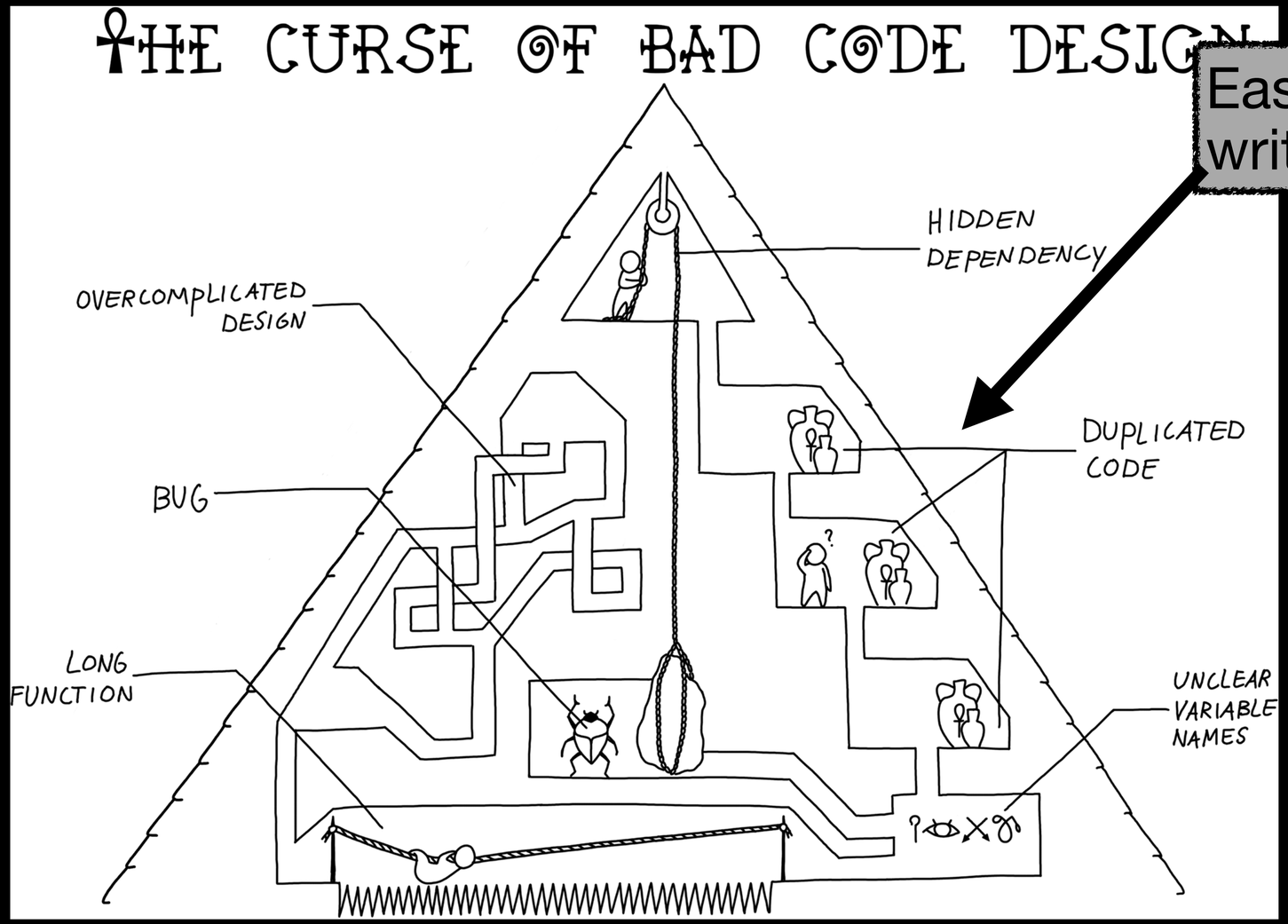

Ease of debugging is a reason to write functions.

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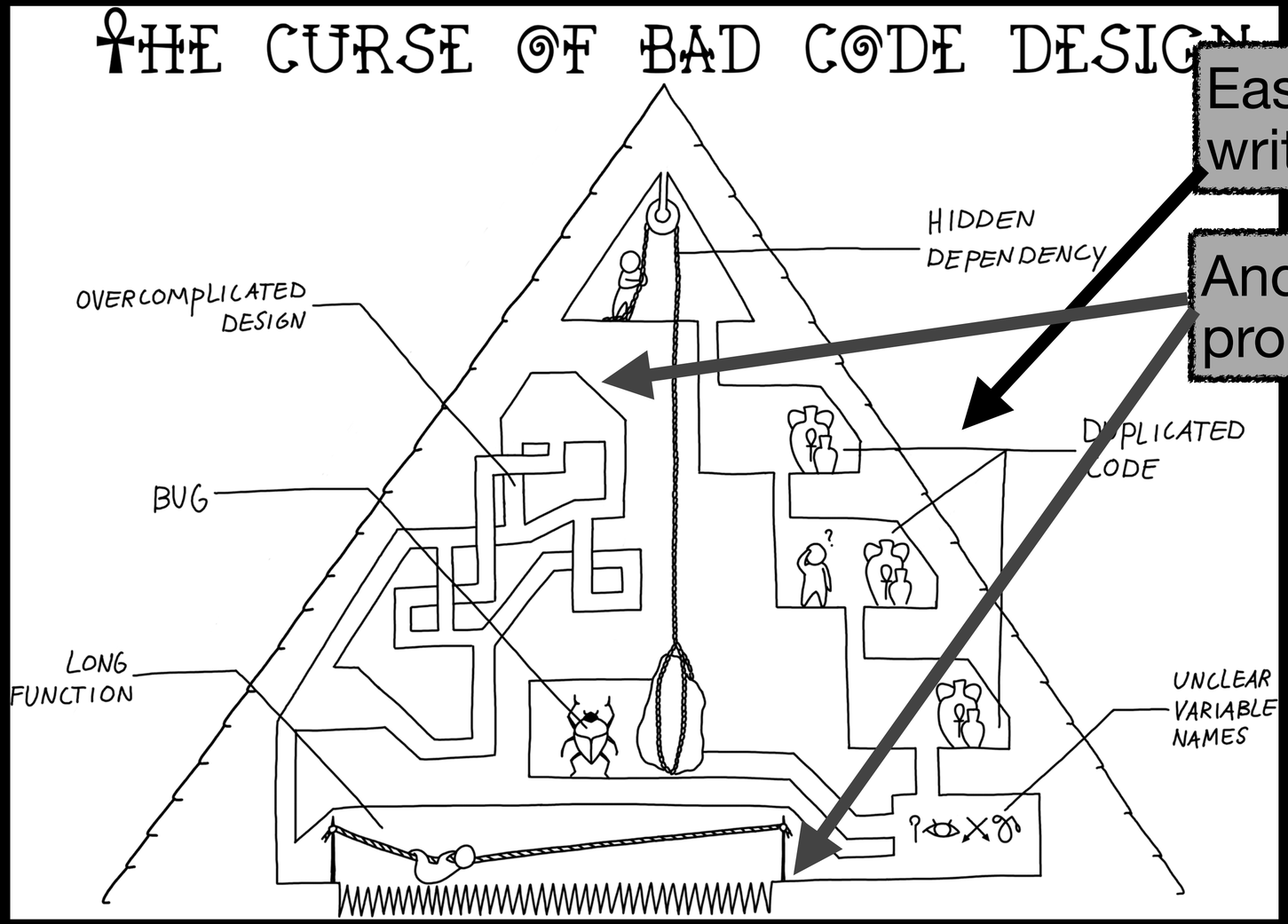

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And to keep functions bite-size and properly scoped.

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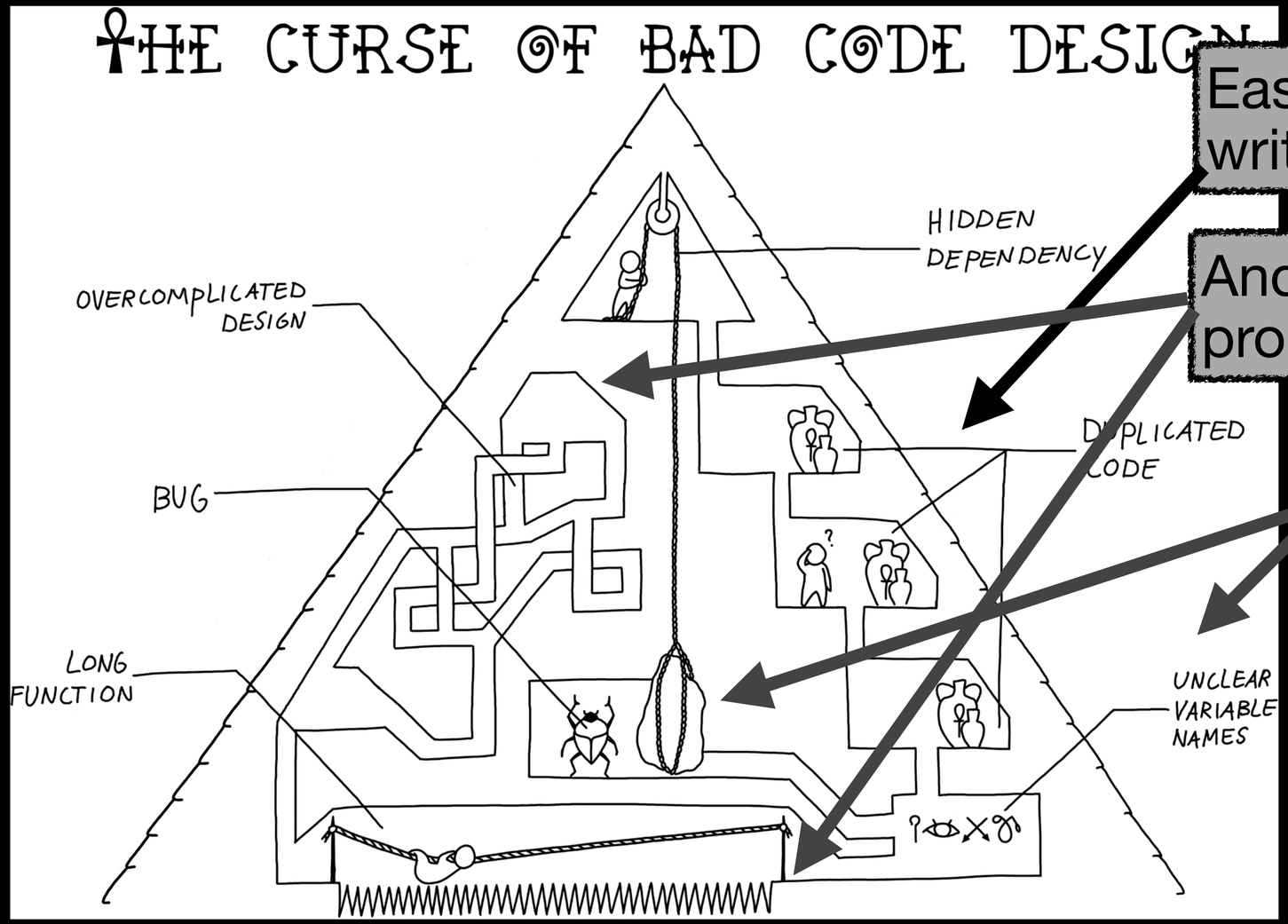

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…and understandable

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Testing

- You have written useful code. :tada:
- You (or someone else) wants to write some more code.
  - How do you make sure you (or they) don’t break it?

—> Testing

Other answers:

- Pull requests
- don’t share your code

Testing
What is it?

- A set of functions that check to make sure other functions are behaving as expected.
- Especially good for **semantic errors**. (The code seems like it is running but…)
- Most effective when a codebase is modular

Testing

Manual vs. automated testing

- We will mostly been discussing **unit testing** - do individual units (e.g., a function or a .py with a set of functions) pass tests.
- Can test any unit manually - pass the units (i.e functions) data, and see if it what comes out makes sense. jupyter notebooks are great!
- There are also many mature tools for automated testing - you set up the tests, and these packages run them
- Other forms of testing integration testing, performance testing, …

Testing

Automation packages

- `unittest`
- `nose, nose2`
- `pytest`
- Behavior-driven development: `Lettuce, Radish, behave`
  - Testing but with what each test does in English so you can understand what is happening. For *very * complicated codebases

Testing
Conventions

- Conventions for python testing: `test_*.py` or `*_test.py`

- These can be in folders of your module, or in a test folder of there own

- Within these, functions named `test_*():` that have an `assert`

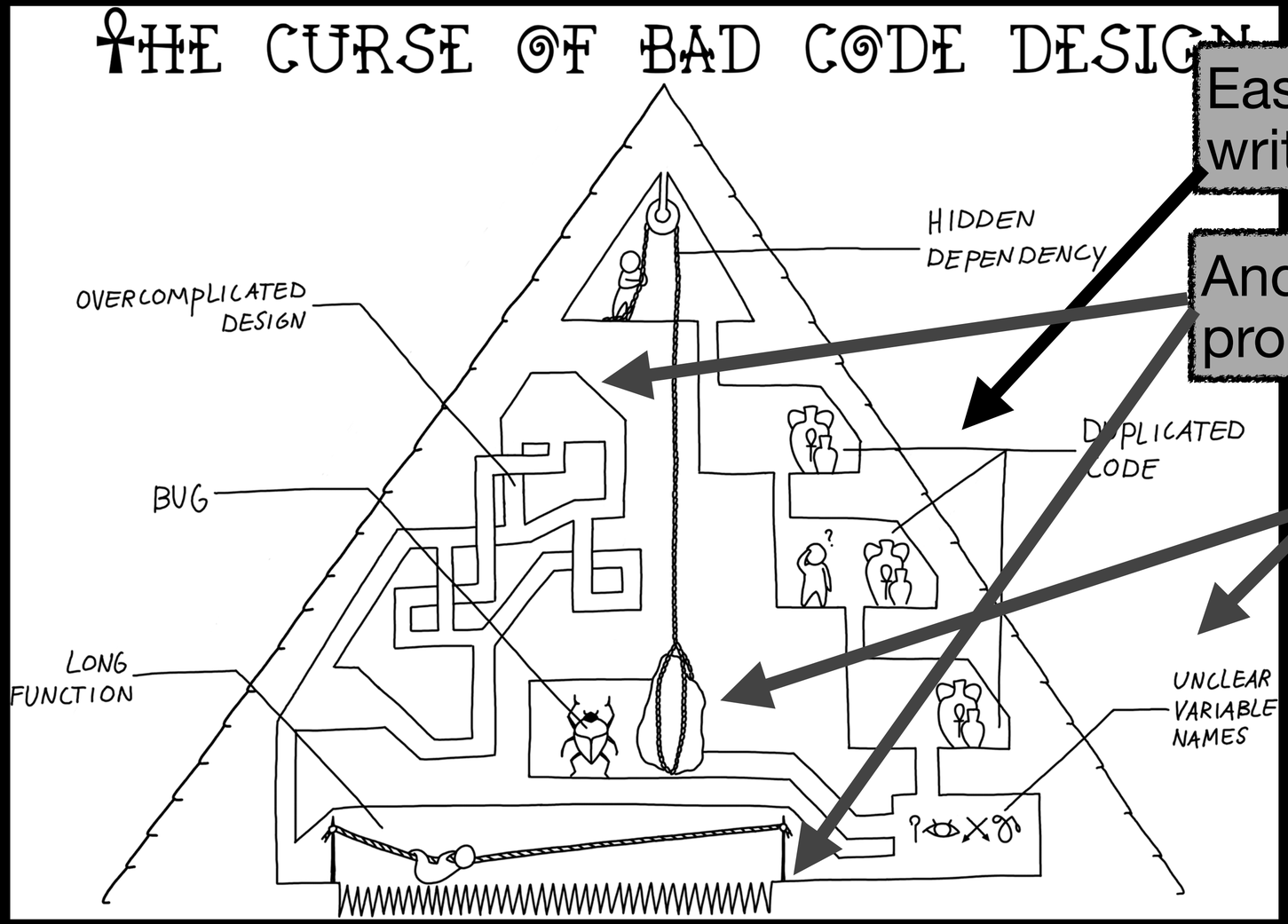
Testing
Example

`patsy`

Testing
Example

```
djd
```

Debugging
Code architecture



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Testing

Can also be for data integrity

- Write tests that traverse data structures (like folder with experiments in them, or images or DataFrames) and make sure all the parts are there and shaped the expected way with `assert`

Testing

Kind of like version control

- You are going to test units no matter what - either manually, with automated tests, or with fancy behavior-drive
- In science, manual tests will be 95%-100% of the time
- and you might consider for the rest, the really important bits, setting up some automated tests
  - Manually testing is **critical**. Your code has to work.
  - Automated is a “nice-to-have” that will make your code better.