Injecting Faults into the Framework

Team Lucky 7
Laura Barber, Venessa Johansen-Barrera, Michael Blackburn

Introduction

Given the design of the methods being tested for our project, there was little to change to break the code. When deciding on what to choose as our fault injections we had countless options. Some of those options included changing the HTTP status codes for valid urls from 200 to some other code, changing the predefined lists of valid served urls to other, invalid urls, and simply injecting syntax errors. All of our choices for breaking the code would allow individual cases to be broken, without breaking the entire framework. We made the decision to go with the choice changing HTTP status codes, changing ands/ors and a few syntax errors. After discussing the steps of what could be done for each option, we decided that focusing on these three would be most beneficial to our project and our knowledge. So from here, we started our fault injections using by focusing on one method and one group of tests at a time.

Fault Injections

We have chosen to induce test failures in three different ways.
1. Change HTTP status codes from 200 OK to anything else.
2. Change *and* to *or,* vice versa.
3. Inject syntax errors by using '=' instead of '==' (A common mistake.)

Planned Test Failures

We are planning to have the following tests return either errors or improper results. We are creating these failures by editing the *nginx-smoke-test.py*.

Tests 1-14

This test normally looks at the method **served_by_nginx**(url), and requires that the url is served by nginx and returns 200 OK.

```
11    def served_by_nginx(url):
12        """Return True if url returns 200 and is served by Nginx."""
13        r = requests.get(url, allow_redirects=False)
14        status = (r.status_code == 207)
15        nginx = ('x-served' in r.headers and r.headers['x-served'] == 'Nginx')
16        return all([status, nginx])
17
```

Usually these tests would all return true, but by changing the status code on line 14 from *200* to *207* they will return false. It still properly checks that the server is served by nginx, but it now checks for a 207 status code (Multi-Status: The message body that follows is an XML message and can contain a number of separate response codes, depending on how many sub-requests were made.) This will then give a False return, resulting in a failed test.

Test	Requirement	Method	Input	Oracle	Output	Result
1	⬀	served_by_nginx	https://pip.readthedocs.org/en/latest/	True	False	✖
2	⬀	served_by_nginx	http://docs.fabfile.org/en/latest/	True	False	✖
3	⬀	served_by_nginx	https://pip.readthedocs.org/en/latest/usage.html	True	False	✖
4	⬀	served_by_nginx	https://pip.readthedocs.org/en/1.4.1/	True	False	✖
5	⬀	served_by_nginx	https://pip.readthedocs.org/en/1.4.1/news.html	True	False	✖
6	⬀	served_by_nginx	http://docs.fabfile.org/en/latest/usage/execution.html	True	False	✖
7	⬀	served_by_nginx	http://phpmyadmin.readthedocs.org/ja/latest/	True	False	✖
8	⬀	served_by_nginx	http://phpmyadmin.readthedocs.org/cs/latest/	True	False	✖
9	⬀	served_by_nginx	http://phpmyadmin.readthedocs.org/en/latest/	True	False	✖
10	⬀	served_by_nginx	https://ericholschercom.readthedocs.org/en/latest/	True	False	✖
11	⬀	served_by_nginx	https://ericholschercom.readthedocs.org/about/	True	False	✖
12	⬀	served_by_nginx	https://ericholschercom.readthedocs.org/en/latest/about/	True	False	✖
13	⬀	served_by_nginx	http://docs.pylonsproject.org/projects/pyramid/en/latest/	True	False	✖
14	⬀	served_by_nginx	http://docs.pylonsproject.org/projects/pyramid-amon/en/latest/genindex.html	True	False	✖

Interestingly, note that Test 22 and 24 which use the **served_by_nginx**(url) method will still pass. As the tests are intended to return False.

22	⬀	served_by_nginx	http://www.microsoft.com	False	False	✔
23	⬀	served_by_perl	http://my.cofc.edu	False	False	✔
24	⬀	served_by_nginx	http://my.cofc.edu	False	False	✔

Tests 15-18 and 25

These tests usually looks at **served_by_django**(url) and requires that the url is served by django and returns 200 OK.

```
19    def served_by_django(url):
20        """Return True if url returns 200 and is served by Django. (NOT Nginx)"""
21        r = requests.get(url, allow_redirects=False)
22        status = (r.status_code == 200)
23        django = ('x-served' not in r.headers and r.headers['x-served'] == 'nginx-via-django')
24        return all([status, django])
25
```

By changing line 23 from the original *r.headers or r.headers[]* to *r.headers and r.headers[]* we get the error below. As the code should normally be checking that x-served, or the server headers, are not in the normal headers <u>or</u> are in the x-served headers. With this error they are now checking that the headers are in <u>both</u>. Resulting in the following error.

```
Traceback (most recent call last):
  File "test.py", line 9, in <module>
    runMethod(*sys.argv[1:])
  File "test.py", line 5, in runMethod
    print(getattr(nginx_smoke_test, method)(url))
  File "../project/src/nginx-smoke-test.py", line 23, in served_by_django
    django = ('x-served' not in r.headers and r.headers['x-served'] == 'nginx-vi
a-django')
  File "/usr/local/lib/python2.7/dist-packages/requests/structures.py", line 77,
 in __getitem__
    return self._store[key.lower()][1]
KeyError: 'x-served'
Performing test 16.
```

The results are also displayed below.

15	☑	served_by_django	https://readthedocs.org/search/	True		✖
16	☑	served_by_django	https://readthedocs.org/api/v1/?format=json	True		✖
17	☑	served_by_django	https://readthedocs.org/accounts/login/	True		✖
18	☑	served_by_django	https://readthedocs.org/accounts/login/	True		✖
19	☑	served_by_perl	http://www.perl.org/	False	False	✔
20	☑	served_by_perl	https://ericholschercom.readthedocs.org/	False	False	✔
21	☑	served_by_perl	http://www.microsoft.com	False	False	✔
22	☑	served_by_nginx	http://www.microsoft.com	False	False	✔
23	☑	served_by_perl	http://my.cofc.edu	False	False	✔
24	☑	served_by_nginx	http://my.cofc.edu	False	False	✔
25	☑	served_by_django	http://my.cofc.edu	True		✖

Given that there are errors, the tests will not actually output a True/False result and comparing the oracle to null will give a failed test, as shown.

All Tests

By injecting a syntax error into line 30 ('=' instead of the proper '==') it causes all tests to fail. All tests are still attempted by the framework, but they each return the error of SyntaxError: invalid syntax.

```
26  def served_by_perl(url):
27      """Return True if url returns 200 and is served by Perl."""
28      r = requests.get(url, allow_redirects=False)
29      status = (r.status_code == 302)
30      perl = ('x-perl-redirect' in r.headers and r.headers['x-perl-redirect'] = 'True')
31      return all([status, perl])
32
```

Similar to the previous error injection it will result in no outputs for all tests, causing all tests to fail.

Test	Requirement	Method	Input	Oracle	Output	Result
1	☐	served_by_nginx	https://pip.readthedocs.org/en/latest/	True		✖
2	☐	served_by_nginx	http://docs.fabfile.org/en/latest/	True		✖
3	☐	served_by_nginx	https://pip.readthedocs.org/en/latest/usage.html	True		✖
4	☐	served_by_nginx	https://pip.readthedocs.org/en/1.4.1/	True		✖
5	☐	served_by_nginx	https://pip.readthedocs.org/en/1.4.1/news.html	True		✖
6	☐	served_by_nginx	http://docs.fabfile.org/en/latest/usage/execution.html	True		✖
7	☐	served_by_nginx	http://phpmyadmin.readthedocs.org/ja/latest/	True		✖
8	☐	served_by_nginx	http://phpmyadmin.readthedocs.org/cs/latest/	True		✖
9	☐	served_by_nginx	http://phpmyadmin.readthedocs.org/en/latest/	True		✖
10	☐	served_by_nginx	https://ericholschercom.readthedocs.org/en/latest/	True		✖
11	☐	served_by_nginx	https://ericholschercom.readthedocs.org/about/	True		✖
12	☐	served_by_nginx	https://ericholschercom.readthedocs.org/en/latest/about/	True		✖
13	☐	served_by_nginx	http://docs.pylonsproject.org/projects/pyramid/en/latest/	True		✖
14	☐	served_by_nginx	http://docs.pylonsproject.org/projects/pyramid-amon/en/latest/genindex.html	True		✖
15	☐	served_by_django	https://readthedocs.org/search/	True		✖
16	☐	served_by_django	https://readthedocs.org/api/v1/?format=json	True		✖
17	☐	served_by_django	https://readthedocs.org/accounts/login/	True		✖
18	☐	served_by_django	https://readthedocs.org/accounts/login/	True		✖
19	☐	served_by_perl	http://www.perl.org/	False		✖
20	☐	served_by_perl	https://ericholschercom.readthedocs.org/	False		✖
21	☐	served_by_perl	http://www.microsoft.com	False		✖
22	☐	served_by_nginx	http://www.microsoft.com	False		✖
23	☐	served_by_perl	http://my.cofc.edu	False		✖
24	☐	served_by_nginx	http://my.cofc.edu	False		✖
25	☐	served_by_django	http://my.cofc.edu	True		✖

Moving Forward

As we are almost finished with our project, all that remains is to put everything together and present our final project.