

Web Application Testing in Python

With an Intro to the Testing Pyramid
and Selenium WebDriver

Guidance

What to Test?

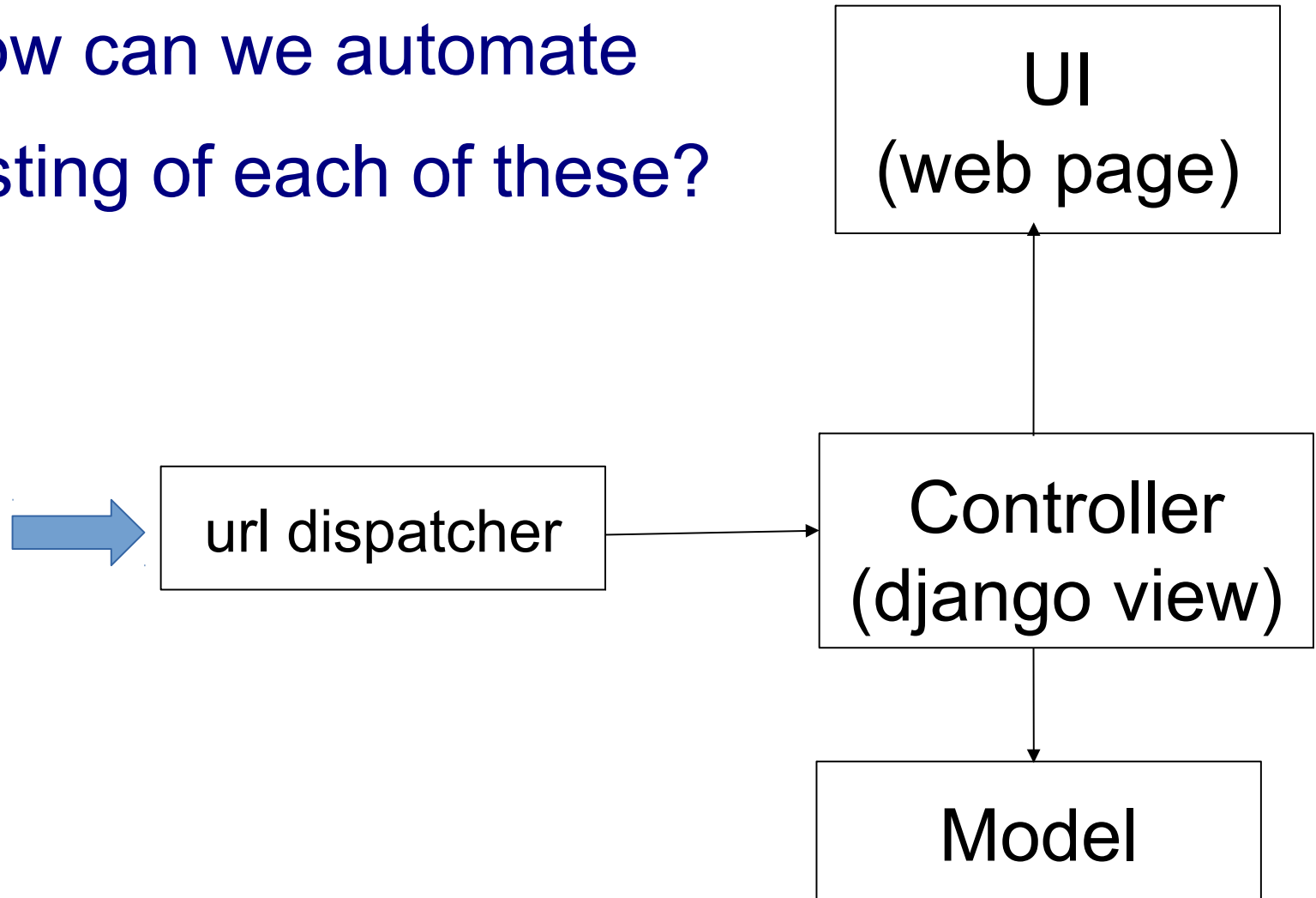
- Application conforms to the requirements
- Logic
- Flow Control
- Application Flow, e.g. Page Flow
- Configuration

"Don't test Constants", e.g. HTML template text

Test your code, not the framework

Testing Parts of a Web App

How can we automate testing of each of these?



Models: test using standard unit tests

```
import django.test
from polls.models import Question

class QuestionTest(django.test.TestCase):
    def test_question_with_future_date(self):
        tomorrow = timezone.now() +
            datetime.timedelta(days=1)
        question = Question( question_text=
            "Is this the future?", pub_date=tomorrow)
        # future date is not "recent"
        self.assertFalse(
            question.was_published_recently() )
```

Not necessary to test the *framework*

```
import django.test
from polls.models import Question

class QuestionTest(django.test.TestCase):
    def setUp(self):
        Question.objects.create(
            question_text="Question One")
        Question.objects.create(
            question_text="Question Two")

    def test_create_questions(self):
        self.assertEqual(2, Questions.objects.count())
```

What is Being Tested? (cont'd)

```
def test_question_text(self):  
    self.assertTrue(  
        any("Question One" in q.question_text  
            for q in Questions.objects.all()) )
```

This is testing Django's persistence framework.

OK to do it occasionally while learning Django.

But its not a useful test of your code.

Test Views and URLs

Use `django.test.Client` to experiment

```
$ python manage.py shell
>>> from django.test import Client
>>> c = Client()
# Get the /polls/ page. Should contain some polls
>>> response = c.get('/polls/')
# Did it succeed?
>>> response.status_code
200
# Print the html content
>>> response.content
'<html>\n<head>\n<style>...\n<h1>Active Polls</h1>...
```

Testing Django Views and URLs

```
class TestViews(django.test.TestCase):  
    def setUp(self):  
        super().setUp()  
        self.client = django.test.Client()  
  
    def test_polls_index(self):  
        poll = Question(question_text="ABCDEFGHIJ", ...)   
        poll.save()  
        response = self.client.get('/polls/')  
        self.assertEqual(response.status_code, 200)  
        # Is test poll included in the page?  
        self.assertContains(response, "ABCDEFGHIJ")
```


Rewrite the Test using reverse()

Instead of writing `"/polls/"` URL as a String, use `reverse()` to get the URL **by name** from `urls.py`.

```
from django.urls import reverse

def test_polls_index(self):
    poll = Question(question_text="ABCDEFGHIJ", ...)
    poll.save()
    url = reverse('polls:index')
    response = self.client.get( url )
    self.assertEqual(response.status_code, 200)
    # Is test poll included in the page?
    self.assertContains(response, "ABCDEFGHIJ")
```

Test the / URL is Redirected

Test that 'GET /' redirects the browser to polls index.

```
def test_redirect_root_url(self):  
    """root url should redirect to polls index"""  
    response = self.client.get('/')  
    # Test using the basic way  
    self.assertEqual(response.status_code, 302)  
    polls_url = reverse('polls:index')  
    self.assertEqual(response.url, polls_url)  
  
    # Better way: use TestCase assertRedirects  
    self.assertRedirects(response, polls_url)
```

Explore Tests using Django Shell

If you are not sure how to test, use Django Shell to try it

```
>>> tc = django.test.TestCase()
>>> client = django.test.Client()
# The root url / should redirect to polls
>>> response = client.get('/')
>>> tc.assertRedirects(response, '/polls/')
# "Location" header field is the redirect url
>>> assert response.get('Location') == '/polls/'
```

Useful django.test.TestCase asserts

the response contains some text

```
assertContains( response, "some text")
```

```
assertNotContains( response, "bad text")
```

response is a redirect to some url

```
assertRedirects( response, url )
```

response uses a template we expect

```
assertUsesTemplate( response,  
                    'polls/detail.html')
```

Useful Info in HttpResponse

`client.get()` or `client.post()` return an `HttpResponse` obj.

```
response = client.get( '/polls/' )
```

`response` has these useful attributes:

`status_code` - the HTTP status code (200 = OK, etc.)

`request` - the `HttpRequest` that caused this response

`templates` - a list of templates used in the response

`content` - body of the response, as a byte-string

`context` - the context that was used to render the template; context contains a key-value map.

Where is the info for TestCase?

How do you know what `TestCase` and `Client` can do?

See the "**Django Testing Tools**" page.

`https://docs.djangoproject.com/en/3.1/
topics/testing/tools/`

The asserts are buried near the bottom of the page, in section "**Assertions**".

How to Test a Template?

```
def test_polls_index(self):  
    poll = Question(question_text="ABCDEFGHIJ", ...)  
    poll.save()  
    response = self.client.get('/polls/')  
    self.assertTemplateUsed(response,  
        template_name='polls/index.html')
```

You can test POST, too

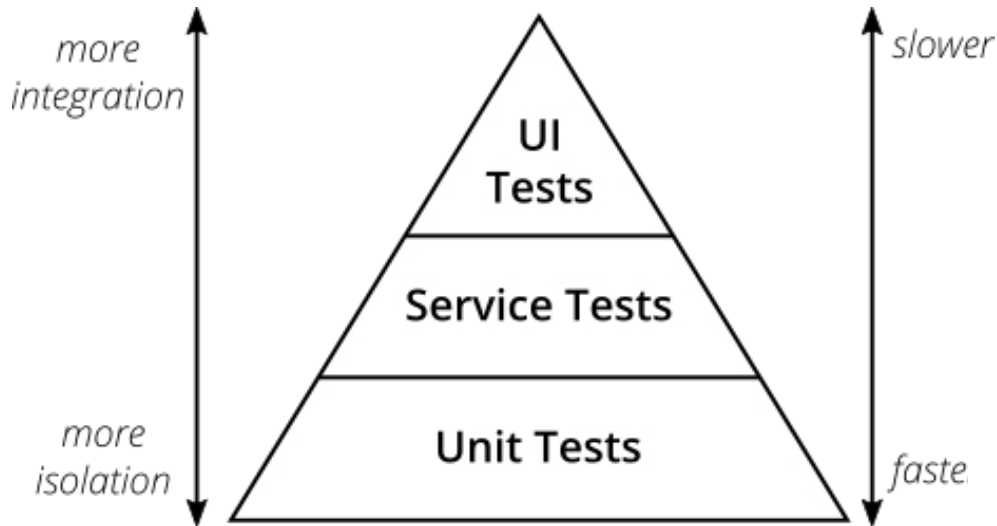
```
# Vote for a poll.  
# This example assumes you somehow know the poll  
# id is 1. Send POST data as a Python dictionary.  
response =  
    self.client.post('/polls/1/', {'choice': '2'})  
# What should POST return? (Should redirect)  
# Test that the vote was recorded in choice.  
# Test an invalid choice  
response2 =  
    self.client.post('/polls/1/', {'choice': '9999'})
```


Are Unit Tests Enough?

No.

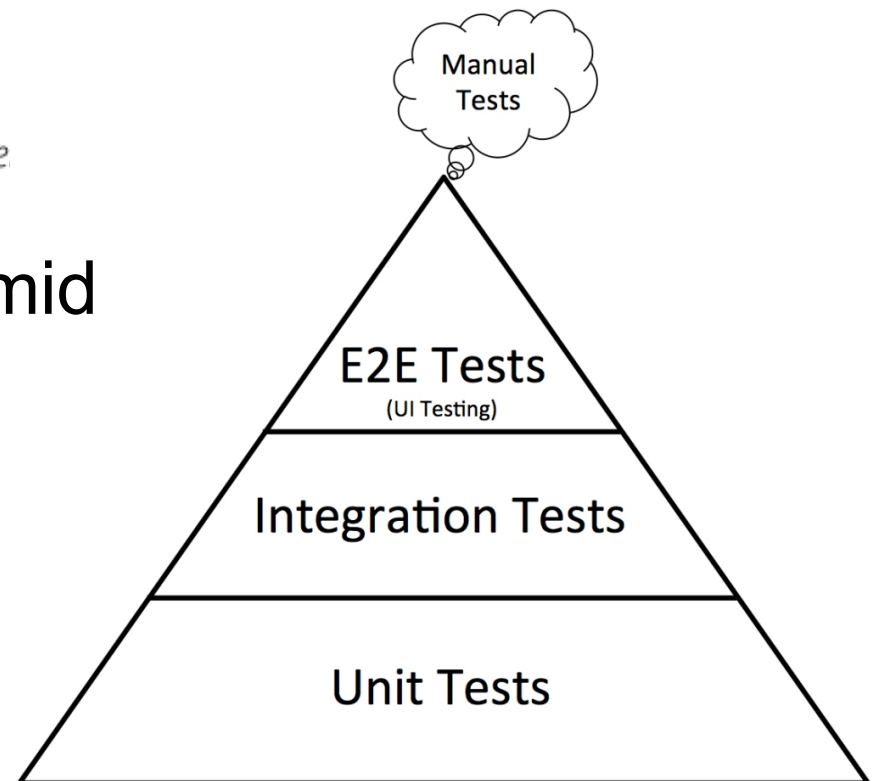
Unit tests don't verify that the **application works**.

The Testing Pyramid



Mike Cohen's original Pyramid

"Practical" pyramid



Integration Testing

Test the interaction between components.

- Components belonging to your app
- Back-end services called by front-end
- **External** components and **web services**

Examples:

- database
- file system used to save user uploaded files
- a Google API used by your app

How to Test:

- often access a "service layer" or your standard URLs.

Functional or "End-to-End" Tests

Test the "development" or "production" app
while its running! -- not a 'test' server.

Run tests through an actual web browser.

Test the application as a whole.

Goals of E2E Testing

1. Verify the application works "*from start to finish*".
2. Can perform the major use cases (user stories) via the browser interface.
 - called "*happy path*" (nothing goes wrong)
3. Test that required *services* work, too.

Goal is not comprehensive testing of every feature.

Secondary Use of E2E Tests

Useful to verify all links, buttons, and menu items work.

No "404" or "5xx" errors.

E2E Testing Tools

Selenium - control an actual web browser **using code**.

- Interface in many languages, incl. Python & Java
- Django has built-in support
- Selenium IDE for creating tests in a web browser

Cypress.io - Javascript testing tool. Natively interacts with pages in your application.

- uses Mocha and Chai for writing tests
- tests written in Javascript

Puppeteer - library for controlling a "headless" Chrome browser. Uses Javascript and node.js.

- uses: page scraping, web crawling, testing

Selenium

Browser automation. Not just testing.

`https://selenium.dev/`

We will use Selenium WebDriver

- programmatically control a web browser

Selenium Example

See `SeleniumExercise.pdf`

Human Readable Test Automation

robotframework.org - write tests in plain English.

For web testing and many other applications.

robotframework example

Test that a login succeeds.

See: <https://robotframework.org/#examples>

```
*** Settings ***
```

```
Documentation A single test for valid login.
```

```
... workflow that is created using keywords in:
```

```
Resource      resource.txt
```

```
*** Test Cases ***
```

```
Valid Login
```

```
    Open Browser To Login Page
```

```
    Input Username      demo
```

```
    Input Password      fatchance
```

```
    Submit Credentials
```

```
    Welcome Page Should Be Open
```

```
    [Teardown]          Close Browser
```

References

The Practical Test Pyramid

<https://martinfowler.com/articles/practical-test-pyramid.html>

Good Selenium Tutorial in Python (7 parts)

<https://blog.testproject.io/2019/07/16/set-your-test-automation-goals/>

The same author has other good testing tutorials:

<https://blog.testproject.io/2019/07/16/>

Django E2E Tests with Selenium

TDD in Python (online book)

Several chapters use Selenium for E2E testing of the Django project used in book.

Testing the Github Public API

`developer.github.com/v3/users/`