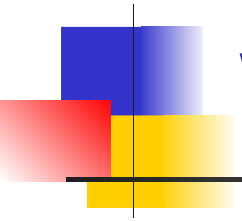


Web Application Testing in Python

With an Intro to Selenium WebDriver

Guidance

What to Test?

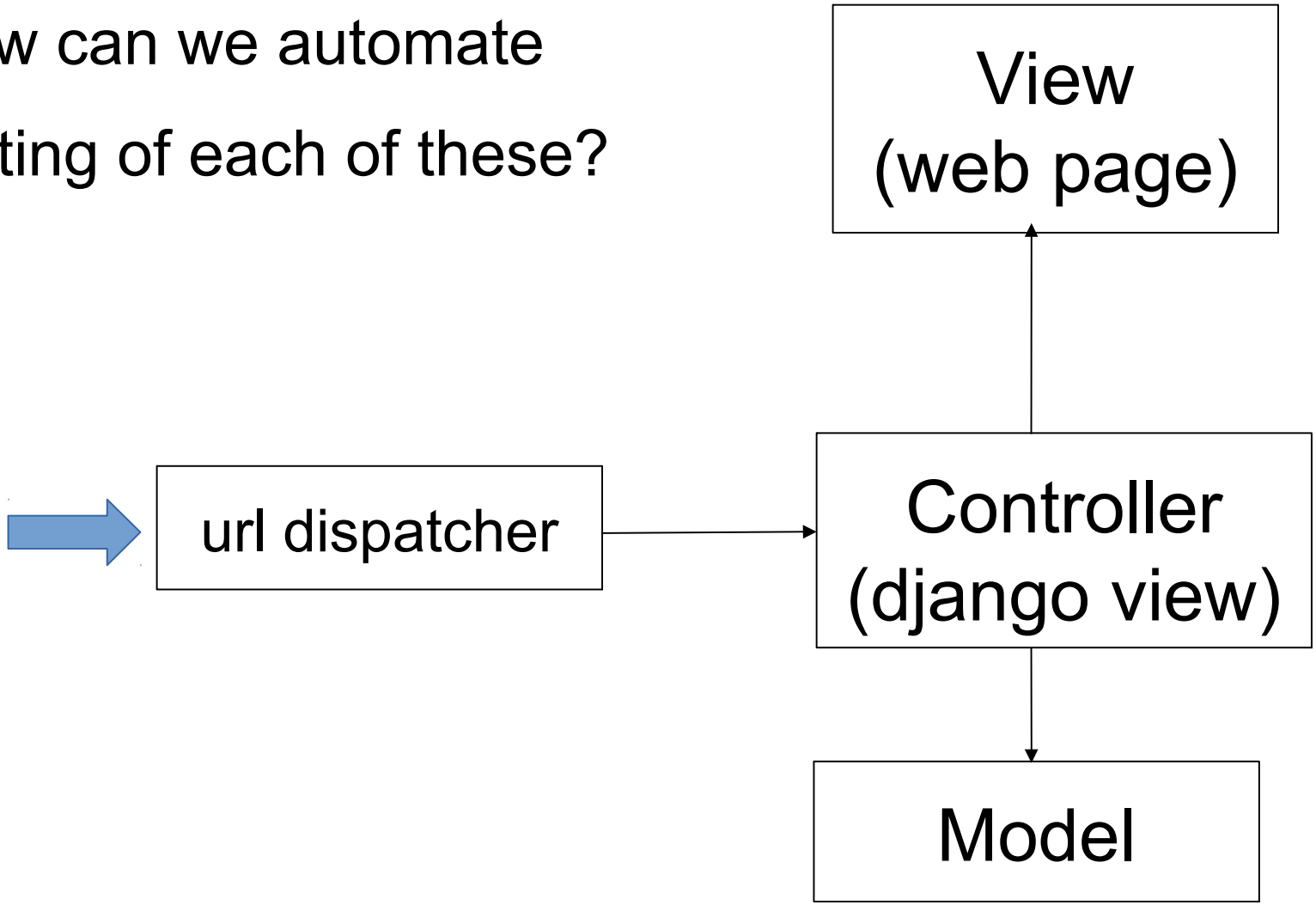
- Application conforms to the requirements
- Logic
- Flow Control
- Application Flow, e.g. Page Flow
- Configuration

"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.

Django 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):
        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.shortcuts 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 )

#  reponse uses the template we expect

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

Useful Info in HttpResponse

When you invoke client.get() or client.post() the `response` in an HttpResponse containing these fields:

`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

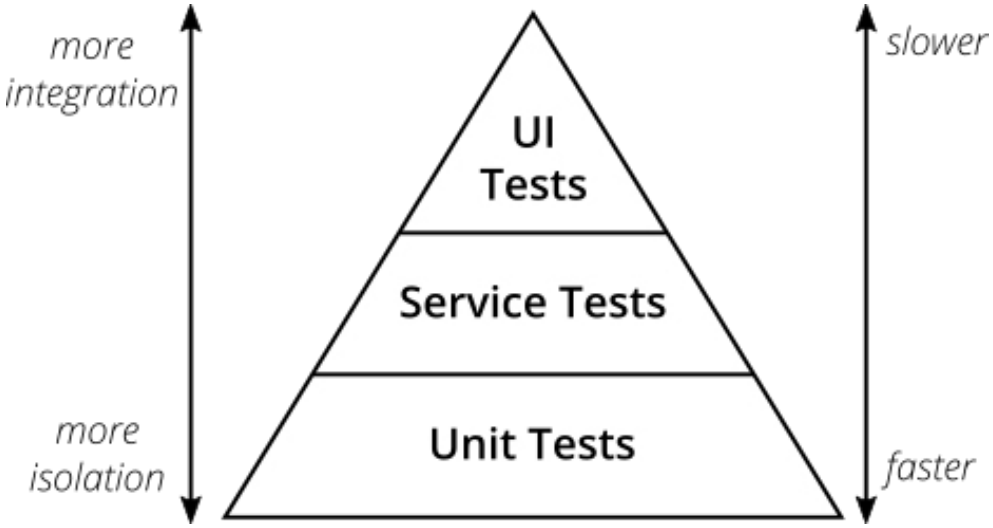
```
# Vote for a poll.
# This example assumes you somehow know the poll
# id is 1.  Send POST data as a Python dictionary.
response =
    self.client.post('/polls/1/', {'choice': '2'})
# What should POST return? (Should redirect)
# Test that the vote was recorded in choice.
# Test an invalid choice
response2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

Are Unit Tests Enough?

No.

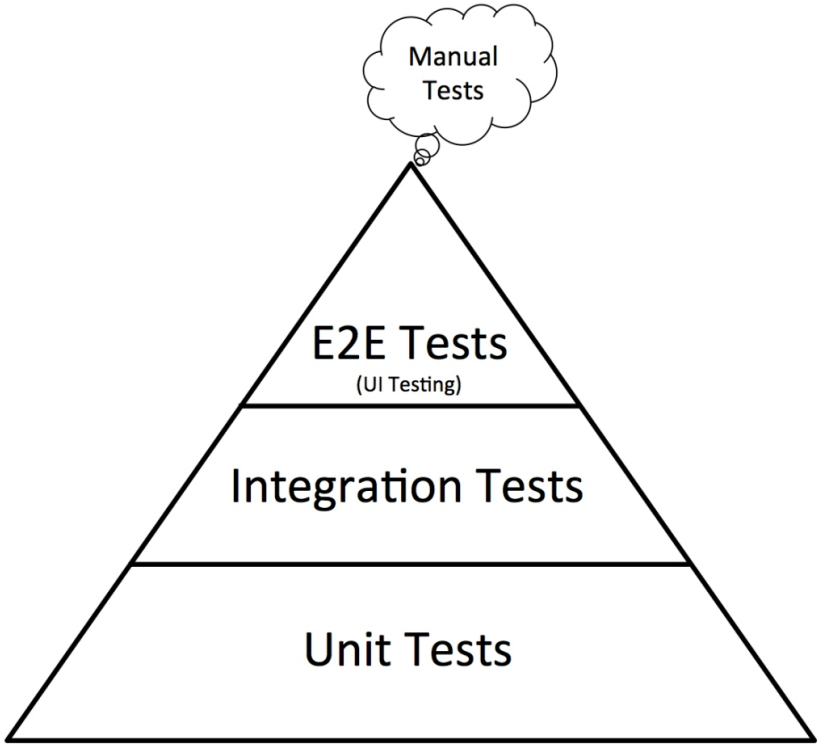
Unit tests don't test whether the application works.

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.

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

Goal:

Use duckduckgo.com to find links to Kasertsart U.

Print the top 10 links.

Requires:

- Selenium WebDriver (`pip install selenium`)
- driver for Firefox browser (called "geckodriver")

  https://github.com/mozilla/geckodriver/releases
- you can use Chrome or Safari instead

Selenium: get a web page

```
from selenium import webdriver
from selenium.webdriver.common.keys import Keys
# browser: WebDriver object
browser = webdriver.Firefox()
browser.implicitly_wait(10) # seconds


# get the duckduckgo search page
url = "https://duckduckgo.com"
browser.get( url )
```

Selenium: find on page & send data

```
# Find the search box on page
# Selenium has many find_by_* commands

field_id = 'search_form_input_homepage'

input_field =
     browser.find_element_by_id(field_id)

input_field.send_keys("Kasetsart Univer")

input_field.send_keys(Keys.RETURN)

# now the browser should display results
```

Page Scraping

```
# get the links from results page
# hacky way: use known CSS formatting

link_divs =
  browser.find_elements_by_css_selector(
  '#links > div')

print(f"Found {len(link_divs)} matches.")

# Each result is a WebElement object
# we can search them. Look for <a href=...

element = link_divs[0]
            .find_element_by_tag_name('a')
```

Page Scraping (2)

```
# element refers to another WebElement:
# <a href="..?..">some text</a>
# Get the 'href' value

url = element.get_attribute('href')

print("First link on page is", url)

# What the heck! Let's go visit...

element.click()

# OK, enough. Go back to search results.

browser.back()
```

Another Way to Find Links

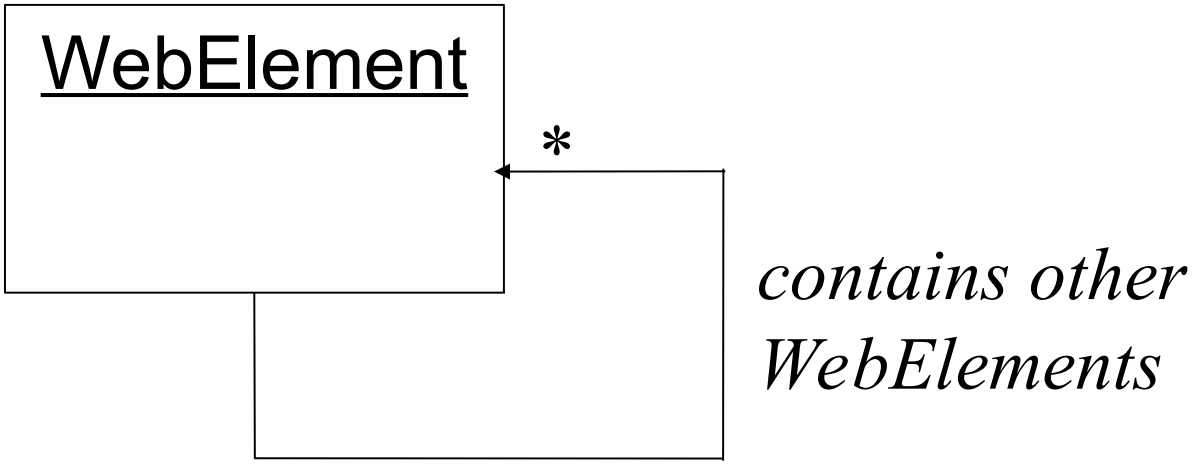
```
# The Hyperlinks use class 'result__a'

links = browser.
  find_elements_by_class_name('result__a')

for link in links:

    if link.tag_name == 'a':

        url = link.get_attribute('href')

        print(url)
```

Composite Design Pattern

`WebElement` may contain other `WebElements`.

`WebElement` is the primary object for interacting with a web page using Selenium.

`WebDriver` contains many of the same methods as WebElement



Headless Browsing

You can run a browser without opening a U.I. window.

This is called headless mode.

May be necessary when running E2E tests on a C.I. server.

It is *faster*, too.

https://developer.mozilla.org/en-US/docs/Mozilla/Firefox/Headless_mode

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/