Behavior-Driven Python

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Friday, May 11th @ PyCon 2018

Who is Andy Knight?

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Agenda

1. Behavior-Driven Development
2. The **behave** Framework
3. Gherkin Features
4. Python Mechanics
5. Running Tests
6. Final Remarks

Behavior-Driven Development

What is a “Behavior”?

be·hav·ior

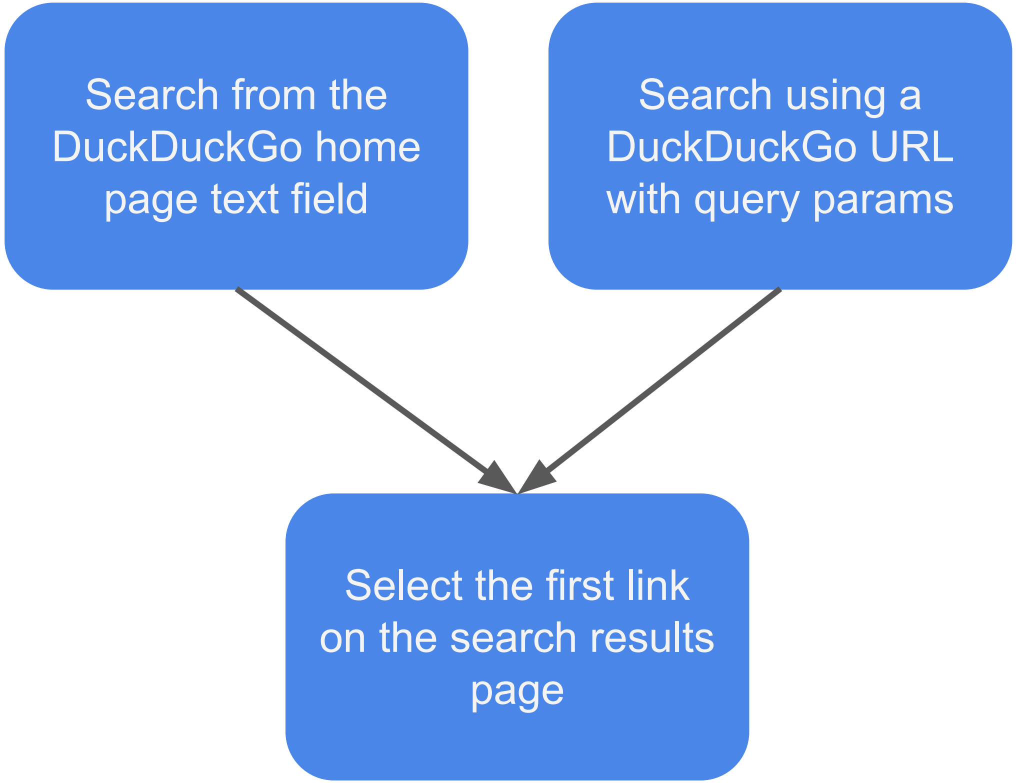
the way in which one acts or conducts oneself

In software, a **behavior** is how a feature operates. A behavior is defined as a scenario of inputs, actions, and outcomes. A product or feature exhibits countless behaviors.

- Submitting forms on a website
- Searching for desired results
- Saving a document
- Making REST API calls
- Running CLI commands

Separating Behaviors

Separating individual behaviors makes it easy to define a system without unnecessary repetition.


Search from the DuckDuckGo home page text field
Search using a DuckDuckGo URL with query params
Select the first link on the search results page

Behavior-Driven Development

BDD is a quality-centric software development process that puts product behaviors first. It complements existing process like Agile.

Behaviors are identified early in development using **specification by example**: *plain-language* descriptions that tell *what* more than *how*. Behavior specs become requirements, acceptance criteria, and acceptance tests all in one.

Test frameworks can directly automate specs as well: every step in a behavior scenario can be "glued" to code to run it.

⚠ Python has many BDD test frameworks. This talk will focus on **behave**.

Gherkin Behavior Spec Example

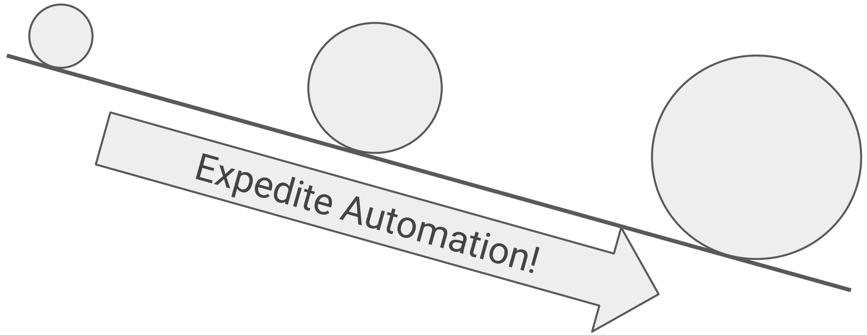
```
Scenario: Basic DuckDuckGo Search
  Given the DuckDuckGo home page is displayed
  When the user searches for "panda"
  Then results are shown for "panda"
```

✓ Concise
✓ Focused
✓ Sensible
✓ Meaningful
✓ Declarative

Benefits of BDD

The main benefits of BDD are better **collaboration** and **automation**.

- Everyone can contribute to development, not just programmers.
- Expected behavior is well defined and understood from the beginning.
- Tests can be automated together with the features they cover.
- Steps can be reused by behavior specs, creating a snowball effect.



The *behave* Framework

How *behave* Works

The **behave** framework essentially automates behavior specs using Python for the purpose of testing. There are two main layers:

1. Behavior specs written in **Gherkin** ".feature" files for *test focus*.
2. Step definitions and hooks written in **Python** for *automation focus*.

Gherkin scenarios use plain language steps:

1. *Given* some initial state
2. *When* an action is taken
3. *Then* verify the outcome

Each step is "glued" by decorator to a Python function when **behave** runs tests.

Installing *behave*

Only one package is needed:

```
pip install behave
```

Other packages may also be useful, such as:

```
pip install requests    # for REST API calls
pip install selenium    # for Web browser interactions
```

✓ Try using **pipenv**! It combines pip, Pipfile, and virtualenv.

Gherkin Features

Example Feature

```
Feature: Cucumber Basket
  As a gardener,
  I want to carry many cucumbers in a basket,
  So that I don’t drop them all.

  Scenario: Add and remove cucumbers
    Given the basket is empty
    When "4" cucumbers are added to the basket
    And "6" more cucumbers are added to the basket
    But "3" cucumbers are removed from the basket
    Then the basket contains "7" cucumbers
```

A Scenario with a Step Table

```
Feature: DuckDuckGo Instant Answer API
  As an application developer,
  I want to get instant answers to search terms via a REST API,
  So that my app can get answers anywhere.

  Scenario: Basic DuckDuckGo API Query
    When the DuckDuckGo API is queried with
      | phrase | format |
      | panda  | json   |
    Then the response status code is "200"
    And the response contains results for "panda"
```

A Scenario with Long Text

```
Feature: DuckDuckGo Web Browsing

  Scenario: Lengthy DuckDuckGo Search
    Given the DuckDuckGo home page is displayed
    When the user searches for the phrase
      """
      When in the Course of human events, it becomes necessary
       for one people to dissolve the political bands which have
       connected them with another
      """
    Then one of the results contains "Declaration of Independence"
```

A Scenario Outline

```gherkin
Feature: DuckDuckGo Web Browsing

  Scenario Outline: Basic DuckDuckGo Search
    Given the DuckDuckGo home page is displayed
    When the user searches for "<phrase>"
    Then results are shown for "<phrase>"

    Examples: Animals
      | phrase   |
      | panda    |
      | python   |
      | platypus |
```

Tags and Comments

```gherkin
@web @duckduckgo
Feature: DuckDuckGo Web Browsing

  # These scenarios should be able to run in any browser

  @search @panda
  Scenario: Basic DuckDuckGo Search
    Given the DuckDuckGo home page is displayed
    When the user searches for "panda"
    Then results are shown for "panda"
```

Python Mechanics

Step Definitions

Step definitions are Python functions that provide implementations for Gherkin steps. Each function is annotated by the step type and a matching string. It also received a shared *context* and any step parameters.

Three step matchers are available: (1) *parse*, (2) *cfparse*, and (3) *re*. The default and simplest is *parse* (shown to the right).

✓ Pro tip:
Surround parameters with " "!

```
from behave import *
from cucumbers.basket import CucumberBasket

@given('the basket has "{initial:d}" cucumbers')
def step_impl(context, initial):
    context.basket = CucumberBasket(initial_count=initial)

@when('"{some:d}" cucumbers are added to the basket')
def step_impl(context, some):
    context.basket.add(some)

@then('the basket contains "{total:d}" cucumbers')
def step_impl(context, total):
    assert context.basket.count == total
```

Gluing Steps to Definitions

```gherkin
Feature: Cucumber Basket

  Scenario: Add and remove cucumbers

    Given the basket has "4" cucumbers

    When "3" cucumbers are added to the basket

    Then the basket contains "7" cucumbers
```

```python
from behave import *
from cucumbers.basket import CucumberBasket

@given('the basket has "{initial:d}" cucumbers')
def step_impl(context, initial):
    context.basket = CucumberBasket(initial_count=initial)

@when('"{some:d}" cucumbers are added to the basket')
def step_impl(context, some):
    context.basket.add(some)

@then('the basket contains "{total:d}" cucumbers')
def step_impl(context, total):
    assert context.basket.count == total
```

Scenario Context

Notice the **context** variable passed into each step def. It holds data specific to the currently-running scenario. This is the proper way to pass data between steps!

Standard fields include *feature*, *scenario*, and *tags*. The *text* and *table* fields get step data. Custom fields may be added, too.

Ⓧ Warning:
Do *not* use globals to share data!

```
from behave import *
from cucumbers.basket import CucumberBasket

@given('the basket has "{initial:d}" cucumbers')
def step_impl(context, initial):
    context.basket = CucumberBasket(initial_count=initial)

@when('"{some:d}" cucumbers are added to the basket')
def step_impl(context, some):
    context.basket.add(some)

@then('the basket contains "{total:d}" cucumbers')
def step_impl(context, total):
    assert context.basket.count == total
```

Hooks

Steps focus on behavior, but automation often has extra needs. For example, Web tests must set up and tear down a WebDriver instance.

Hooks in the **environment.py** file can add instructions before and after steps, scenarios, features, tags, and the whole test run. This is similar to *Aspect-Oriented Programming*.

✓ Use tags to selectively apply hooks!

Ⓧ Don’t put cleanup in steps!

```python
from selenium import webdriver

def before_scenario(context, scenario):
    if 'web' in context.tags:
        context.browser = webdriver.Firefox()
        context.browser.implicitly_wait(10)

def after_scenario(context, scenario):
    if 'web' in context.tags:
        context.browser.quit()
```

Fixtures

While hooks can insert any sort of logic, **fixtures** specifically handle setup and cleanup with more advanced options.

For example, any scenario tagged with the fixture to the right will have a Firefox WebDriver instance automatically created before the scenario and cleaned up after the scenario.

Check **behave**'s doc for examples of *composite* fixtures and *registries*.

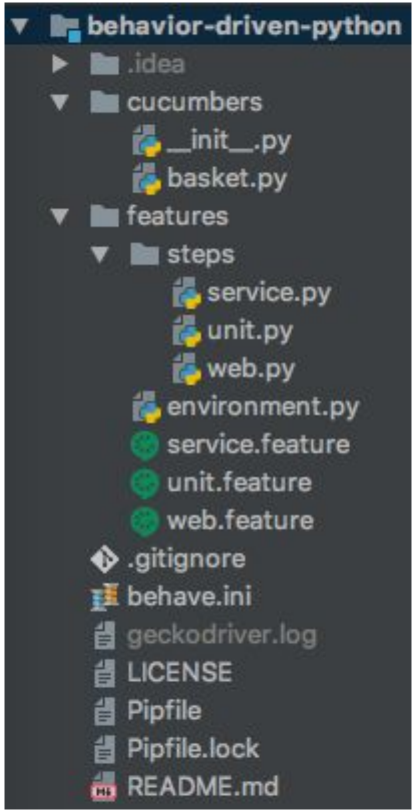
```
from behave import fixture
from selenium import webdriver

# The tag to use for the following fixture is:
# @fixture.browser.firefox

@fixture
def browser_firefox(context):
    # -- SETUP-FIXTURE PART:
    context.browser = webdriver.Firefox()
    context.browser.implicitly_wait(10)
    yield context.browser
    # -- CLEANUP-FIXTURE PART:
    context.browser.quit()
```

Directory Layout

behave is picky about the directory layout. By default, all feature files and the environment module must be under a directory named “features/”, and all step definition modules must be under “features/steps/”.

Feature file paths may be overridden by the *paths* config option. It’s popular to put everything under “tests/”.

✓ Feature files can use step definitions from *any* module under “steps”. Files don’t need to have the same name.



```
▼ behavior-driven-python
  ▶ .idea
  ▼ cucumbers
      __init__.py
      basket.py
  ▼ features
    ▼ steps
        service.py
        unit.py
        web.py
      environment.py
      service.feature
      unit.feature
      web.feature
    .gitignore
    behave.ini
    geckodriver.log
    LICENSE
    Pipfile
    Pipfile.lock
    README.md
```

Support Classes

Any Python packages or custom modules can be used with **behave**. Use them to build a better framework! Major packages include *logging*, *requests*, and *selenium*.

Be sure to employ **good design patterns** as well. For example, use the Page Object Model or the Screenplay Pattern instead of raw WebDriver calls for Web tests. Step def code should be concise!

Running Tests

Running Tests

Use the **behave** command from the project root directory to run features as tests:

```
# run all tests
behave

# run the scenarios in a feature file
behave features/web.feature

# filter tests by tag
behave --tags-help
behave --tags @duckduckgo
behave --tags ~@unit
behave --tags @basket --tags @add,@remove
```

⚠ Use "pipenv run behave" if using **pipenv**.

Config Files

Options may be provided in **config files**, too. Config files may be named ".behaverc", "behave.ini", "setup.cfg", or "tox.ini". They follow Windows INI format and use the "[behave]" label. The best place to put the file is under the project root.

Run "behave --help" to see all available options. Popular ones include:

- Custom feature file paths
- JUnit reporting
- Logging options

⚠ Command line options override config file options.

Testing Considerations

1. Using **virtual environments** for package isolation is a Python best practice, especially for test automation. Using a tool like **pipenv** is even better. Packages used only for testing (like **behave**) can be dev dependencies.

2. The **behave** framework does not support **parallel execution** out of the box. Offshoot projects make it happen, but it is still an open issue for the main project. Alternatively, scripts could be written to partition tests across separate processes and then aggregate results into one report.

3. **Build server integration** is easy: just recreate the virtual environment and run the commands. JUnit reports are widely compatible (for example, Jenkins).

Final Remarks

Other Python BDD Frameworks

pytest-bdd	● Gherkin-style BDD plugin for **pytest** ● Benefits from all **pytest** features and plugins ● Joint execution and filtering with non-Gherkin tests ● More flexible fixtures and directory layout
radish	● BDD framework compatible with Cucumber Gherkin ● Adds Scenario Loops and Preconditions to Gherkin ● Rich command line options
lettuce	● Another Gherkin-style BDD framework ● Small differences in framework mechanics ● Little recent GitHub activity

Links and Resources

behave

- GitHub project: https://github.com/behave/behave
- Official docs: http://behave.readthedocs.io/en/latest/index.html
- Andy's examples: https://github.com/AndyLPK247/behavior-driven-python

Automation Panda

- Twitter: **@AutomationPanda**
- More on BDD: https://automationpanda.com/bdd/
- More on Testing: https://automationpanda.com/testing/
- More on Python: https://automationpanda.com/python/

Thank you!