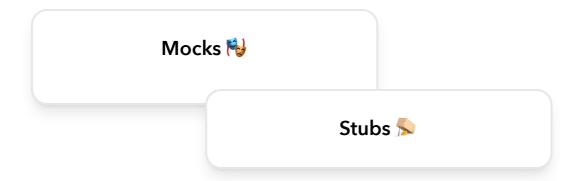
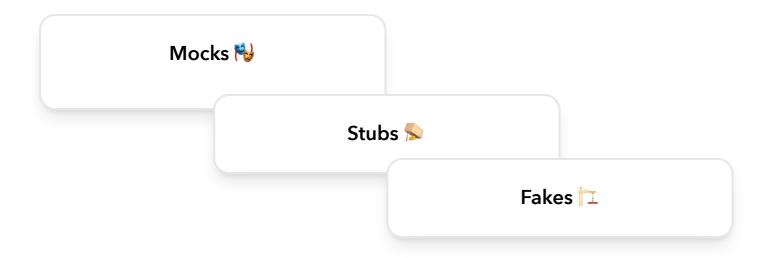
To mock or not to mock?

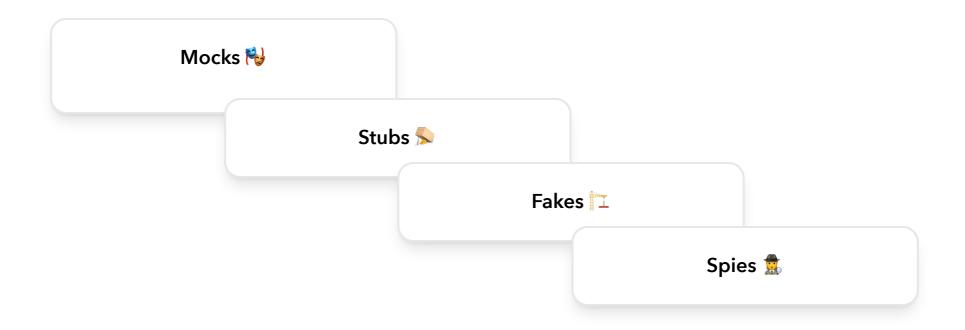
What is a test double?

A test double is to code what a stunt double is to an actor.

Mocks 😜







What is a mock?

A type of test double that we can use to replace real objects in our code.

Replace real object Control behavior Track interactions (call arguments)

In unittest framework create mocks with either Mock or MagicMock.

```
import unittest.mock as mock

mock_object = mock.Mock()

mock_object.some_method(x=1, y=2) # returns a new mock object
mock_object.some_method.assert_called_once() # after the call, track interactions with the mock

mock_object.some_method(3, y=4) # call again
mock_object.some_method.assert_has_calls([mock.call(x=1, y=2), mock.call(3, y=4)]) # assert many calls
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Difference between MagicMock and Mock

MagicMock supports "magic methods", while Mock does not.

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MagicMock supports "magic methods", while Mock does not.

Prefer MagicMock when using **magic methods**, like Sequence (list, tuple) or a context manager that defines __enter__ & __exit__.

```
example_magic_mock_pass.py <a>V</a>
     import unittest.mock as mock
     mock object = mock.MagicMock()
     # MagicMock has enter & exit magic methods 👍
     with mock object as m:
         pass
     # any other magic methods are also available 👍
     len(mock object)
10
11
     # track interactions with the mock object
12
     mock_object.__enter__.assert_called_once()
13
     mock object. len .assert called once()
14
```

```
example_mock_fail.py X

1   import unittest.mock as mock
2
3   mock_object = mock.Mock()
4
5   # Mock does not have __enter__ & __exit__
6   with mock_object as m:
7    pass
8
9   # TypeError   'Mock' object does not support
10   # the context manager protocol
```

How to replace an object with a test double?

Does the function we are testing **own** the dependency we want to replace?

Then use mock.patch where the dependency is used not where it is defined.

```
example_with_dep.py

1  from io import FileIO

2  
3  # function directly uses FileIO
4  def read_file(filename: str) → bytes:
5  with FileIO(filename) as f:
6  return f.read()
```

How to replace an object with a test double?

Does the function we are testing **own** the dependency we want to replace?

Then use mock.patch where the dependency is used not where it is defined.

```
test_example_with_dep.py

import example_with_dep
import unittest.mock as mock

# @mock.patch("io.FileIO") * does not work

mock.patch("example_with_dep.FileIO") # works

def test_read_file(mock_io: mock.MagicMock):
    example_with_dep.read_file("some-file.txt")

# assert that we entered the with block
mock_io.return_value.__enter__.assert_called_once()
```

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Why global patching does not work?

- 1. from io import FileIO binds local reference to FileIO in the example_with_dep module.
- 2. Our patch targets io.FileIO, but read_file uses the local reference.
- 3. We would have to patch before importing or reload(example_with_dep) both not a good practice.

Better way: use Dependency Injection

If the function we are testing expects the dependency as a parameter.

pass the MagicMock instead, no need to use mock.patch

```
import example_with_di
import unittest.mock as mock

def test_read_file():
    mock_io = mock.MagicMock(spec=FileIO)

example_with_di.read_file(mock_io)

# assert that we entered the with block
mock_io.read.assert_called_once()

mock_io.arbitrary_method() # raises AttributeError **

# Mock object has no attribute 'arbitrary_method'
```

```
example_with_di.py

1  from io import FileIO

2  
3  # function directly uses FileIO

4  def read_file(opened_file: FileIO) → bytes:

5  # just operate on the file object

6  # caller manages opening/closing

7  return opened_file.read()
```

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pass the MagicMock instead, no need to use mock.patch

```
test_example_with_di.py
     import example with di
     import unittest.mock as mock
     def test read file():
       mock io = mock.MagicMock(spec=FileIO)
 6
       example with di.read file(mock io)
 9
       # assert that we entered the with block
       mock io.read.assert called once()
10
11
       mock io.arbitrary method() # raises AttributeError **
12
       # Mock object has no attribute 'arbitrary method'
13
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example_with_di.py

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Extra: Other ways to patch

Besides the decorator, we can also use mock.patch as a context manager.

You can also use mock.patch.object to patch attributes on an already imported object.

```
test_example_with_dep_context.py

import example_with_dep
import unittest.mock as mock

def test_read_file():
    with mock.patch(
        "example_with_dep.FileIO", autospec=True
) as mock_:
    example_with_dep.read_file("some-file.txt")

# assert that we entered the with block
mock_.return_value.__enter__.assert_called_once()
```

```
test_example_with_dep_object.py

import example_with_dep
import unittest.mock as mock

def test_read_file():
    with mock.patch.object(
    example_with_dep, "FileIO", autospec=True
) as mock_io:
    example_with_dep.read_file("some-file.txt")

# assert that we entered the with block
mock_.return_value.__enter__.assert_called_once()
```

Use autospec to automatically follow FileIO 's protocol.

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What is a stub? So How does it differ from a mock?

It provides predefined responses to function calls, but does not track interactions.

We can use a Mock or MagicMock object for stubbing by fixing the return_value of a method.

```
example_stub_fixed.py
     import unittest.mock as mock
     mock object = mock.Mock()
     mock object.some method.return value = "some value"
     assert mock object.some method() = "some value"
     mock object.some method.side effect = [1, 2]
     assert mock object.some method() = 1
     assert mock object.some method() = 2
10
11
12
     # we can also raise exceptions
     mock object.raise method.side effect = ValueError("some value")
13
     mock object.raise method() # raises ValueError **
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```

You are given an in-house authentication library to get a token, with the following signature:

```
authlib.py
     def authenticate(account id: str, resource id: Optional[str] = None) → str:
         Calls a remote authentication service to get a token for a specific resource.
         Args
             account id: str, example "some-project-dev"
             resource id: Optional[str], a target service id that
 8
                 we want to authneticate for, e.g. "STORAGE-SERVICE-XXXXXX"
 9
10
11
         Returns
12
13
             str, a token
14
15
```

We want to include the token in the Authorization header of our HTTP requests, along with some static headers. These headers are part of a client library we are writing.

```
headers.py
     class Configuration:
      user id: str
      resource id: Optional[str] = None
     def get headers(config: Configuration) → dict:
      token = authlib.authenticate(
        config.user id,
        config.resource id
 8
 9
10
11
      return {
12
        "Content-Type": "application/json",
        "Authorization": f"Bearer {token}"
13
14
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13
14
```

Mocks + stubs: verify behaviour and results

We stub authenticate to control the token with expected results

```
test_headers.py

1  @mock.patch("headers.authlib.authenticate")
2  def test_get_headers(self, mock_auth):
3    mock_auth.return_value = "token"

4    expected = {
6        "Content-Type": "application/json",
7        "Authorization": "Bearer token"
8    }
9

10    actual = get_headers(mock.Mock())
11    self.assertEqual(actual, expected) # validate result
```

```
headers.py
    import authlib
    adataclass
    class Configuration:
     user id: str
     resource id: Optional[str] = None
    def get headers(config: Configuration) → dict:
     token = authlib.authenticate(
        config.user id
10
11
        # a bug 🀞 here
14
     return {
       "Content-Type": "application/json",
       "Authorization": f"Bearer {token}"
17 }
```

Mocks + stubs: verify behaviour and results

We stub authenticate to control the token with expected results, then assert the arguments of the call.

```
test_headers.py
    @mock.patch("headers.authlib.authenticate")
    def test get headers(self, mock auth):
       config =
         "user id": "a machine",
         "resource id": "STORAGE-SERVICE-XXXXXX",
       mock auth.return value = "token"
 8
 9
       expected = {
         "Content-Type": "application/json",
         "Authorization": "Bearer token"
14
       actual = get headers(mock.Mock(**config))
       self.assertEqual(actual, expected) # validate result
       # validate interaction with 3rd party
       mock auth.assert called once with(
         config["user_id"],
         config["resource id"]
21
```

```
headers.py
    import authlib
    adataclass
    class Configuration:
     user id: str
     resource id: Optional[str] = None
    def get headers(config: Configuration) → dict:
     token = authlib.authenticate(
       config.user id,
10
11
       config.resource id # was missing
     return {
14
       "Content-Type": "application/json",
       "Authorization": f"Bearer {token}"
17 }
```

What is a fake?

A fake is a working implementation, but it is kept lightweight for testing purposes.

Avoids complex dependencies, I/O operations, or external services + no need maintaining stub states.

```
storage.py
     # real dependency (talks to a service)
     # assume StorageProvider implements connection methods
     class StorageClient(Mapping, StorageProvider):
       def enter (self):
         self.connect()
         return self
       def exit (self, exc type, exc value, traceback):
 8
         self.disconnect()
 9
10
11
       def getitem (self, key: str):
         return self.read from service(key)
12
13
       def setitem (self, key: str, value):
14
15
         self.write to service(key, value)
```

```
fake_storage.py
     # fake dependency (in-memory implementation)
     class FakeStorageClient(Mapping):
       def init (self):
         self. store = {}
       def enter (self):
         return self
 8
 9
       def exit (self, exc type, exc value, traceback):
10
         pass
11
       def getitem (self, key: str):
12
         return self.__store.get(key)
13
14
15
       def setitem (self, key: str, value):
         self. store[key] = value
16
```

```
service.py
     import json
     from storage import StorageClient
     def save object(storage: StorageClient, key: str, obj: dict, *, chunk size: int = 8) → None:
       """Serialize to JSON, split into fixed-size chunks, store parts + index."""
       data = json.dumps(obj).encode("utf-8") # encode
       chunks = [data[i:i+chunk size] for i in range(0, len(data), chunk size)]
       for i, chunk in enumerate(chunks):
 8
           storage[f"{key}/chunk/{i}"] = chunk
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     def load object(storage: StorageClient, key: str) → dict:
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     def save object(storage: StorageClient, key: str, obj: dict, *, chunk size: int = 8) → None:
       """Serialize to JSON, split into fixed-size chunks, store parts + index."""
       data = json.dumps(obj).encode("utf-8") # encode
       chunks = [data[i:i+chunk size] for i in range(0, len(data), chunk size)]
       for i, chunk in enumerate(chunks):
 8
           storage[f"{key}/chunk/{i}"] = chunk
 9
       storage[f"{key}/chunks length"] = len(chunks)
10
11
     def load object(storage: StorageClient, key: str) → dict:
12
         """Read index, reassemble chunks, deserialize."""
13
         n = storage[f"{key}/chunks length"]
14
         data = b"".join(storage[f"{key}/chunk/{i}"] for i in range(n))
15
16
         return json.loads(data.decode("utf-8"))
```

Using stubs to test this gets complicated

```
test_with_stub.py
     from storage
     from service import save json, load json
 3
     def test save load round trip():
       # Stub only: no state, everything pre-scripted
       storage = mock.Mock(spec=StorageClient)
       payload = {"name": "Alice", "age": 30, "bio": "lipsum" * 100}
 8
       data = json.dumps(payload).encode("utf-8")
       parts = [data[i:i+8] for i in range(0, len(data), 8)] # duplicate chunking logic ↔
 9
10
11
       # omitted for brevity, we need to stub getitem / setitem for index and chunks
       # can be several lines of implementation just for the sake of stubbing
12
13
       storage. getitem .side effect = ...
       storage. setitem .side effect = ...
14
15
16
       save json(storage, "user", payload, chunk size=8)
17
       assert load json(storage, "user") = payload
```

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Faking with dependency injection

FakeStoragClient is a drop in replacement for StorageClient.

Just inject the FakeStorageClient, you can also wrap it through a Mock, to track interactions

```
test_with_fake.py
     from fake storage import FakeStorageClient
     from service import save json, load json
     def test save load round trip():
      fake = FakeStorageClient()
       save json(mock fake, "user 001", {"name": "Alice", "age": 30, "bio": "lipsum" * 100})
       assert load json(mock fake, "user 001") = {"name": "Alice", "age": 30, "bio": "lipsum" * 100}
 8
 9
     def test save load round trip fake plus mock():
10
       fake = FakeStorageClient()
11
       mock fake = mock.MagicMock(wraps=fake, autospec=True)
12
13
14
       save json(mock fake, "user 001", {"name": "Alice", "age": 30, "bio": "lipsum" * 100})
       assert load json(mock fake, "user 001") = {"name": "Alice", "age": 30, "bio": "lipsum" * 100}
15
16
17
       mock fake. getitem .assert called with("user 001/chunks length")
```

Faking with dependency injection

FakeStoragClient is a drop in replacement for StorageClient.

Just inject the FakeStorageClient, you can also wrap it through a Mock, to track interactions

```
test_with_fake.py
     from fake storage import FakeStorageClient
     from service import save json, load json
     def test save load round trip():
      fake = FakeStorageClient()
       save json(mock fake, "user 001", {"name": "Alice", "age": 30, "bio": "lipsum" * 100})
       assert load json(mock fake, "user 001") = {"name": "Alice", "age": 30, "bio": "lipsum" * 100}
 8
 9
     def test save load_round_trip_fake_plus_mock():
11
       fake = FakeStorageClient()
12
       mock fake = mock.MagicMock(wraps=fake, autospec=True)
13
       save json(mock fake, "user 001", {"name": "Alice", "age": 30, "bio": "lipsum" * 100})
14
       assert load json(mock fake, "user 001") = {"name": "Alice", "age": 30, "bio": "lipsum" * 100}
15
16
17
       mock fake. getitem .assert called with("user 001/chunks length")
```

A spy is a test double that wraps a real object, allowing us to monitor its interactions while still using its actual implementation.

```
example_spy.py
     import unittest.mock as mock
     class DollarConverter:
     rates = {
        "USD": 1,
     "EUR": 0.9,
     "GBP": 0.8,
      } # static data
 9
       def convert(self, amount: float, currency: str) → float:
10
11
         return rates.get(currency, 0) * amount
12
     spy object = mock.Mock(wraps=DollarConverter(), autospec=True)
13
     euros = spy object.convert(10, "EUR")
14
15
     assert euros = 9 # uses the real method
16
     spy object.convert.assert called once with(10, "EUR") # tracks the call
17
```

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```

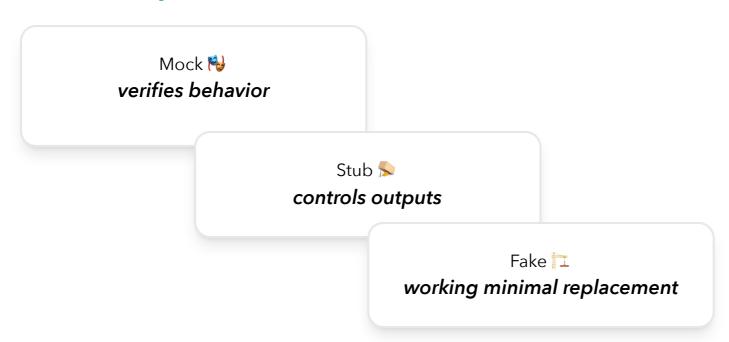
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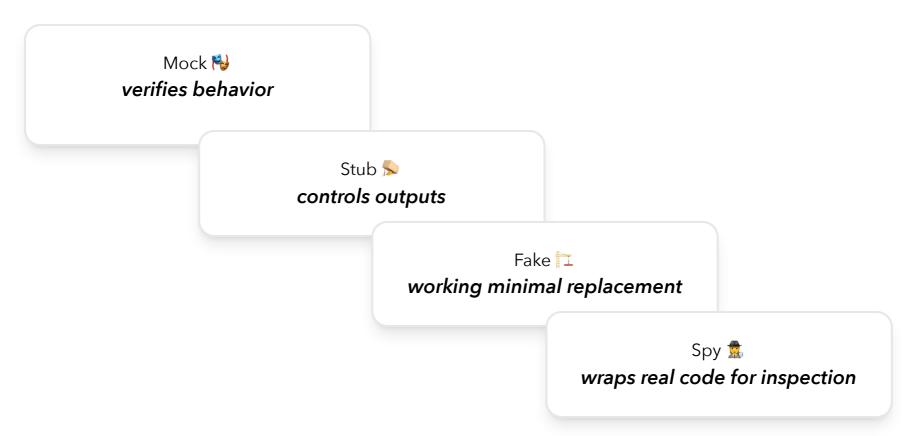
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       def convert(self, amount: float, currency: str) → float:
10
11
         return rates.get(currency, 0) * amount
12
     spy object = mock.Mock(wraps=DollarConverter(), autospec=True)
13
     euros = spy_object.convert(10, "EUR")
14
15
     assert euros = 9 # uses the real method
16
     spy object.convert.assert called once with(10, "EUR") # tracks the call
```

Mock **№** verifies behavior

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Stub
controls outputs





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- In unittest, Mock & MagicMock can be used in a way that combines all types of test doubles, to achieve completeness

Thank you very much! 😊