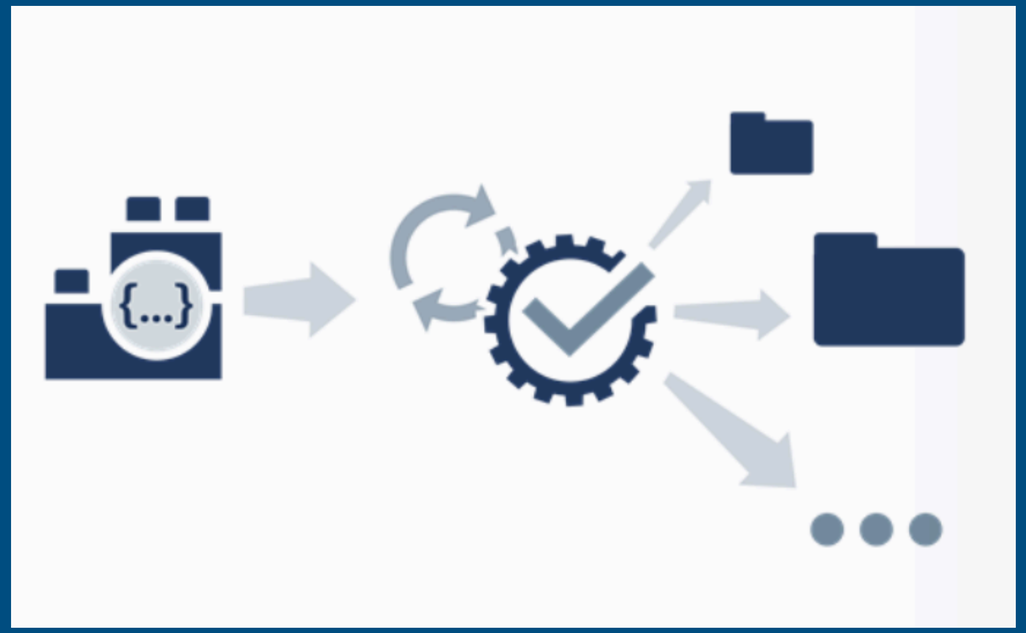
TDD Store



Full Stack Web Development

Test + Test Runner

Fixtures

Test Setup

Test Fail/Fix/Pass cycle

Exhaustive Tests

Test Runner

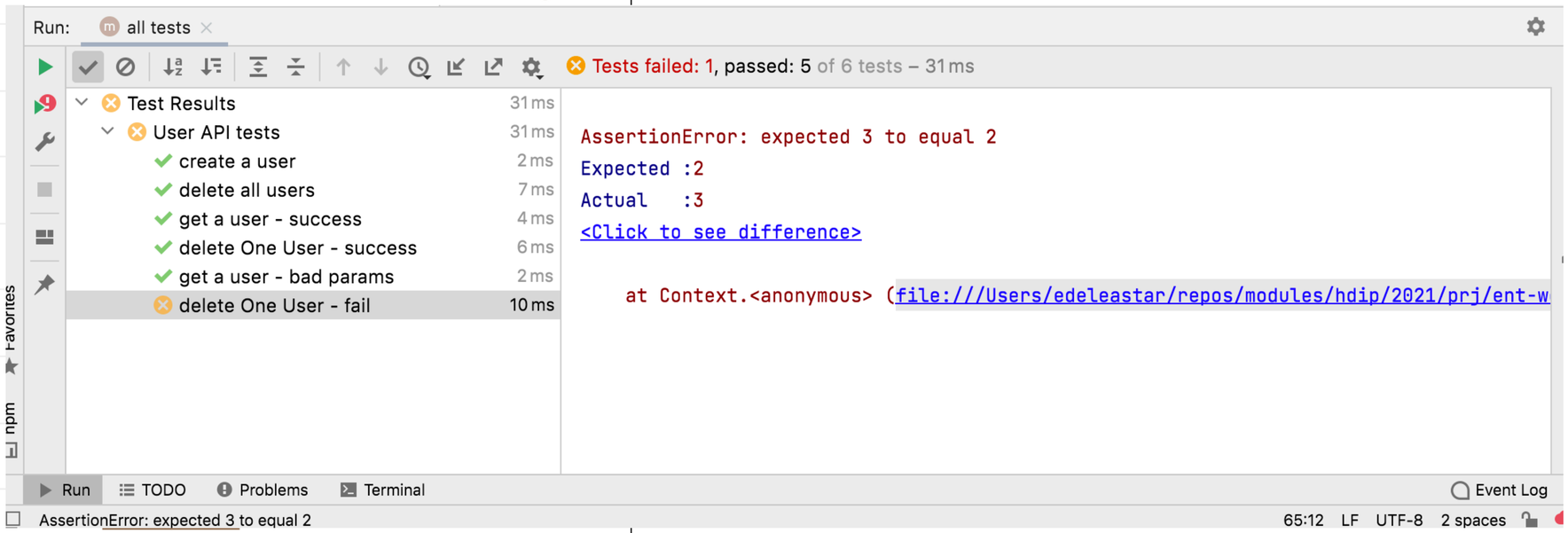
- Sometimes call xUnit Runners, each language/environment will usually be serviced by a tool to execute tests
- These tools provide a simplified green/red for pass/ fail + support simple at a glance report as to overall status

simple, flexible, fun

Mocha is a feature-rich JavaScript test framework running on Node.js and in the browser, making asynchronous testing *simple* and *fun*. Mocha tests run serially, allowing for flexible and accurate reporting, while mapping uncaught exceptions to the correct test cases. Hosted on GitHub.

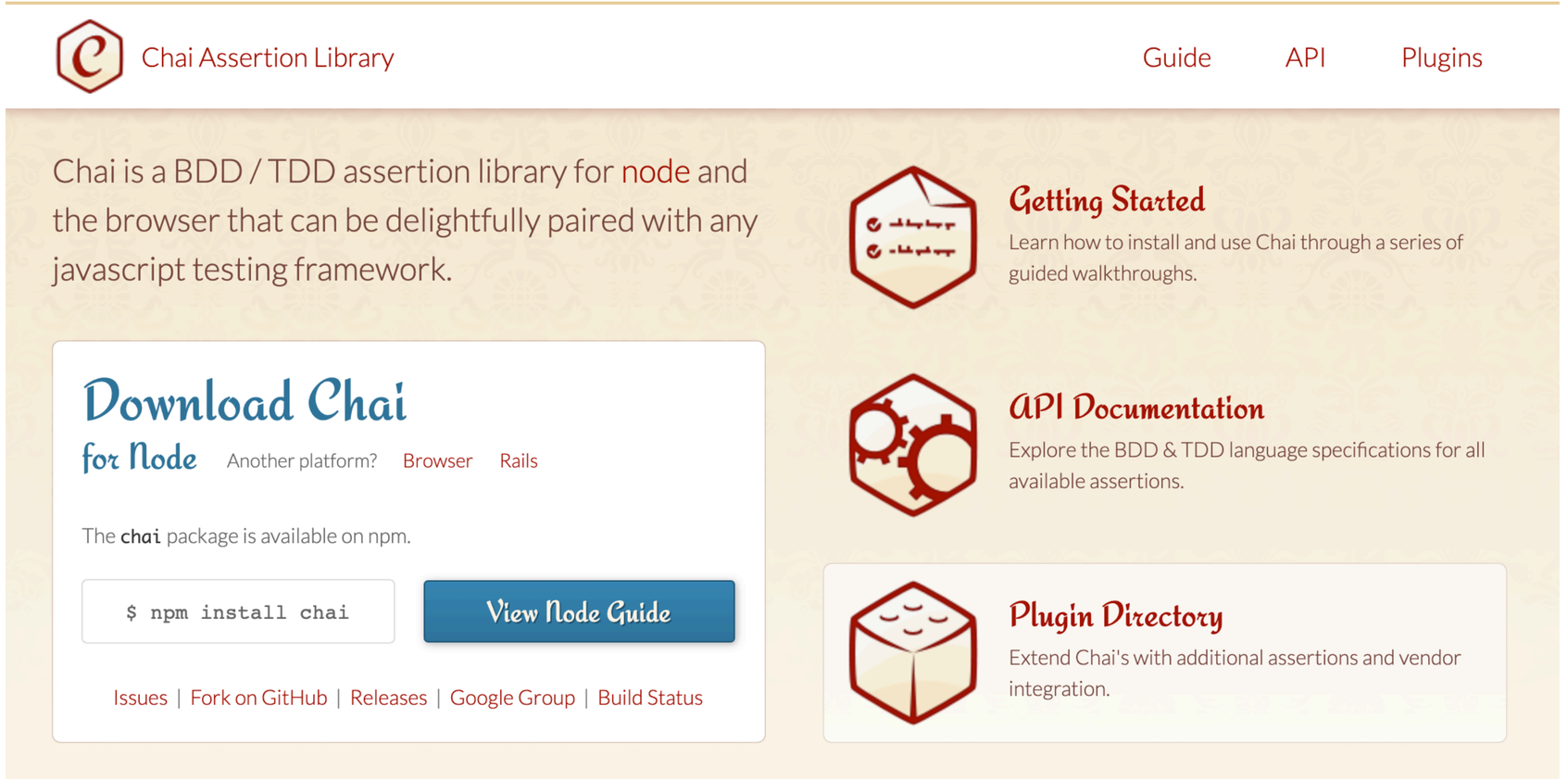
https://mochajs.org

- IDEs provide plugins to support Mocha test runners



- Webstorm (above) and VSCode supported

- In addition to a test runner we also need an assertion library
- This specifies how we ‘assert’ predicates within our tests



Chai has several interfaces that allow the developer to choose the most comfortable. The chain-capable BDD styles provide an expressive language & readable style, while the TDD assert style provides a more classical feel.

Should

```
chai.should();

foo.should.be.a('string');
foo.should.equal('bar');
foo.should.have.lengthOf(3);
tea.should.have.property('flavors')
  .with.lengthOf(3);
```

Visit Should Guide

Expect

```
var expect = chai.expect;

expect(foo).to.be.a('string');
expect(foo).to.equal('bar');
expect(foo).to.have.lengthOf(3);
expect(tea).to.have.property('flavors')
  .with.lengthOf(3);
```

Visit Expect Guide

Assert

```
var assert = chai.assert;

assert.typeOf(foo, 'string');
assert.equal(foo, 'bar');
assert.lengthOf(foo, 3)
assert.property(tea, 'flavors');
assert.lengthOf(tea.flavors, 3);
```

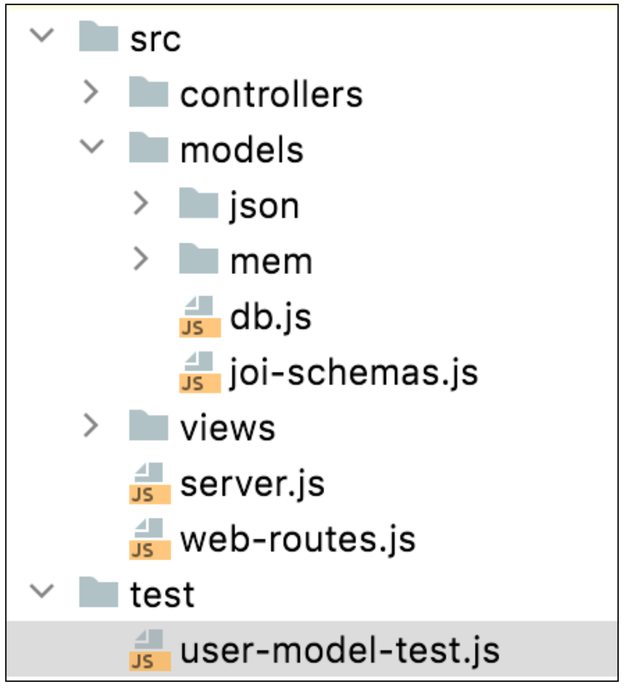
Visit Assert Guide

- Multiple styles supported
- We will use the Assert library

- Install as developer dependencies

```
npm install -D mocha
npm install -D chai
```

```
"devDependencies": {
  "chai": "^4.3.4",
  "eslint": "^7.32.0",
  "eslint-config-airbnb-base": "^15.0.0",
  "eslint-config-prettier": "^8.3.0",
  "eslint-plugin-import": "^2.25.3",
  "mocha": "^9.1.3",
  "prettier": "^2.5.0"
}
```



- Introduce a new module - a “test”
- Not part of production code, so we keep in ‘test’ folder

user-model-test.js

```
import { assert } from "chai";
import { db } from "../src/models/db.js";

suite("User API tests", () => {

  const maggie = {
    firstName: "Maggie",
    lastName: "Simpson",
    email: "maggie@simpson.com",
    password: "secret",
  };

  setup(async () => {
    db.init();
  });

  test("create a user", async () => {
    const newUser = await db.userStore.addUser(maggie);
    assert.deepEqual(maggie, newUser)
  });
});
```

System we are going to test

The test suite - Mocha will run all the test in this suite:

user-model-test.js

```
import { assert } from "chai";
import { db } from "../src/models/db.js";

suite("User API tests", () => {

  const maggie = {
    firstName: "Maggie",
    lastName: "Simpson",
    email: "maggie@simpson.com",
    password: "secret",
  };

  setup(async () => {
    db.init();
  });

  test("create a user", async () => {
    const newUser = await db.userStore.addUser(maggie);
    assert.deepEqual(maggie, newUser)
  });
});
```

Some test data (fixture)

setup function to be run before *each* test

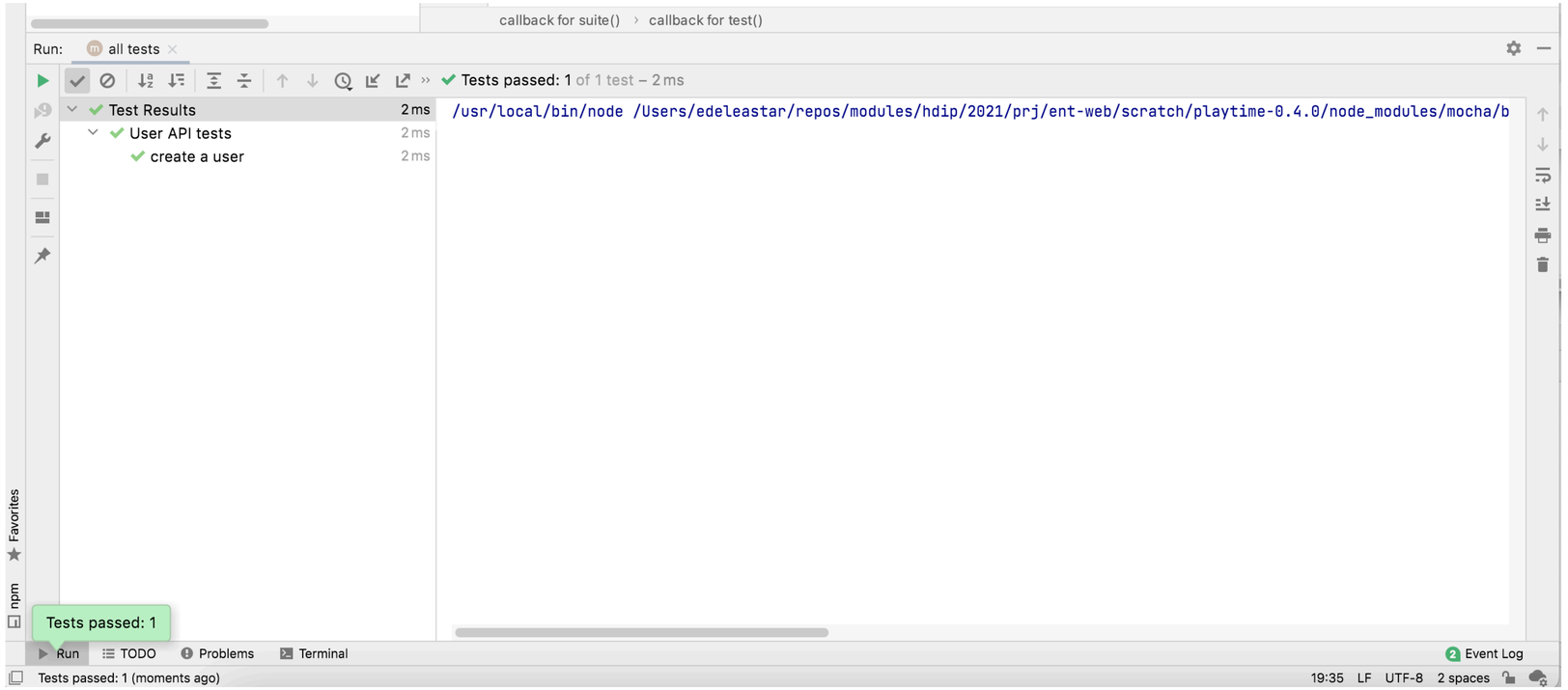
A single test

user-model-test.js

```
import { assert } from "chai";
import { db } from "../src/models/db.js";

suite("User API tests", () => {

  const maggie = {
    firstName: "Maggie",
    lastName: "Simpson",
    email: "maggie@simpson.com",
    password: "secret",
  };

  setup(async () => {
    db.init();
  });

  test("create a user", async () => {
    const newUser = await db.userStore.addUser(maggie);
    assert.deepEqual(maggie, newUser)
  });
});
```

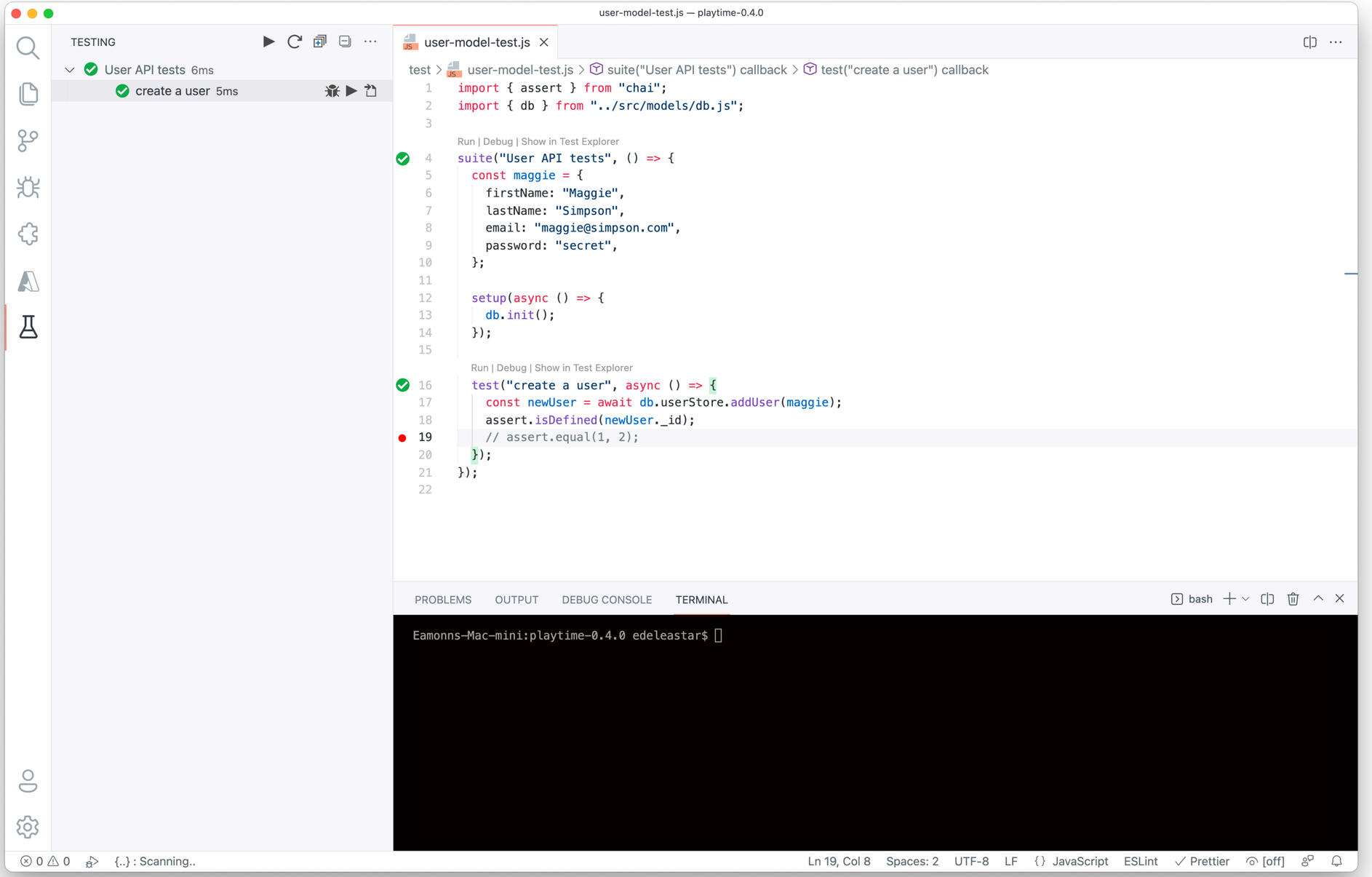
Mocha Test Runner (WebStorm)

All Pass



Fail

Mocha Test Runner (VSCode)



Running test from the command line (Mocha)

```
npm run test
```

package.json

```
"scripts": {
  "start": "node src/server.js",
  "dev": "./node_modules/.bin/nodemon --verbose src/server.js",
  "lint": "./node_modules/.bin/eslint . --ext .js",
  "test": "./node_modules/mocha/bin/mocha --ui tdd test/**.js"
}
```

Test script

Mocha Test Runner (Mocha command line)

All Pass

```
npm run test
```

```
> playtime@0.3.0 test
> ./node_modules/mocha/bin/mocha --ui tdd test/**.js



  User API tests
    ✔ create a user


  1 passing (4ms)
```

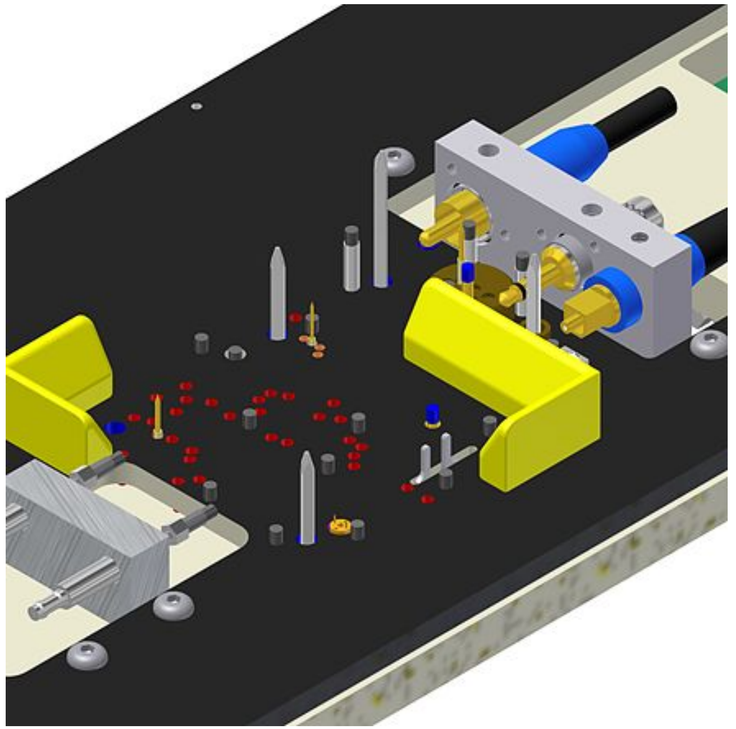
Fail

```
User API tests
   1) create a user


 0 passing (4ms)
 1 failing

 1) User API tests
      create a user:

     AssertionError: expected 1 to equal 2
     + expected - actual

     -1
     +2
```

Fixtures

A test fixture is an environment used to consistently test some item, device, or piece of software. Test fixtures can be found when testing electronics, software and physical devices.

- Allows for tests to be repeatable since each test is always starting with the same setup.
- Ease test code design by allowing the developer to separate methods into different functions and reuse each function for other tests.
- Test fixtures preconfigure tests into a known initial state instead of working with whatever was left from a previous test run



https://en.wikipedia.org/wiki/Test_fixture

user-model-test.js

```
import { assert } from "chai";
import { db } from "../src/models/db.js";

suite("User API tests", () => {
  const maggie = {
    firstName: "Maggie",
    lastName: "Simpson",
    email: "maggie@simpson.com",
    password: "secret",
  };

  setup(async () => {
    db.init();
  });

  test("create a user", async () => {
    const newUser = await db.userStore.addUser(maggie);
    assert.deepEqual(maggie, newUser)
  });
});
```

- Move fixtures to separate module

fixtures.js

```
export const maggie = {
  firstName: "Maggie",
  lastName: "Simpson",
  email: "maggie@simpson.com",
  password: "secret",
};
```

```
import { assert } from "chai";
import { db } from "../src/models/db.js";
import { maggie } from "./fixtures.js";

suite("User API tests", () => {

  setup(async () => {
    db.init();
  });

  test("create a user", async () => {
    const newUser = await db.userStore.addUser(maggie);
    assert.equal(newUser, maggie);
  });
});
```

- Import fixtures as needed in tests

Test Setup

```
export const testUsers = [
  {
    firstName: "Homer",
    lastName: "Simpson",
    email: "homer@simpson.com",
    password: "secret",
  },
  {
    firstName: "Marge",
    lastName: "Simpson",
    email: "marge@simpson.com",
    password: "secret",
  },
  {
    firstName: "Bart",
    lastName: "Simpson",
    email: "bart@simpson.com",
    password: "secret",
  },
];
```

Fixtures

user-model-test.js

```
test("delete all users", async () => {
  for (let i = 0; i < testUsers.length; i += 1) {
    // eslint-disable-next-line no-await-in-loop
    await db.userStore.addUser(testUsers[i]);
  }
  let returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 3);
  await db.userStore.deleteAll();
  returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 0);
});
```

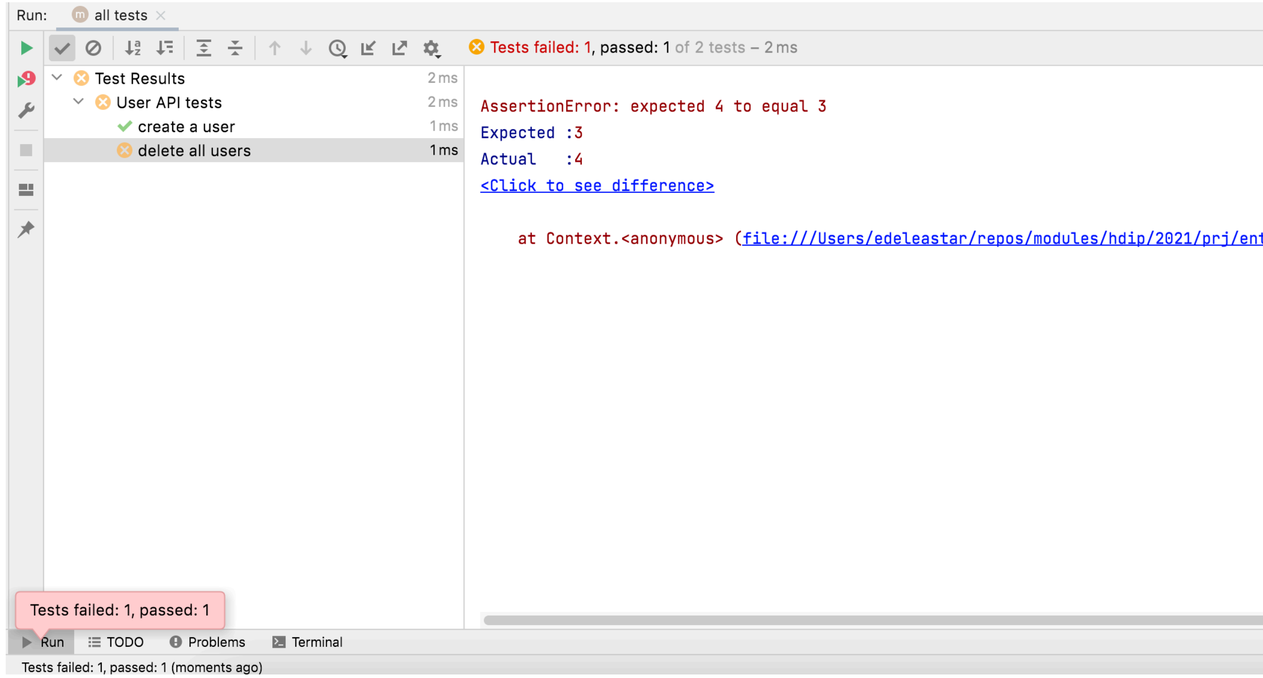
- Add some users
- Verify they have been added
- Delete all users
- Verify that there are 0 users

- The tests will fail

user-model-test.js

```
test("delete all users", async () => {
  for (let i = 0; i < testUsers.length; i += 1) {
    // eslint-disable-next-line no-await-in-loop
    await db.userStore.addUser(testUsers[i]);
  }
  let returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 3);
  await db.userStore.deleteAll();
  returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 0);
});
```

```
test("create a user", async () => {
  const newUser = await db.userStore.addUser(maggie);
  assert.equal(newUser, maggie);
});
```



- The tests will fail

- Failure cause by two tests interfering with each other

- "create a user” leaves behind a user in the store - causing “delete all users” to fail

user-model-test.js

```
test("delete all users", async () => {
  for (let i = 0; i < testUsers.length; i += 1) {
    // eslint-disable-next-line no-await-in-loop
    await db.userStore.addUser(testUsers[i]);
  }
  let returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 3);
  await db.userStore.deleteAll();
  returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 0);
});
```

```
test("create a user", async () => {
  const newUser = await db.userStore.addUser(maggie);
  assert.equal(newUser, maggie);
});
```

```
setup(async () => {
  db.init();
  await db.userStore.deleteAll();
});
```

- For *each* test, delete all users before the test runs

- Increase the rigour of the a test

```
test("get a user - success", async () => {
  const user = await db.userStore.addUser(maggie);
  const returnedUser1 = await db.userStore.getUserById(user._id);
  assert.deepEqual(user, returnedUser1);
  const returnedUser2 = await db.userStore.getUserByEmail(user.email);
  assert.deepEqual(user, returnedUser2);
});
```

.deepEqual(actual, expected, [message])

- @param *{ Mixed }* actual
- @param *{ Mixed }* expected
- @param *{ String }* message

Asserts that `actual` is deeply equal to `expected`.

https://www.chaijs.com/api/assert/

assert

fail

isOk

isNotOk

equal

notEqual

strictEqual

notStrictEqual

deepEqual

notDeepEqual

isAbove

isAtLeast

isBelow

isAtMost

isTrue

isNotTrue

isFalse

isNotFalse

isNull

Test Fail/Fix/Pass cycle

```
test("delete One User - success", async () => {
  for (let i = 0; i < testUsers.length; i += 1) {
    // eslint-disable-next-line no-await-in-loop
    testUsers[i] = await db.userStore.addUser(testUsers[i]);
  }
  await db.userStore.deleteUserById(testUsers[0]._id);
  const returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, testUsers.length - 1);
  const deletedUser = await db.userStore.getUserById(testUsers[0]._id);
  assert.isNull(deletedUser);
});
```

- Delete a user test:
  - *Add some users*
  - *Delete one of these users*
  - *Check if we have 1 user less in the store*

```
User API tests
  ✔ create a user
  ✔ delete all users
  ✔ get a user - success
  1) delete One User - success


3 passing (21ms)
1 failing

1) User API tests
     delete One User - success:
   AssertionError: expected undefined to equal null
   (...playtime-0.4.0/test/user-model-test.js:46:12)
```

- Test fails:

```
assert.isNull(deletedUser);
```

```
async getUserById(id) {
  await db.read();
  return db.data.users.find((user) => user._id === id);
},
```

```
async getUserById(id) {
  await db.read();
  let u = db.data.users.find((user) => user._id === id);
  if (u === undefined) u = null;
  return u;
},
```

- Bug in getUserById()
- Find return ‘undefined’, not ‘null’ if it cannot locate object
- We convert this to null, and our test will now pass

- Deliberately look for users that should not be there.

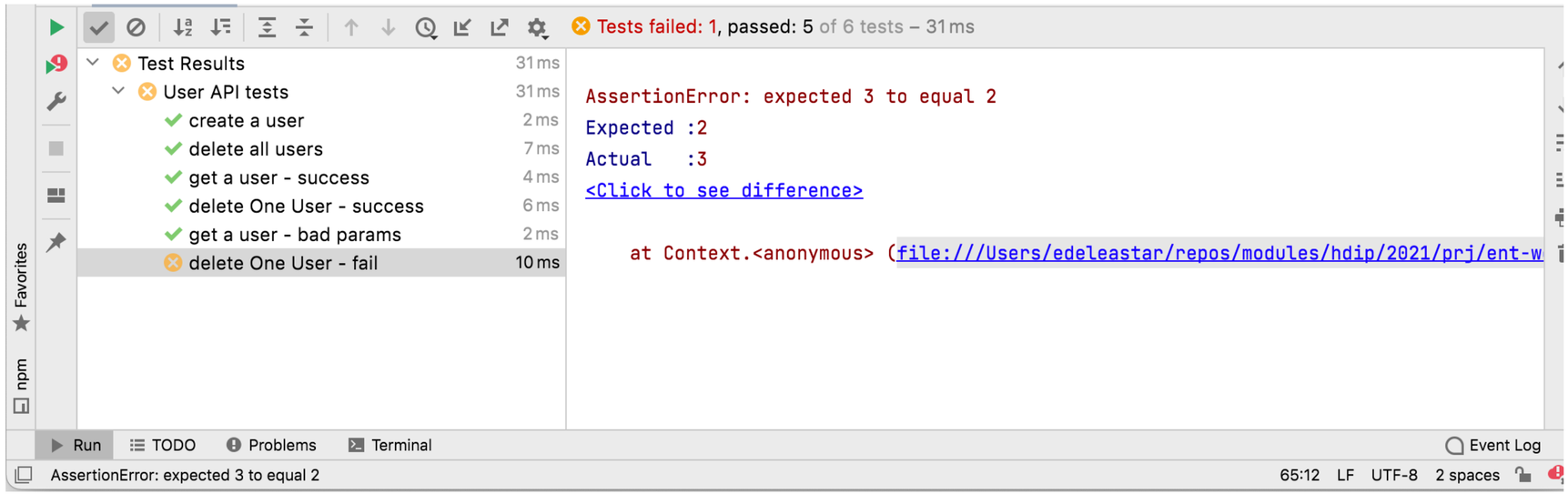
```
test("get a user - failures", async () => {
  const noUserWithId = await db.userStore.getUserById("123");
  assert.isNull(noUserWithId);
  const noUserWithEmail = await db.userStore.getUserByEmail("no@one.com");
  assert.isNull(noUserWithEmail);
});
```

- Provide invalid or null parameters

```
test("get a user - bad params", async () => {
  let nullUser = await db.userStore.getUserByEmail("");
  assert.isNull(nullUser);
  nullUser = await db.userStore.getUserById("");
  assert.isNull(nullUser);
  nullUser = await db.userStore.getUserById();
  assert.isNull(nullUser);
});
```

- Create some users
- Call delete with an incorrect ID
- Make sure no change in user store
- Error!

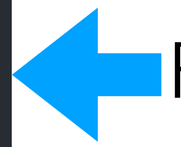
```
test("delete One User - fail", async () => {
  for (let i = 0; i < testUsers.length; i += 1) {
    // eslint-disable-next-line no-await-in-loop
    await db.userStore.addUser(testUsers[i]);
  }
  await db.userStore.deleteUserById("bad-id");
  const allUsers = await db.userStore.getAllUsers();
  assert.equal(testUsers.length, allUsers.length);
});
```



```
async deleteUserById(id) {
  await db.read();
  const index = db.data.users.findIndex((user) => user._id === id);
  db.data.users.splice(index, 1);
  await db.write();
},
```

- Call to splice removes an object - even if -1 provided!

```
async deleteUserById(id) {
  await db.read();
  const index = db.data.users.findIndex((user) => user._id === id);
  if (index !== -1) db.data.users.splice(index, 1);
  await db.write();
},
```



Fix

Exhaustive Tests

```
import { assert } from "chai";
import { db } from "../src/models/db.js";
import { maggie, testUsers } from "./fixtures.js";

suite("User API tests", () => {

  setup(async () => {
    db.init();
    await db.userStore.deleteAll();
    for (let i = 0; i < testUsers.length; i += 1) {
      // eslint-disable-next-line no-await-in-loop
      await db.userStore.addUser(testUsers[i]);
    }
  });

  test("create a user", async () => {
    const newUser = await db.userStore.addUser(maggie);
    assert.equal(newUser, maggie);
  });

  test("delete all users", async () => {
    let returnedUsers = await db.userStore.getAllUsers();
    assert.equal(returnedUsers.length, 3);
    await db.userStore.deleteAll();
    returnedUsers = await db.userStore.getAllUsers();
    assert.equal(returnedUsers.length, 0);
  });
```

```
  test("get a user - success", async () => {
    const user = await db.userStore.addUser(maggie);
    const returnedUser1 = await db.userStore.getUserById(user._id);
    assert.deepEqual(user, returnedUser1);
    const returnedUser2 = await db.userStore.getUserByEmail(user.email);
    assert.deepEqual(user, returnedUser2);
  });

  test("delete One User - success", async () => {
    await db.userStore.deleteUserById(testUsers[0]._id);
    const returnedUsers = await db.userStore.getAllUsers();
    assert.equal(returnedUsers.length, testUsers.length - 1);
    const deletedUser = await db.userStore.getUserById(testUsers[0]._id);
    assert.isNull(deletedUser);
  });

  test("get a user - bad params", async () => {
    assert.isNull(await db.userStore.getUserByEmail(""));
    assert.isNull(await db.userStore.getUserById(""));
    assert.isNull(await db.userStore.getUserById());
  });

  test("delete One User - fail", async () => {
    await db.userStore.deleteUserById("bad-id");
    const allUsers = await db.userStore.getAllUsers();
    assert.equal(testUsers.length, allUsers.length);
  });
});
```

```
setup(async () => {
  db.init();
  await db.userStore.deleteAll();
  for (let i = 0; i < testUsers.length; i += 1) {
    // eslint-disable-next-line no-await-in-loop
    await db.userStore.addUser(testUsers[i]);
  }
});
```

- Create users in setup
- Tests will assume these users have been created, and can then focus in a specific feature to exercise

```
test("create a user", async () => {
  const newUser = await db.userStore.addUser(maggie);
  assert.equal(newUser, maggie);
});

test("delete all users", async () => {
  let returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 3);
  await db.userStore.deleteAll();
  returnedUsers = await db.userStore.getAllUsers();
  assert.equal(returnedUsers.length, 0);
});
```

```
  test("get a user - success", async () => {
    const user = await db.userStore.addUser(maggie);
    const returnedUser1 = await db.userStore.getUserById(user._id);
    assert.deepEqual(user, returnedUser1);
    const returnedUser2 = await db.userStore.getUserByEmail(user.email);
    assert.deepEqual(user, returnedUser2);
  });

  test("delete One User - success", async () => {
    await db.userStore.deleteUserById(testUsers[0]._id);
    const returnedUsers = await db.userStore.getAllUsers();
    assert.equal(returnedUsers.length, testUsers.length - 1);
    const deletedUser = await db.userStore.getUserById(testUsers[0]._id);
    assert.isNull(deletedUser);
  });

  test("get a user - bad params", async () => {
    assert.isNull(await db.userStore.getUserByEmail(""));
    assert.isNull(await db.userStore.getUserById(""));
    assert.isNull(await db.userStore.getUserById());
  });

  test("delete One User - fail", async () => {
    await db.userStore.deleteUserById("bad-id");
    const allUsers = await db.userStore.getAllUsers();
    assert.equal(testUsers.length, allUsers.length);
  });
});
```

Arrange-Act-Assert

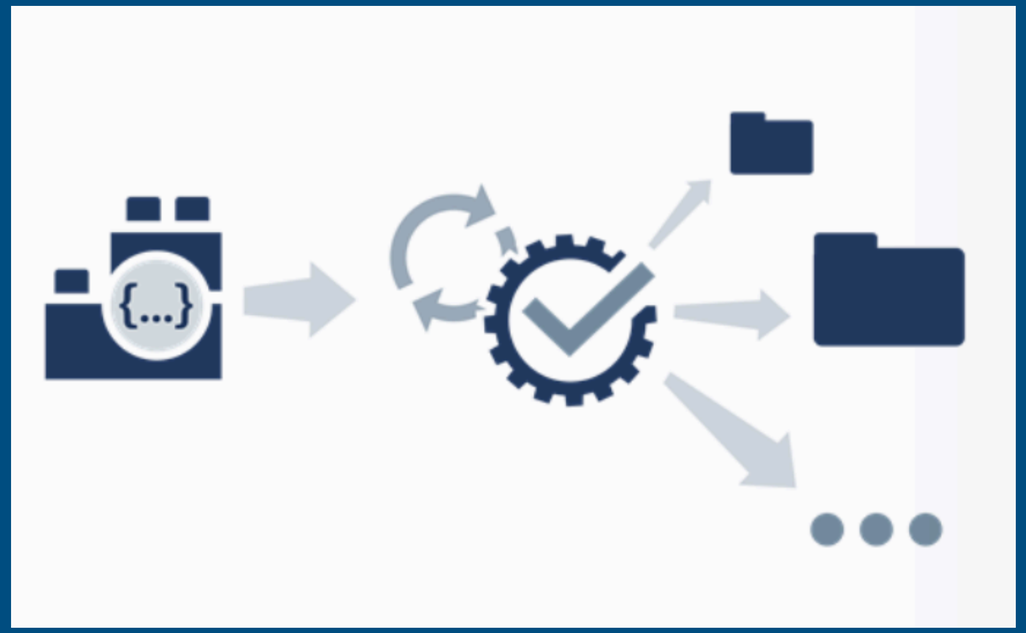
- Arrange inputs and targets. Arrange steps should set up the test case. Does the test require any objects or special settings? Does it need to prep a database?

- Act on the target behaviour. Act steps should cover the main thing to be tested. This could be calling a function or method, Keep actions focused on the target behaviour.

- Assert expected outcomes. Act steps should elicit some sort of response. Assert steps verify the goodness or badness of that response. Sometimes, assertions are as simple as checking numeric or string values. Other times, they may require checking multiple facets of a system. Assertions will ultimately determine if the test passes or fails

https://automationpanda.com/2020/07/07/arrange-act-assert-a-pattern-for-writing-good-tests/

TDD Store



Full Stack Web Development