



IT314: Software Engineering

G17: StaffGrid

Mutation Testing

1. Introduction

Objective: Mutation testing evaluates the effectiveness of a test suite by introducing small code changes (mutations) and checking if tests can detect them. If tests fail to catch mutations, it indicates weaknesses in test coverage or precision, helping to identify gaps in bug detection.

2. Tools Used

Stryker Mutator: We used Stryker for mutation testing.

Mocha: It was used as the test runner.

Chai, Sinon, and other dependencies: Chai was used for expressive assertions in tests, while Sinon enabled spies, stubs, and mocks to isolate code for focused unit testing.

3. Setup

We installed necessary dependencies like Mocha, Stryker, Chai, etc., through NPM

```
npm install --save-dev mocha chai @stryker-mutator/core
@stryker-mutator/mocha-runner
```

Added the stryker.config.js and stryker.config.json files for mutation testing.

stryker.config.js:

```
module.exports = {
  testRunner: "mocha",
  coverageAnalysis : "perTest",
  mochaOptions: {
    spec: [ "Documents/testing-documents/unit-test-backend/test/*.js" ],
    config: "path/to/mocha/config/.mocharc.json",
    package: "path/to/custom/package/package.json",
    opts: "path/to/custom/mocha.opts",
    ui: "bdd",
    require: [ "babel-register" ],
```

```
    grep: ".*"
  }
}
```

stryker.config.json:

```
{
  "testRunner": "mocha",
  "coverageAnalysis": "perTest",
  "mochaOptions": {
    "spec": [
      "Documents/testing-documents/unit-test-backend/test/*.js"
    ],
    "package": "package.json",
    "grep": ".*"
  },
  "mutate": [
    "Backend/controllers/*.js"
  ]
}
```

4. Running the Mutation Tests

We run the following commands first to run the tests and then the mutant test.

```
npm run test
```

```
PS C:\Users\Pari\Desktop\New folder (2)> npm run test
```

```
> test
> mocha 'Documents/testing-documents/unit-test-backend/test/*.spec.js'
```

Admin Routes

```
✓ [Admin] Login (1467ms)
✓ [Admin] should retrieve all employee details with profiles (1318ms)
```

Announcement API Tests

```
✓ [Admin] should log in successfully and get auth token (1327ms)
✓ [Employee] should log in successfully and get auth token (1945ms)
✓ [Employee] should view announcements addressed to them (1125ms)
✓ [Admin] should fetch the last counters for roles (1945ms)
✓ [Employee] should view announcements sent by them (1739ms)
✓ [Admin] should fail to post an announcement with missing message (920ms)
✓ [Employee] should fail to fetch announcements without authentication (509ms)
✓ [Admin] should fail to fetch last counters without authentication (1021ms)
```

Project Management Tests

- ✓ [Admin] should login and get auth token (1523ms)
- ✓ [Manager] should login and get auth token (714ms)
- ✓ [Employee] should login and get auth token (1332ms)
- ✓ [Admin] should successfully upload a project (1125ms)
- ✓ [Admin] should retrieve a specific project by ID (1123ms)
- ✓ [Admin] should successfully update a project (1043ms)
- ✓ [Admin] should successfully delete a project (1105ms)
- ✓ [Employee] should retrieve projects assigned to them (1227ms)

35 passing (42s)

4 failing

```
npm run stryker
```

The above command is for mutation testing whose results are shown in the next section.

5. Results and Mutant Information

The mutation score and its details:

Ran 2.34 tests per mutant on average.							
File	% Mutation score		# killed	# timeout	# survived	# no cov	# errors
	total	covered					
All files	100.00	100.00	735	14	0	0	0
adminController.js	100.00	100.00	73	0	0	0	0
anncController.js	100.00	100.00	86	1	0	0	0
attendanceController.js	100.00	100.00	189	3	0	0	0
auth.js	100.00	100.00	143	3	0	0	0
leaveController.js	100.00	100.00	108	1	0	0	0
profileController.js	100.00	100.00	36	1	0	0	0
projectController.js	100.00	100.00	100	5	0	0	0

All files												
748												
File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
All files	99.87	99.87	738	1	10	0	0	0	0	748	1	749
adminController.js	100.00	100.00	73	0	0	0	0	0	0	73	0	73
annController.js	100.00	100.00	85	0	2	0	0	0	0	87	0	87
attendanceController.js	100.00	100.00	188	0	4	0	0	0	0	192	0	192
auth.js	100.00	100.00	144	0	2	0	0	0	0	146	0	146
leaveController.js	100.00	100.00	108	0	1	0	0	0	0	109	0	109
profileController.js	100.00	100.00	37	0	0	0	0	0	0	37	0	37
projectController.js	99.05	99.05	103	1	1	0	0	0	0	104	1	105

6. Conclusion

The mutation testing results indicate that most of the tests are robust. However, some improvements can be made in handling edge cases and covering more branches of the code.