IT314

SOFTWARE ENGINEERING

Group 16
Online Examination System

Mutation Testing

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1. Introduction:

Mutation Testing is the method to improve unit tests by making small changes in the code and identify those changes using tests that we have. Each version of the code with small changes is called mutant. If tests fail on mutant that means mutant is killed otherwise mutant is survived. The goal of this process is to identify weaknesses of the test suite and improve it.
Below are objectives of mutation testing:
- To check whether the current test suite detects code changes
- To check the effectiveness of test suits

2. What We have Done:

We have used MERN Stack for our Project. We used mocha for unit testing. For mutation Testing, we used the javascript framework **stryker-mutator (v8.6.0)** and **mocha-runner (v8.6.0)**.

We set up the configuration for these frameworks by following the documentation.

Then we specify the files in which we wish to add mutants and also where unit tests are.

Below are some Images of the configuration:

```js
// stryker.conf.js
module.exports = {
   testRunner: "mocha",
   coverageAnalysis: "perTest",
   mochaOptions: {
      spec: ["test/**/*.js"],
```

```
        package: "package.json",
        require: ["babel-register"],
        grep: ".*",
    },
};
```

```
// stryker.conf.json

{
    "testRunner": "mocha",
    "coverageAnalysis": "perTest",
    "mochaOptions": {
        "spec": [ "test/**/*.js" ],
        "package": "package.json",
        "grep": ".*"
    },
    "mutate": [
        "./backend/controller/*.js"
    ]
}
```

We defined the script as below in the package. Json

```
"test:mutation": "stryker run"
```

Script for running mutation testing framework

```
npm run test:mutation
```

3. Results:

Here are the results that we have obtained after performing mutation testing.

```
Ran 1.10 tests per mutant on average.
-------------------------|-----------------|----------|-----------|-----------|----------|----------|
                         | % Mutation score|          |           |           |          |          |
File                     | total | covered | # killed | # timeout | # survived| # no cov | # errors |
-------------------------|-------|---------|----------|-----------|-----------|----------|----------|
All files                | 56.11 |  76.22  |   1075   |    124    |    374    |   564    |    0     |
 authentication.js       | 63.60 |  74.69  |    259   |     45    |    103    |    71    |    0     |
 exam.js                 | 49.10 |  64.20  |    193   |     24    |    121    |   104    |    0     |
 examiner.js             | 62.98 |  74.03  |     85   |     29    |     40    |    27    |    0     |
 exams_result.js         | 36.52 |  89.36  |     30   |     12    |      5    |    68    |    0     |
 past_upcoming_exams.js  | 17.10 |  53.49  |     40   |      6    |     40    |   183    |    0     |
 questions.js            | 86.11 |  88.93  |    209   |      8    |     27    |     8    |    0     |
 student.js              | 64.75 |  87.21  |    259   |      0    |     38    |   103    |    0     |
-------------------------|-------|---------|----------|-----------|-----------|----------|----------|
02:00:29 (43735) INFO HtmlReporter Your report can be found at: file:///Users/devangvaghani/Desktop/G16_eExam/reports/mutation/mutation.html
02:00:29 (43735) INFO MutationTestExecutor Done in 1 minute 50 seconds.
```

All files

Mutants   Tests

All files

| 1199 | 374 | 564 |

File / Directory	Mutation Score Of total	Mutation Score Of covered	Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
All files	56.11	76.22	1075	374	124	564	0	0	0	1199	938	2137
authentication.js	63.60	74.69	259	103	45	71	0	0	0	304	174	478
exam.js	49.10	64.20	193	121	24	104	0	0	0	217	225	442
examiner.js	62.98	74.03	85	40	29	27	0	0	0	114	67	181
exams_result.js	36.52	89.36	30	5	12	68	0	0	0	42	73	115
past_upcoming_exams.js	17.10	53.49	40	40	6	183	0	0	0	46	223	269
questions.js	86.11	88.93	209	27	8	8	0	0	0	217	35	252
student.js	64.75	87.21	259	38	0	103	0	0	0	259	141	400