

# IT314 - Software engineering

## Group - 11

### Mutation Testing

#### Tools Used :

- Stryker: The primary tool used for mutation testing. It inserts small mutants into the JavaScript source code and runs the tests to see if they fail (to kill the mutant) or pass.
- Mocha: The test runner that executes the test suite against every mutant generated by Stryker.
- Chai: The assertion library used within the tests to define expected outcomes.
- c8: Used for code coverage.

#### Overall Mutation score:

All files

1492

1328

1048

File / Directory		Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
		Of total	Of covered										
All files		<div><div></div></div> 38.57	<div><div></div></div> 52.91	1490	1328	2	1048	742	4	0	1492	2376	4614
controllers		<div><div></div></div> 83.86	<div><div></div></div> 83.86	582	112	0	0	742	0	0	582	112	1436
JS middlewares/authMiddleware.js		<div><div></div></div> 90.00	<div><div></div></div> 90.00	27	3	0	0	0	0	0	27	3	30
models		<div><div></div></div> 90.78	<div><div></div></div> 90.78	128	13	0	0	0	4	0	128	13	145
routes		<div><div></div></div> 100.00	<div><div></div></div> 100.00	28	0	0	0	0	0	0	28	0	28
services		<div><div></div></div> 11.72	<div><div></div></div> 14.10	85	518	0	122	0	0	0	85	640	725
utils		<div><div></div></div> 23.97	<div><div></div></div> 42.50	502	682	2	917	0	0	0	504	1599	2103
JS server.js		<div><div></div></div> 93.88	<div><div></div></div> 100.00	138	0	0	9	0	0	0	138	9	147

## 1) Controllers:

File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
controllers	83.86	83.86	582	112	0	0	742	0	0	582	112	1436
JS authController.js	72.75	72.75	299	112	0	0	0	0	0	299	112	411
JS complaintController.js	100.00	100.00	126	0	0	0	742	0	0	126	0	868
JS notificationController.js	100.00	100.00	73	0	0	0	0	0	0	73	0	73
JS reportController.js	100.00	100.00	84	0	0	0	0	0	0	84	0	84

## 2) Middleware:

All files / middlewares / authMiddleware.js												
1492			1328						1048			
File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
JS authMiddleware.js	90.00	90.00	27	3	0	0	0	0	0	27	3	30

## 3) Models:

Mutants Tests												
All files / models												
1492			1328						1048			
File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
models	90.78	90.78	128	13	0	0	0	4	0	128	13	145
JS Complaint.js	82.19	82.19	60	13	0	0	0	1	0	60	13	74
JS Notification.js	100.00	100.00	18	0	0	0	0	1	0	18	0	19
JS otpModel.js	100.00	100.00	7	0	0	0	0	1	0	7	0	8
JS userModel.js	100.00	100.00	43	0	0	0	0	1	0	43	0	44

## 4) Routes:

File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
routes	100.00	100.00	28	0	0	0	0	0	0	28	0	28
analyticsRoutes.js	100.00	100.00	1	0	0	0	0	0	0	1	0	1
authRoutes.js	100.00	100.00	8	0	0	0	0	0	0	8	0	8
complaintRoutes.js	100.00	100.00	14	0	0	0	0	0	0	14	0	14
notificationRoutes.js	100.00	100.00	4	0	0	0	0	0	0	4	0	4
reportRoutes.js	100.00	100.00	1	0	0	0	0	0	0	1	0	1

## 5) Services:

All files / services												
1492			1328						1048			
File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
services	11.72	14.10	85	518	0	122	0	0	0	85	640	725
routingClassifier.js	5.70	5.88	27	432	0	15	0	0	0	27	447	474
spamClassifier.js	23.11	40.28	58	86	0	107	0	0	0	58	193	251

### Reasons for low mutation score of Routing and Spam classifier services:

**Primary reasons** are **Keyword Dictionaries** and **Pattern-Based Logic**.

- These files depend on large lists of keywords, like ['hack', 'cheat', 'kill', 'urgent', 'wifi'], to detect certain categories. During mutation testing, Stryker creates a separate mutant for every keyword. To kill each one of these mutants, we would need a dedicated test case that triggers every individual keyword. (In the code, the dictionary contains a large set of words, but our tests only use a handful of them, that means remaining mutants remain untouched — which sharply reduces the mutation score.)

- Cumulative Scoring: Many of these classifiers don't rely on a single keyword. Instead, they accumulate points (For example, "If score > 5, classify as spam"). If an input triggers several keywords and reaches a score of 10, the test will still pass even if the mutation changes the threshold from > 5 to > 8. This resilience is good for the classifier's reliability, but it makes mutation testing much harder because certain mutations don't meaningfully affect the outcome.

## 6) Utils:

File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
utils	23.97	42.50	502	682	2	917	0	0	0	504	1599	2103
JS aiRouting.js	20.63	38.36	405	654	2	912	0	0	0	407	1566	1973
JS emailService.js	71.67	76.79	43	13	0	4	0	0	0	43	17	60
JS fileUploadService.js	75.76	76.92	50	15	0	1	0	0	0	50	16	66
JS generateToken.js	100.00	100.00	4	0	0	0	0	0	0	4	0	4

### Reasons for Lower mutation score of aiRouting.js :

- Running a heavy Python ML model during unit tests is slow and flaky. Therefore, our tests use an E2E\_MODE flag or mock functions to bypass the actual Python execution. Since the test suite skips the Python execution block entirely (to rely on mocks). So, any mutants injected into the Python-handling logic (which is a major portion of the file) are never executed, so they survive by default.
- Stryker sees that huge amount of mutants are still surviving after running the test suite which results in the significantly low mutation score of aiRouting.js.

File	% Mutation score		# killed	# timeout	# survived	# no cov	# errors
	total	covered					
All files	38.57	52.91	1490	2	1328	1048	4
controllers	83.86	83.86	582	0	112	0	0
authController.js	72.75	72.75	299	0	112	0	0
complaintController.js	100.00	100.00	126	0	0	0	0
notificationController.js	100.00	100.00	73	0	0	0	0
reportController.js	100.00	100.00	84	0	0	0	0
middlewares	90.00	90.00	27	0	3	0	0
authMiddleware.js	90.00	90.00	27	0	3	0	0
models	90.78	90.78	128	0	13	0	4
Complaint.js	82.19	82.19	60	0	13	0	1
Notification.js	100.00	100.00	18	0	0	0	1
otpModel.js	100.00	100.00	7	0	0	0	1
userModel.js	100.00	100.00	43	0	0	0	1
routes	100.00	100.00	28	0	0	0	0
analyticsRoutes.js	100.00	100.00	1	0	0	0	0
authRoutes.js	100.00	100.00	8	0	0	0	0
complaintRoutes.js	100.00	100.00	14	0	0	0	0
notificationRoutes.js	100.00	100.00	4	0	0	0	0
reportRoutes.js	100.00	100.00	1	0	0	0	0
services	11.72	14.10	85	0	518	122	0
routingClassifier.js	5.70	5.88	27	0	432	15	0
spamClassifier.js	23.11	40.28	58	0	86	107	0
utils	23.97	42.50	502	2	682	917	0
aiRouting.js	20.63	38.36	405	2	654	912	0
emailService.js	71.67	76.79	43	0	13	4	0
fileUploadService.js	75.76	76.92	50	0	15	1	0
generateToken.js	100.00	100.00	4	0	0	0	0
server.js	93.88	100.00	138	0	0	9	0
04:38:25 (2404) INFO HtmlReporter Your report can be found at: file:///C:/Users/nee14/IT314_Project/Campus-Complai							
nt-Management-System/reports/mutation/mutation.html							