

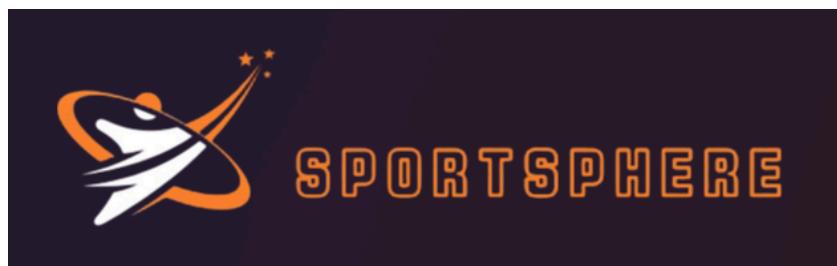
IT314 - Software Engineering

Mutation Testing



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1. Introduction

Mutation testing is an advanced software testing technique used to **measure the effectiveness of unit test cases**. Instead of checking whether the code simply runs, mutation testing checks whether the tests can **detect small bugs intentionally introduced into the source code**.

These small injected changes are called **mutants**.

2. What is Mutation Testing?

Mutation Testing works by:

1. **Modifying the source code slightly** (creating *mutants*)
 - Replace > with >=
 - Replace + with -
 - Remove a condition
 - Invert a boolean
2. Running all test cases against these modified versions
3. Checking whether the tests **fail** when behavior changes

Goal

If the tests detect the change → **Mutant is Killed**

If the tests do NOT detect the change → **Mutant Survived** (weak test)

3. Stryker (Mutation Testing Tool)

- Generates mutants (code changes) automatically
- Runs the existing Jest tests against each mutant
- Produces HTML dashboards
- Highlights weak areas in the code

4. Setup

Installed Stryker:

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

- Created *stryker.conf.json*

Ran:

```
npm run test:mutation
```

Stryker generated:

- **mutation.html**
- **dashboard report**
- **mutation score**

Game Controllers

Before:

95		54											
File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total	
	Of total	Of covered											
All files	63.76	63.76	95	54	0	0	0	0	0	95	54	149	
TS getGames.ts	63.76	63.76	95	54	0	0	0	0	0	95	54	149	

After:

530												37		
File / Directory	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total		
	Of total	Of covered												
All files	93.47	93.47	309	37	221	0	0	0	0	530	37	567		
TS getGames.ts	81.94	81.94	99	28	28	0	0	0	0	127	28	155		
TS hostGame.ts	95.27	95.27	68	7	73	0	0	0	0	141	7	148		
TS joinRequestController.ts	99.42	99.42	104	1	67	0	0	0	0	171	1	172		
TS postGame.ts	98.91	98.91	38	1	53	0	0	0	0	91	1	92		

Game Middleware

7

File / Directory 	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
All files	100.00	100.00	7	0	0	0	0	1	0	7	0	8
ts gameMiddleware.ts	100.00	100.00	7	0	0	0	0	1	0	7	0	8

Calendar Link

12

File / Directory 	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
All files	100.00	100.00	12	0	0	0	0	0	0	12	0	12
ts getCalendarLink.ts	100.00	100.00	12	0	0	0	0	0	0	12	0	12

Coach Controllers

524

1

File / Directory 	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
All files	96.86	98.13	10	10	514	7	0	0	0	524	17	541
ts coachController.ts	96.86	98.13	10	10	514	7	0	0	0	524	17	541

Admin Controllers:

Before:

File / Directory 	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
	Of total	Of covered										
All files	81.28	86.62	210	57	159	28	0	0	0	369	85	454
ts adminAuthController.ts	89.36	89.36	42	5	0	0	0	0	0	42	5	47
ts adminManagementController.ts	84.21	85.50	70	19	42	2	0	0	0	112	21	133
ts ticketController.ts	78.47	86.69	98	33	117	26	0	0	0	215	59	274

After:

Mutation Report											61	10	
File / Directory	I	Mutation Score		Killed	Survived	Timeout	No coverage	Ignored	Runtime errors	Compile errors	Detected	Undetected	Total
		Of.total	Of.covered										
All files		84.36	86.26	291	61	92	10	0	0	0	383	71	454
adminAuthController.ts	TS	93.62	93.62	34	3	10	0	0	0	0	44	3	47
adminManagementController.ts	TS	85.71	85.71	90	19	24	0	0	0	0	114	19	133
ticketController.ts	TS	82.12	85.23	167	39	58	10	0	0	0	225	49	274

Google Auth :

Ran 5.54 tests per mutant on average.

File % Mutation score # killed # timeout # survived # no cov # errors

All files 84.15 84.15 62 7 13 0 0
googleAuth.ts 84.15 84.15 62 7 13 0 0

Payment :

Ran 6.00 tests per mutant on average.

File % Mutation score # killed # timeout # survived # no cov # errors

All files 83.00 83.00 58 25 17 0 0
directBooking.ts 83.00 83.00 58 25 17 0 0

Ran 6.46 tests per mutant on average.

File % Mutation score # killed # timeout # survived # no cov # errors

All files 83.78 85.52 85 39 21 3 0
retryPayment.ts 83.78 85.52 85 39 21 3 0

Ran 4.64 tests per mutant on average.

File % Mutation score # killed # timeout # survived # no cov # errors

All files 76.60 78.26 56 16 20 2 0
gameBooking.ts 76.60 78.26 56 16 20 2 0

Ran 5.00 tests per mutant on average.

File % Mutation score # killed # timeout # survived # no cov # errors

All files 83.72 87.80 36 0 5 2 0
verifyPayment.ts 83.72 87.80 36 0 5 2 0

Ran 2.86 tests per mutant on average.

File	% Mutation score		# killed	# timeout	# survived	# no cov	# errors
	total	covered					
All files	85.94	85.94	55	0	9	0	0
getMyVenueBooking.ts	85.94	85.94	55	0	9	0	0

Ran 10.61 tests per mutant on average.

File	% Mutation score		# killed	# timeout	# survived	# no cov	# errors
	total	covered					
All files	88.89	88.89	56	24	10	0	0
stripeWebhook.ts	88.89	88.89	56	24	10	0	0

Venue and SubVenue Controllers:

File	% Mutation score		# killed	# timeout	# survived	# no cov	# errors
	total	covered					
All files	83.12	86.14	261	0	42	11	0
venueController.ts	83.12	86.14	261	0	42	11	0

TimeSlotcontroller:

Ran 0.79 tests per mutant on average.

File	% Mutation score		# killed	# timeout	# survived	# no cov	# errors
	total	covered					
All files	80.00	80.00	18	2	5	0	0
timeslotController.ts	80.00	80.00	18	2	5	0	0

04:36:27 (93039) INFO HtmlReporter Your report can be found at: file:///mnt/c/SE_project/SportSphere/reports/