Assignment 3

OP10 - SEM 20

1. *TimestampTracker.class* (boardserver)

- Before adding new tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.boardserver.embeddable

Number of Classes	Line Coverage	Mutation Coverage
1	65% 13/20	38% 5/13

Breakdown by Class

Name	Line Coverage	Mutation Coverage
TimestampTracker.java	65% 13/20	38% 5/13

Mutations

26	1. replaced return value with null for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::getCreated → KILLED
34	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::isEdited → KILLED 2. negated conditional → KILLED
38	1. replaced return value with null for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::getEdited → KILLED
47	1. negated conditional → SURVIVED
48	1. replaced boolean return with false for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::equals → KILLED
50	1. negated conditional → NO_COVERAGE
51	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::equals → NO_COVERAGE
54	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::equals → NO_COVERAGE 2. negated conditional → NO_COVERAGE
55	1. negated conditional → NO_COVERAGE
60	1. replaced int return with 0 for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::hashCode → SURVIVED
65	1. replaced return value with "" for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::toString → SURVIVED

- After adding new tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.boardserver.embeddable

Number of Classes	Line Coverage	Mutation Coverage
1	95% 19/20	92% 12/13

Breakdown by Class

Name	Line Coverage	Mutation Coverage
TimestampTracker.java	95% 19/20	92% 12/13

Mutations

26	1. replaced return value with null for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::getCreated → KILLED
34	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::isEdited → KILLED 2. negated conditional → KILLED
38	1. replaced return value with null for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::getEdited → KILLED
47	1. negated conditional → KILLED
48	1. replaced boolean return with false for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::equals → KILLED
50	1. negated conditional → KILLED
51	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::equals → NO_COVERAGE
54	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::equals → KILLED 2. negated conditional → KILLED
55	1. negated conditional → KILLED
60	1. replaced int return with 0 for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::hashCode → KILLED
65	1. replaced return value with "" for nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::toString → KILLED

2. *ExtendedBaseEntity.class* (Board Server)

- Before adding new tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.boardserver.entities

Number of Classes	Line Coverage		Mutation Coverage	
3	88%	74/84	76%	26/34

Breakdown by Class

Name	Line Coverage		Mutation Coverage	
BaseEntity.java	91%	21/23	80%	8/10
Board.java	100%	29/29	100%	11/11
ExtendedBaseEntity.java	75%	24/32	54%	7/13

Mutations

39	1. replaced return value with "" for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::getUsername → KILLED
47	1. replaced return value with null for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::getTimestampTracker → KILLED
62	1. negated conditional → SURVIVED
63	1. removed call to nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::setCreated → NO_COVERAGE
64	1. removed call to nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::setEdited → NO_COVERAGE
70	1. negated conditional → KILLED
72	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::equals → KILLED 2. negated conditional → KILLED
73	1. negated conditional → KILLED
74	1. negated conditional → KILLED
77	1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::equals → NO_COVERAGE
82	1. replaced int return with 0 for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::hashCode → NO_COVERAGE
88	1. replaced return value with "" for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::toString → NO_COVERAGE

- After adding new tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.boardserver.entities

Number of Classes	Line Coverage		Mutation Coverage	
3	98%	82/84	94%	32/34

Breakdown by Class

Name	Line Coverage		Mutation Coverage	
BaseEntity.java	91%	21/23	80%	8/10
Board.java	100%	29/29	100%	11/11
ExtendedBaseEntity.java	100%	32/32	100%	13/13

```
Mutations

39  1. replaced return value with "" for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::getUsername → KILLED
47  1. replaced return value with null for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::getTimestampTracker → KILLED
62  1. negated conditional → KILLED
63  1. removed call to nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::setCreated → KILLED
64  1. removed call to nl/tudelft/sem/group20/boardserver/embeddable/TimestampTracker::setEdited → KILLED
70  1. negated conditional → KILLED
72  1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::equals → KILLED
    2. negated conditional → KILLED
73  1. negated conditional → KILLED
74  1. negated conditional → KILLED
77  1. replaced boolean return with true for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::equals → KILLED
82  1. replaced int return with 0 for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::hashCode → KILLED
88  1. replaced return value with "" for nl/tudelft/sem/group20/boardserver/entities/ExtendedBaseEntity::toString → KILLED
```

3. *VerifyAuth.class and VerifyBoard.Class* (Content Server)

Two classes that work together during authentication

- Before adding the new tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.contentserver.architecturepatterns

Number of Classes	Line Coverage		Mutation Coverage	
5	100%	32/32	68%	13/19

Breakdown by Class

Name	Line Coverage		Mutation Coverage	
BaseHandler.java	100%	4/4	33%	1/3
CheckRequest.java	100%	8/8	100%	1/1
HandlerBuilder.java	100%	7/7	100%	4/4
VerifyAuth.java	100%	6/6	60%	3/5
VerifyBoard.java	100%	7/7	67%	4/6

- After adding some effective tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.contentserver.architecturepatterns

Number of Classes	Line Coverage		Mutation Coverage	
5	100%	32/32	79%	15/19

Breakdown by Class

Name	Line Coverage		Mutation Coverage	
BaseHandler.java	100%	4/4	33%	1/3
CheckRequest.java	100%	8/8	100%	1/1
HandlerBuilder.java	100%	7/7	100%	4/4
VerifyAuth.java	100%	6/6	80%	4/5
VerifyBoard.java	100%	7/7	83%	5/6

- Both are affected by the equivalent mutants simply returning True. These are equivalent mutants since the functions either return true or throws and exception. So if there are no exceptions, true is alwasy returned.

```
1. negated conditional → KILLED
2. negated conditional → KILLED
1. negated conditional → KILLED
2. negated conditional → KILLED
1. replaced boolean return with false for nl/tudelft/sem/group20/contentserver/architecturepatterns/VerifyBoard::handle → KILLED
2. replaced boolean return with true for nl/tudelft/sem/group20/contentserver/architecturepatterns/VerifyBoard::handle → SURVIVED

1. negated conditional → KILLED
2. negated conditional → KILLED
1. removed call to nl/tudelft/sem/group20/contentserver/architecturepatterns/CheckRequest::setUsername → KILLED
1. replaced boolean return with false for nl/tudelft/sem/group20/contentserver/architecturepatterns/VerifyAuth::handle → KILLED
2. replaced boolean return with true for nl/tudelft/sem/group20/contentserver/architecturepatterns/VerifyAuth::handle → SURVIVED
```

4. *PostService.class* (Content Server)

- Before adding tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.contentserver.services

Number of Classes	Line Coverage		Mutation Coverage	
3	91%	108/119	61%	31/51

Breakdown by Class

Name	Line Coverage		Mutation Coverage	
ContentService.java	94%	15/16	100%	9/9
PostService.java	81%	38/47	52%	11/21
ThreadService.java	98%	55/56	52%	11/21

Mutations

38	1. replaced return value with Collections.emptyList for nl/tudelft/sem/group20/contentserver/services/PostService::getPosts → KILLED
54	1. removed call to nl/tudelft/sem/group20/contentserver/services/PostService::isBoardLocked → KILLED
61	1. removed call to nl/tudelft/sem/group20/contentserver/entities/BoardThread::addPost → SURVIVED
63	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::createPost → KILLED
77	1. negated conditional → KILLED
81	1. removed call to nl/tudelft/sem/group20/contentserver/entities/Post::setBody → SURVIVED
82	1. removed call to nl/tudelft/sem/group20/contentserver/entities/Post::setEditedTime → SURVIVED
84	1. removed call to nl/tudelft/sem/group20/contentserver/services/PostService::updateThread → SURVIVED
88	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::updatePost → KILLED
102	1. negated conditional → KILLED
107	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::getPostById → KILLED
122	1. replaced return value with Collections.emptyList for nl/tudelft/sem/group20/contentserver/services/PostService::getPostsFromThread → KILLED
135	1. replaced Boolean return with False for nl/tudelft/sem/group20/contentserver/services/PostService::isEdited → KILLED 2. replaced Boolean return with True for nl/tudelft/sem/group20/contentserver/services/PostService::isEdited → KILLED 3. negated conditional → KILLED
152	1. negated conditional → KILLED
157	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::retrieveThread → KILLED
170	1. negated conditional → KILLED
173	1. removed call to nl/tudelft/sem/group20/contentserver/entities/BoardThread::removePost → NO_COVERAGE
177	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::lambda$updateThread$0 → NO_COVERAGE
179	1. removed call to nl/tudelft/sem/group20/contentserver/entities/Post::setBoardThread → NO_COVERAGE
180	1. removed call to nl/tudelft/sem/group20/contentserver/entities/BoardThread::addPost → NO_COVERAGE

Mutations

38	1. replaced return value with Collections.emptyList for nl/tudelft/sem/group20/contentserver/services/PostService::getPosts → KILLED
55	1. removed call to nl/tudelft/sem/group20/contentserver/services/PostService::isBoardLocked → KILLED
62	1. removed call to nl/tudelft/sem/group20/contentserver/entities/BoardThread::addPost → SURVIVED
64	1. replaced long return with 0 for nl/tudelft/sem/group20/contentserver/services/PostService::createPost → SURVIVED
77	1. negated conditional → KILLED
81	1. removed call to nl/tudelft/sem/group20/contentserver/entities/Post::setBody → SURVIVED
82	1. removed call to nl/tudelft/sem/group20/contentserver/entities/Post::setEditedTime → SURVIVED
84	1. removed call to nl/tudelft/sem/group20/contentserver/services/PostService::updateThread → SURVIVED
100	1. negated conditional → KILLED
105	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::getPostById → KILLED
120	1. replaced return value with Collections.emptyList for nl/tudelft/sem/group20/contentserver/services/PostService::getPostsFromThread → KILLED
133	1. replaced Boolean return with False for nl/tudelft/sem/group20/contentserver/services/PostService::isEdited → KILLED 2. replaced Boolean return with True for nl/tudelft/sem/group20/contentserver/services/PostService::isEdited → KILLED 3. negated conditional → KILLED
150	1. negated conditional → KILLED
155	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::retrieveThread → KILLED
168	1. negated conditional → SURVIVED
171	1. removed call to nl/tudelft/sem/group20/contentserver/entities/BoardThread::removePost → NO_COVERAGE
175	1. replaced return value with null for nl/tudelft/sem/group20/contentserver/services/PostService::lambda$updateThread$0 → NO_COVERAGE
177	1. removed call to nl/tudelft/sem/group20/contentserver/entities/Post::setBoardThread → NO_COVERAGE
178	1. removed call to nl/tudelft/sem/group20/contentserver/entities/BoardThread::addPost → NO_COVERAGE

- After adding tests:

Pit Test Coverage Report

Package Summary

nl.tudelft.sem.group20.contentserver.services

Number of Classes	Line Coverage		Mutation Coverage	
3	97%	115/119	71%	37/52

Breakdown by Class

Name	Line Coverage		Mutation Coverage	
ContentService.java	94%	15/16	100%	9/9
PostService.java	96%	45/47	77%	17/22
ThreadService.java	98%	55/56	52%	11/21

Summary

- *TimestampTracker.class* went from 38% mutation coverage to 92% mutation coverage (54% improvement!)
- *ExtendedBaseEntity.class* went from 54% mutation coverage to 100% mutation coverage (46% improvement!)
- *VerifyAuth.class* went from 60% mutation coverage to 80% mutation coverage (20% improvement)
- *VerifyBoard.Class* went from 67% mutation coverage to 82% mutation coverage (15% improvement)
- *PostService.Class* went from 52% mutation coverage to 77% mutation coverage (25% improvement)

Conclusion: massive improvement in system fault tolerance and resilience.