

Table 3

| ID | project | class | # Orig. test methods | ProportionalMutationScore | # New test methods | RQ1 | | | | RQ2 | | | | time(min) |
|---------------------|---------------|-------------------------------------|----------------------|---------------------------|--------------------|------------------------------|------------------------------|-------------------------|-----------------------|-----------------------|-----------------|---------|---|-----------|
| | | | | | | # Executed expressions Orig. | # Executed expressions Ampl. | Expr. Coverage Increase | # Killed mutants orig | # Killed mutants ampl | Increase killed | | | |
| High Mutation Score | | | | | | | | | | | | | | |
| 1 | javapoet | UtilTest | 2 | 88.75% | 0 | 80 | 80 | 0.0% | → | 71 | 71 | 0.0% | → | 16.90 |
| 2 | javapoet | NameAllocatorTest | 11 | 87.78% | 0 | 90 | 90 | 0.0% | → | 79 | 79 | 0.0% | → | 4.76 |
| 3 | mybatis | SqlBuilderTest | 5 | 100.0% | 0 | 193 | 193 | 0.0% | → | 193 | 193 | 0.0% | → | 1.52 |
| 4 | mybatis | SelectBuilderTest | 5 | 100.0% | 0 | 193 | 193 | 0.0% | → | 193 | 193 | 0.0% | → | 1.52 |
| 5 | traccar | PatternBuilderTest | 1 | 100.0% | 0 | 43 | 43 | 0.0% | → | 43 | 43 | 0.0% | → | 2.56 |
| 6 | traccar | StringFinderTest | 1 | 100.0% | 0 | 14 | 14 | 0.0% | → | 14 | 14 | 0.0% | → | 0.38 |
| 7 | stream-lib | TestLookup3Hash | 2 | 95.67% | 0 | 485 | 485 | 0.0% | → | 464 | 464 | 0.0% | → | 6.76 |
| 8 | stream-lib | TestDoublyLinkedList | 7 | 92.86% | 1 | 112 | 113 | 0.89% | ↗ | 104 | 105 | 0.96% | ↗ | 3.03 |
| 9 | mustache.java | HtmlEscaperTest | 1 | 100.0% | 0 | 15 | 15 | 0.0% | → | 15 | 15 | 0.0% | → | 4.66 |
| 10 | mustache.java | ClasspathResolverTest | 10 | 67.57% | 0 | 74 | 74 | 0.0% | → | 50 | 50 | 0.0% | → | 4.18 |
| 11 | twilio-java | UrlUtilsTest | 18 | 100.0% | 0 | 135 | 135 | 0.0% | → | 135 | 135 | 0.0% | → | 20.90 |
| 12 | twilio-java | EnqueueTest | 2 | 100.0% | 7 | 40 | 44 | 10.0% | ↗ | 40 | 44 | 10.0% | ↗ | 2.31 |
| 13 | jsoup | ParserSettingsTest | 1 | 100.0% | 0 | 14 | 14 | 0.0% | → | 14 | 14 | 0.0% | → | 4.69 |
| 14 | jsoup | CharacterReaderTest | 19 | 79.84% | 71 | 387 | 391 | 1.03% | ↗ | 309 | 336 | 8.74% | ↗ | 57.06 |
| 15 | jsoup | AttributesTest | 5 | 52.58% | 9 | 601 | 604 | 0.5% | ↗ | 316 | 322 | 1.9% | ↗ | 6.21 |
| 16 | protostuff | LowCopyProtostuffOutputTest | 1 | 75.8% | 0 | 471 | 471 | 0.0% | → | 357 | 357 | 0.0% | → | 1.69 |
| 17 | protostuff | LinkBufferTest | 3 | 75.86% | 12 | 87 | 136 | 56.32% | ↗ | 66 | 90 | 36.36% | ↗ | 3.24 |
| 18 | protostuff | CodedInputTest | 1 | 60.0% | 29 | 180 | 400 | 122.22% | ↗ | 108 | 166 | 53.7% | ↗ | 0.88 |
| 19 | logback | SecureRandomFactoryBeanTest | 4 | 100.0% | 0 | 28 | 28 | 0.0% | → | 28 | 28 | 0.0% | → | 0.03 |
| 20 | logback | SyslogAppenderBaseTest | 1 | 99.31% | 1 | 144 | 149 | 3.47% | ↗ | 143 | 148 | 3.5% | ↗ | 7.88 |
| 21 | retrofit | ResponseTest | 14 | 100.0% | 0 | 88 | 88 | 0.0% | → | 88 | 88 | 0.0% | → | 3.81 |
| 22 | retrofit | ServiceMethodTest | 1 | 100.0% | 0 | 10 | 10 | 0.0% | → | 10 | 10 | 0.0% | → | 7.80 |
| 23 | retrofit | ExecutorCallAdapterFactoryTest | 7 | 62.3% | 0 | 191 | 191 | 0.0% | → | 119 | 119 | 0.0% | → | 0.09 |
| 24 | retrofit | CallTest | 35 | 69.78% | 3 | 920 | 922 | 0.22% | ↗ | 642 | 644 | 0.31% | ↗ | 52.84 |
| Low PMS | | | | | | | | | | | | | | |
| 25 | javapoet | FieldSpecTest | 2 | 32.13% | 12 | 694 | 712 | 2.59% | ↗ | 223 | 316 | 41.7% | ↗ | 4.44 |
| 26 | javapoet | ParameterSpecTest | 2 | 32.77% | 11 | 653 | 663 | 1.53% | ↗ | 214 | 293 | 36.92% | ↗ | 3.66 |
| 27 | mybatis | WrongNamespacesTest | 2 | 8.97% | 6 | 870 | 870 | 0.0% | → | 78 | 249 | 219.23% | ↗ | 29.70 |
| 28 | mybatis | WrongMapperTest | 1 | 8.91% | 3 | 1089 | 1089 | 0.0% | → | 97 | 325 | 235.05% | ↗ | 7.13 |
| 29 | traccar | GeolocationProviderTest | 2 | 0.0% | 0 | 4 | 4 | 0.0% | → | 0 | 0 | 0.0% | → | 0.02 |
| 30 | traccar | At2000ProtocolDecoderTest | 1 | 0.0% | 0 | 4 | 4 | 0.0% | → | 0 | 0 | 0.0% | → | 0.94 |
| 31 | stream-lib | TestICardinality | 2 | 7.66% | 0 | 248 | 248 | 0.0% | → | 19 | 19 | 0.0% | → | 2.13 |
| 32 | stream-lib | TestMurmurHash | 2 | 25.74% | 40 | 202 | 292 | 44.55% | ↗ | 52 | 275 | 428.85% | ↗ | 2.18 |
| 33 | mustache.java | ConcurrencyTest | 2 | 28.89% | 2 | 727 | 728 | 0.14% | ↗ | 210 | 342 | 62.86% | ↗ | 315.56 |
| 34 | mustache.java | ExplicitMapNullTest | 1 | 37.12% | 0 | 563 | 566 | 0.53% | ↗ | 209 | 210 | 0.48% | ↗ | 3.03 |
| 35 | twilio-java | AllTimeTest | 3 | 42.23% | 0 | 386 | 386 | 0.0% | → | 163 | 163 | 0.0% | → | 0.02 |
| 36 | twilio-java | DailyTest | 3 | 42.23% | 0 | 386 | 386 | 0.0% | → | 163 | 163 | 0.0% | → | 0.02 |
| 37 | jsoup | AttributeTest | 2 | 40.73% | 33 | 437 | 489 | 11.9% | ↗ | 178 | 225 | 26.4% | ↗ | 10.76 |
| 38 | protostuff | CodedDataInputTest | 1 | 1.11% | 0 | 451 | 451 | 0.0% | → | 5 | 5 | 0.0% | → | 3.58 |
| 39 | logback | FileAppenderResilience_AS_ROOT_Test | 1 | 4.6% | 0 | 87 | 87 | 0.0% | → | 4 | 4 | 0.0% | → | 0.65 |
| 40 | logback | Basic | 1 | 10.53% | 0 | 57 | 57 | 0.0% | → | 6 | 6 | 0.0% | → | 0.89 |