Simple HashMap and Collections.synchronizedMap fail with ConcurrentModificationException:

A screenshot of a computer

Description automatically generated with medium confidence

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ConcurrentHashMap works without exceptions.

Data for map with 1000 nodes:

class java.util.concurrent.ConcurrentHashMap, size - 1000, sum - 4266, average sum time - 0.0174 ms

For other maps before exception:

class java.util.HashMap, size - 182, sum - 837, average sum time - 0.0395

class java.util.Collections$SynchronizedMap, size - 89, sum - 395, average sum time - 0.104

Adding time:

class java.util.HashMap, average adding time - 0.002

class java.util.Collections$SynchronizedMap, average adding time - 0.001

class java.util.concurrent.ConcurrentHashMap, average adding time - 0.001

For thread safe maps average benchmark test was passed:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Benchmark | (limit) | Mode | Cnt | Score | Error | Units |
| ThreadSafeTest.testNonSynchronizedMap | 1000 | avgt | 5 | 2.724 | 0.553 | ms/op |
| ThreadSafeTest.testNonSynchronizedMap | 5000 | avgt | 5 | 4.064 | 2.182 | ms/op |
| ThreadSafeTest.testNonSynchronizedMap | 10000 | avgt | 5 | 5.470 | 5.926 | ms/op |
| ThreadSafeTest.testNonSynchronizedMap | 20000 | avgt | 5 | 5.844 | 2.474 | ms/op |
| ThreadSafeTest.testNonSynchronizedMap | 50000 | avgt | 5 | 17.754 | 12.354 | ms/op |
| ThreadSafeTest.testSynchronizedMap | 1000 | avgt | 5 | 14.579 | 8.788 | ms/op |
| ThreadSafeTest.testSynchronizedMap | 5000 | avgt | 5 | 21.434 | 27.183 | ms/op |
| ThreadSafeTest.testSynchronizedMap | 10000 | avgt | 5 | 42.903 | 201.826 | ms/op |
| ThreadSafeTest.testSynchronizedMap | 20000 | avgt | 5 | 20.259 | 19.652 | ms/op |
| ThreadSafeTest.testSynchronizedMap | 50000 | avgt | 5 | 46.676 | 173.715 | ms/op |