Program Structure and Algorithms (INFO-6205 SEC01) Assignment – 2 Benchmark

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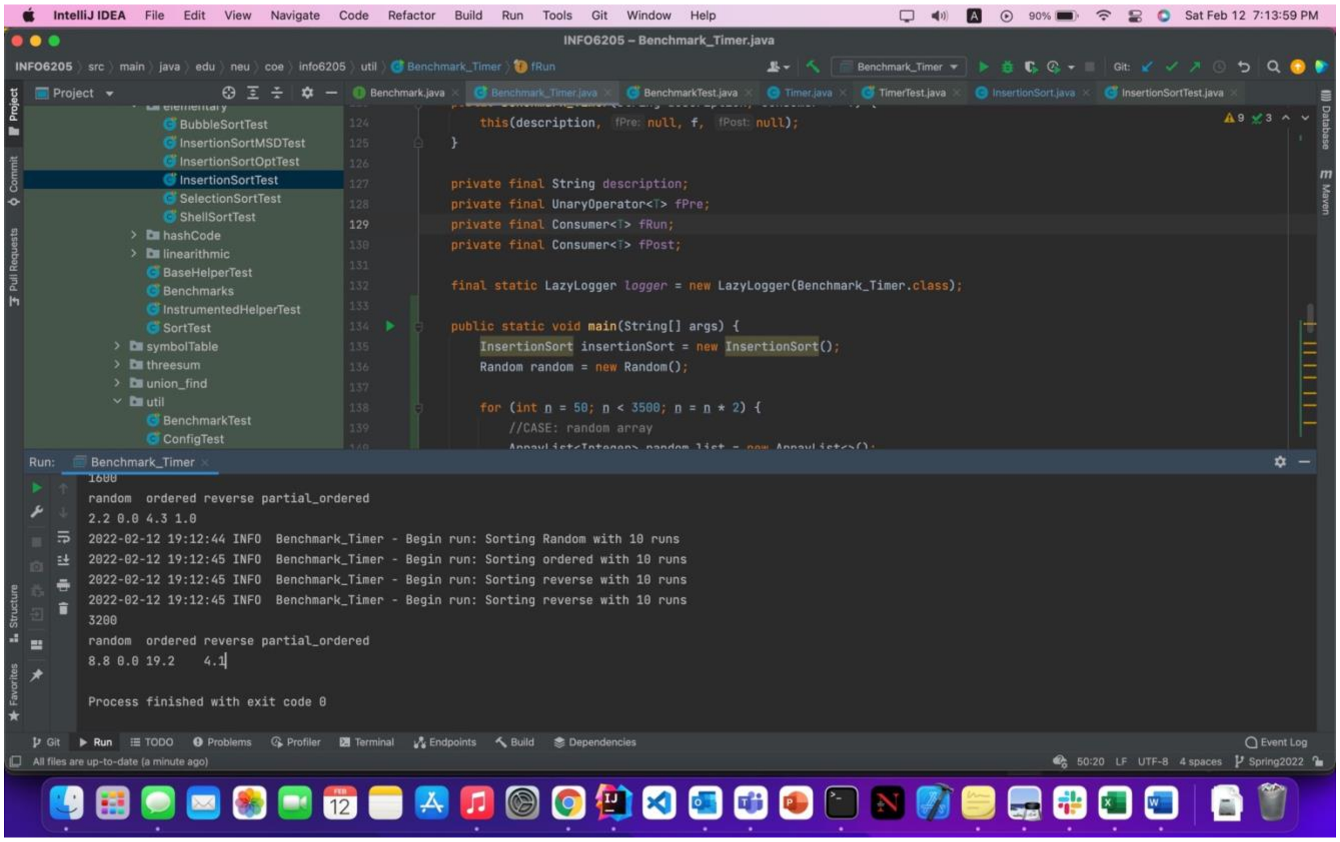
TASK

Task for this assignment is in three parts.

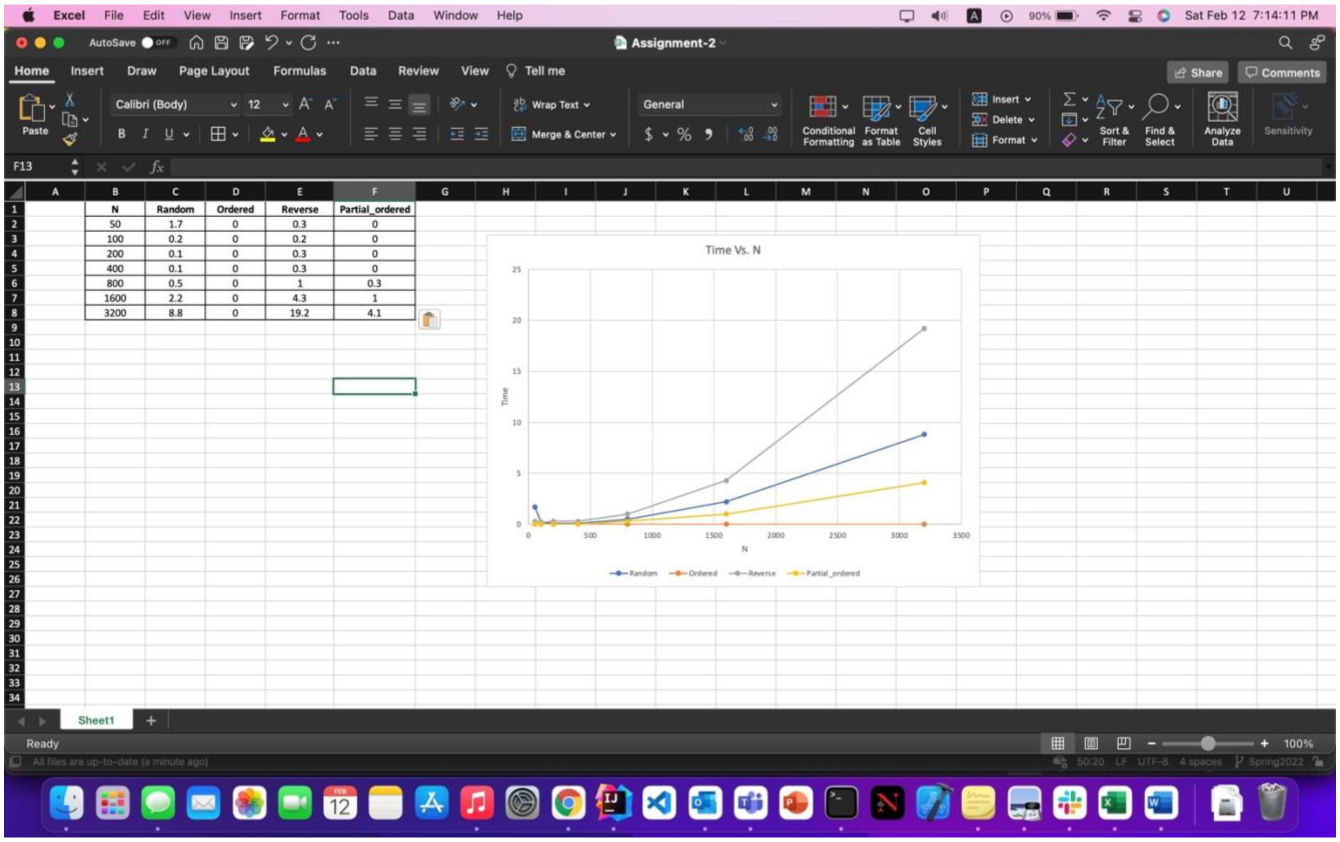
1. Implement three methods (*repeat*, *getClock*, and *toMillisecs*) of a class called *Timer*.
2. Implement Insertion Sort (in the InsertionSort class) by simply looking up the insertion code used by Arrays.sort.
3. Implement a main program to actually run the following benchmarks: measure the running times of this sort, using four different initial array ordering situations: random, ordered, partially ordered and reverse ordered.

OUTPUT SCREENSHOT



```java
        this(description, fPre: null, f, fPost: null);
    }

    private final String description;
    private final UnaryOperator<T> fPre;
    private final Consumer<T> fRun;
    private final Consumer<T> fPost;

    final static LazyLogger logger = new LazyLogger(Benchmark_Timer.class);

    public static void main(String[] args) {
        InsertionSort insertionSort = new InsertionSort();
        Random random = new Random();

        for (int n = 50; n < 3500; n = n * 2) {
            //CASE: random array
```

```
1600
random  ordered reverse partial_ordered
2.2 0.0 4.3 1.0
2022-02-12 19:12:44 INFO  Benchmark_Timer - Begin run: Sorting Random with 10 runs
2022-02-12 19:12:45 INFO  Benchmark_Timer - Begin run: Sorting ordered with 10 runs
2022-02-12 19:12:45 INFO  Benchmark_Timer - Begin run: Sorting reverse with 10 runs
2022-02-12 19:12:45 INFO  Benchmark_Timer - Begin run: Sorting reverse with 10 runs
3200
random  ordered reverse partial_ordered
8.8 0.0 19.2    4.1

Process finished with exit code 0
```



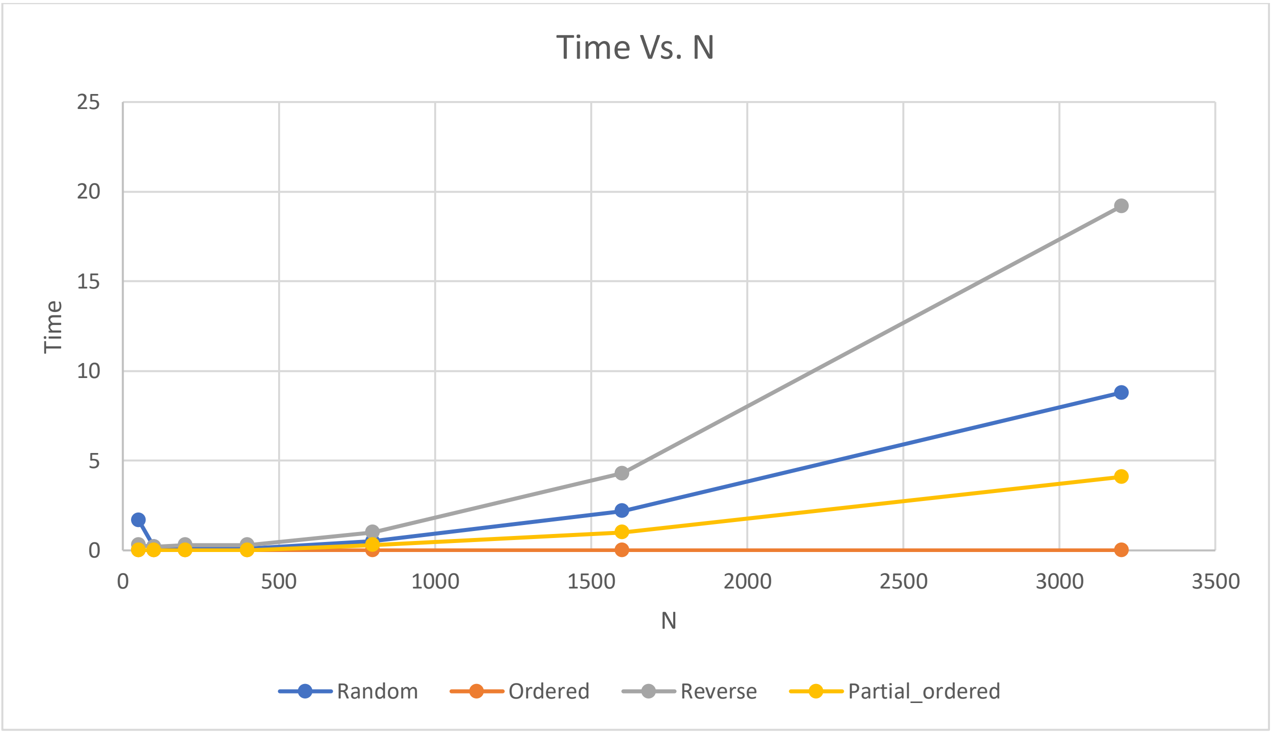
N	Random	Ordered	Reverse	Partial_ordered
50	1.7	0	0.3	0
100	0.2	0	0.2	0
200	0.1	0	0.3	0
400	0.1	0	0.3	0
800	0.5	0	1	0.3
1600	2.2	0	4.3	1
3200	8.8	0	19.2	4.1

CONCLUSION

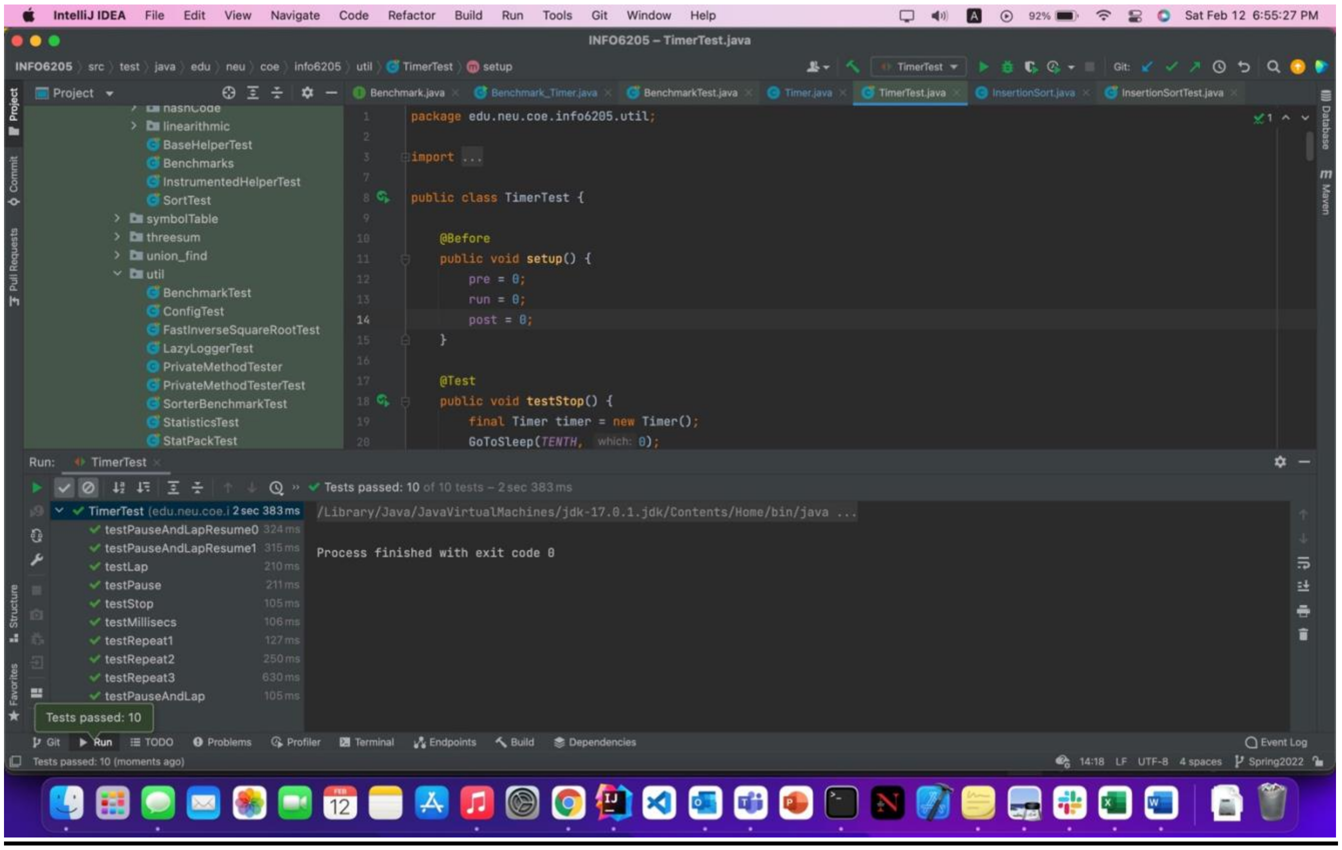
Reverse-ordered array has the highest sorting time according to the benchmark. It is followed by random-ordered arrays, then partial-ordered arrays and then ordered arrays. The worst-case scenario is for reverse ordered arrays sorting as it has O(N^2) time complexity.

EVIDENCE

N	Random	Ordered	Reverse	Partial_ordered
50	1.7	0	0.3	0
100	0.2	0	0.2	0
200	0.1	0	0.3	0
400	0.1	0	0.3	0
800	0.5	0	1	0.3
1600	2.2	0	4.3	1
3200	8.8	0	19.2	4.1



UNIT TESTS:



```java
package edu.neu.coe.info6205.util;

import ...

public class TimerTest {

    @Before
    public void setup() {
        pre = 0;
        run = 0;
        post = 0;
    }

    @Test
    public void testStop() {
        final Timer timer = new Timer();
        GoToSleep(TENTH, which: 0);
```

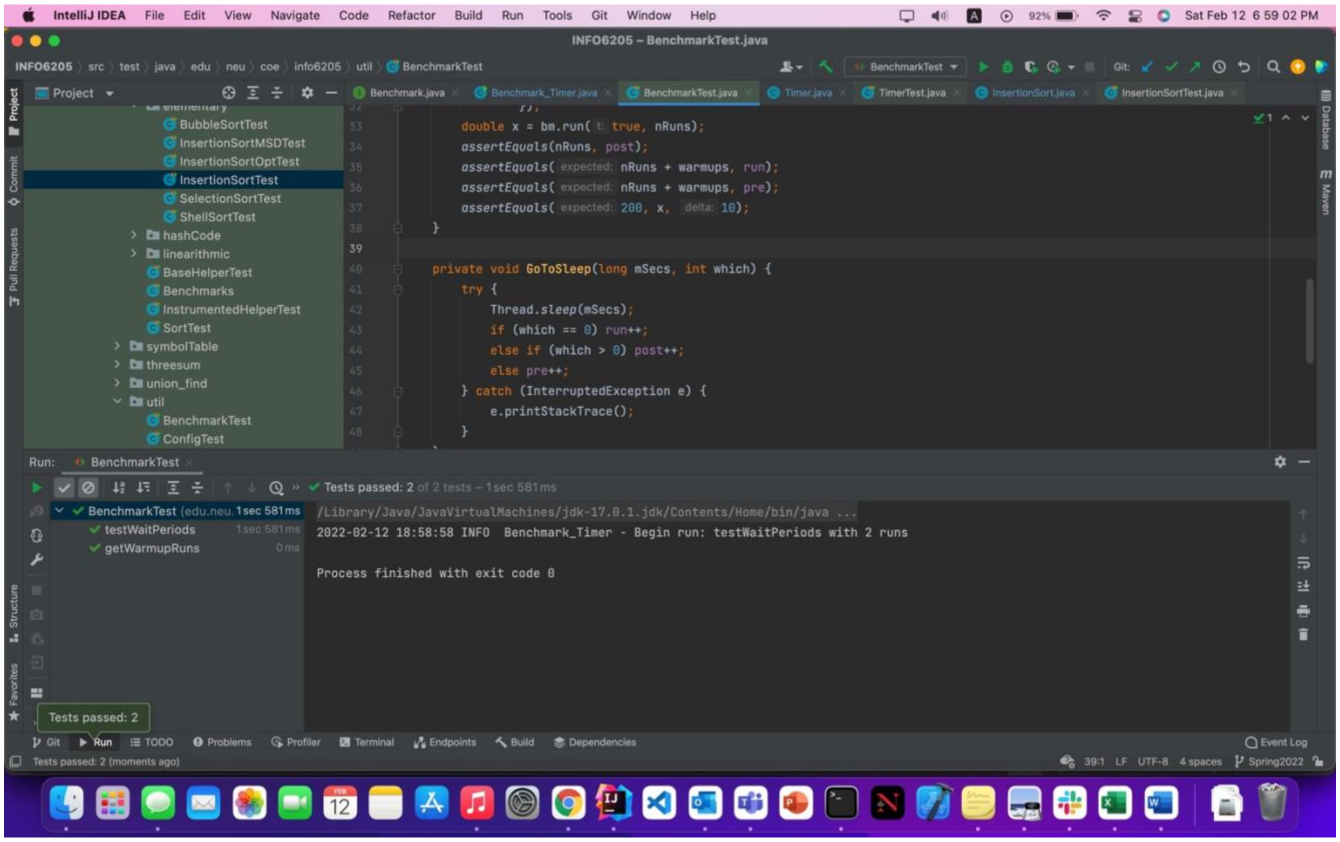
Tests passed: 10 of 10 tests – 2 sec 383 ms

```
TimerTest (edu.neu.coe.i 2 sec 383 ms
    testPauseAndLapResume0   324 ms
    testPauseAndLapResume1   315 ms
    testLap                  210 ms
    testPause                211 ms
    testStop                 105 ms
    testMillisecs            106 ms
    testRepeat1              127 ms
    testRepeat2              250 ms
    testRepeat3              630 ms
    testPauseAndLap          105 ms
```

```
/Library/Java/JavaVirtualMachines/jdk-17.0.1.jdk/Contents/Home/bin/java ...

Process finished with exit code 0
```

Tests passed: 10

Tests passed: 10 (moments ago)



INFO6205 – BenchmarkTest.java

```java
        double x = bm.run( t: true, nRuns);
        assertEquals(nRuns, post);
        assertEquals( expected: nRuns + warmups, run);
        assertEquals( expected: nRuns + warmups, pre);
        assertEquals( expected: 200, x,  delta: 10);
    }

    private void GoToSleep(long mSecs, int which) {
        try {
            Thread.sleep(mSecs);
            if (which == 0) run++;
            else if (which > 0) post++;
            else pre++;
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
```

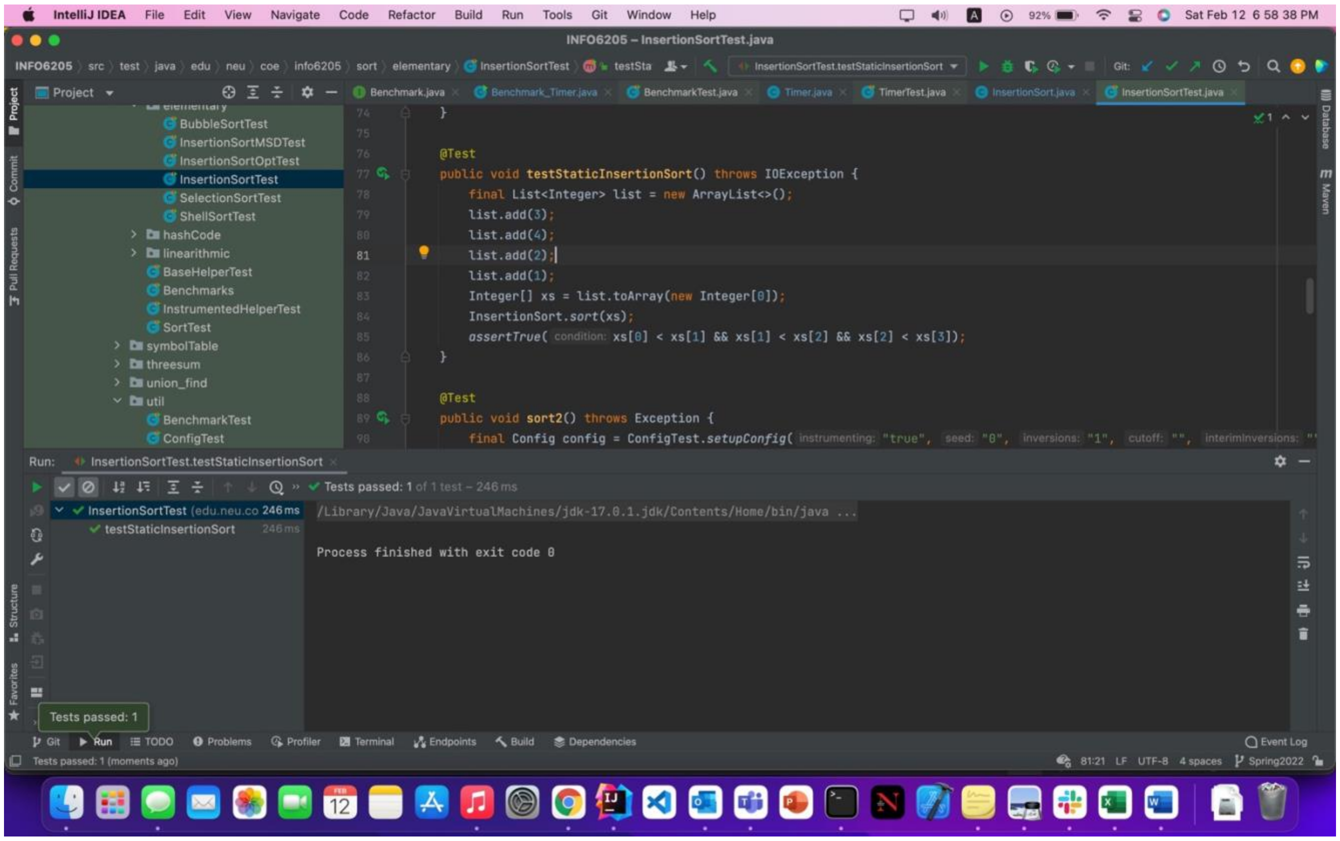
Run: BenchmarkTest

Tests passed: 2 of 2 tests – 1 sec 581 ms

```
BenchmarkTest (edu.neu. 1 sec 581 ms
  testWaitPeriods        1 sec 581 ms
  getWarmupRuns                  0 ms
```

```
/Library/Java/JavaVirtualMachines/jdk-17.0.1.jdk/Contents/Home/bin/java ...
2022-02-12 18:58:58 INFO  Benchmark_Timer - Begin run: testWaitPeriods with 2 runs

Process finished with exit code 0
```

Tests passed: 2 (moments ago)



INFO6205 – InsertionSortTest.java

```java
    }

    @Test
    public void testStaticInsertionSort() throws IOException {
        final List<Integer> list = new ArrayList<>();
        list.add(3);
        list.add(4);
        list.add(2);
        list.add(1);
        Integer[] xs = list.toArray(new Integer[0]);
        InsertionSort.sort(xs);
        assertTrue( condition: xs[0] < xs[1] && xs[1] < xs[2] && xs[2] < xs[3]);
    }

    @Test
    public void sort2() throws Exception {
        final Config config = ConfigTest.setupConfig( instrumenting: "true",  seed: "0",  inversions: "1",  cutoff: "",  interimInversions: "
```

Run: InsertionSortTest.testStaticInsertionSort

Tests passed: 1 of 1 test – 246 ms

```
InsertionSortTest (edu.neu.co 246 ms
  testStaticInsertionSort     246 ms
```

```
/Library/Java/JavaVirtualMachines/jdk-17.0.1.jdk/Contents/Home/bin/java ...

Process finished with exit code 0
```

Tests passed: 1 (moments ago)