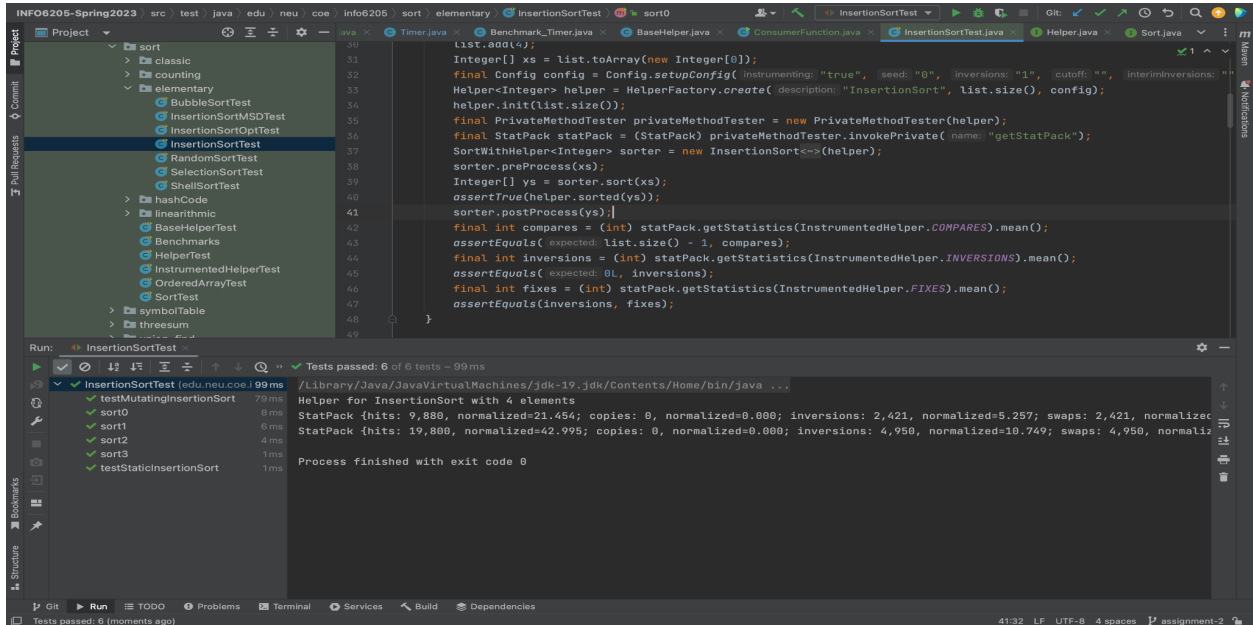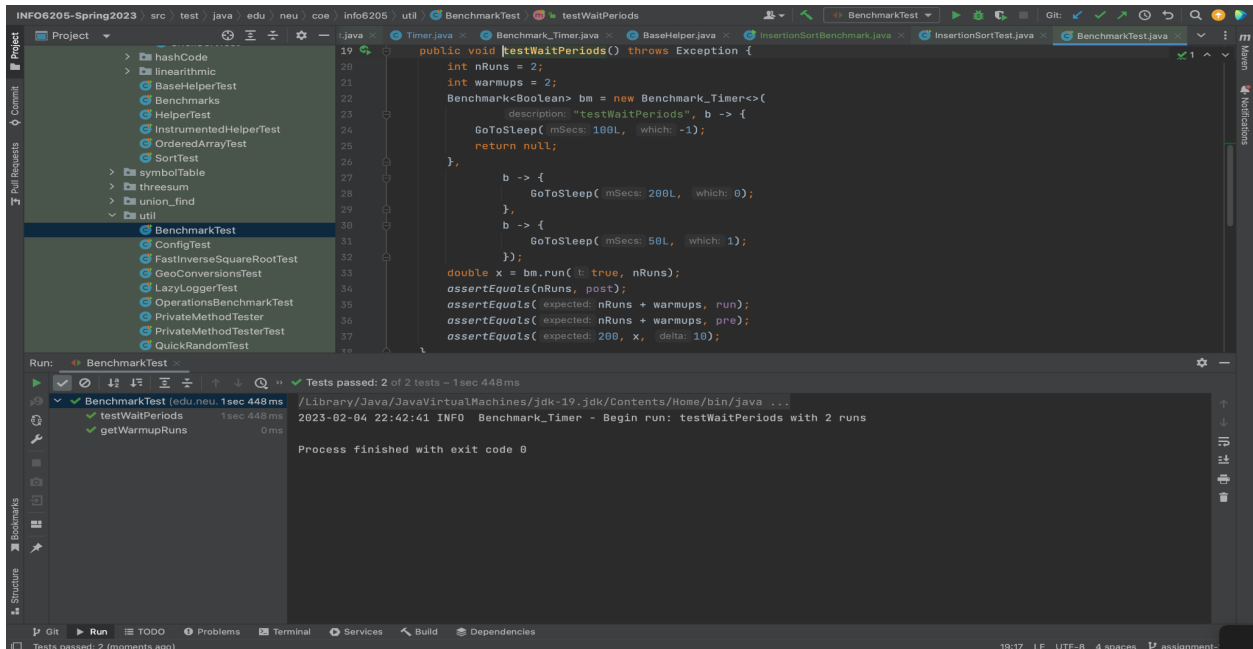# Assignment - 3 | Benchmark
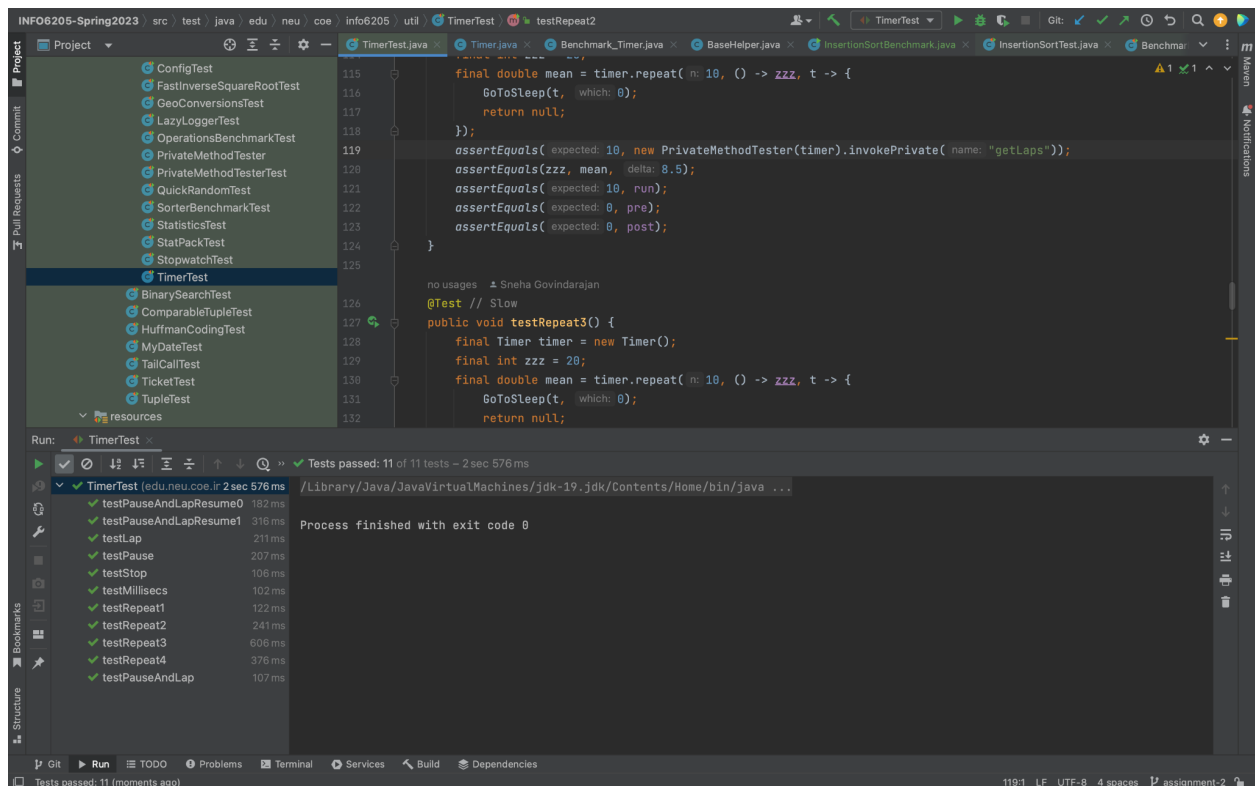
a.) Screenshot of the Unit test cases Insertion Sort

b.) Screenshot for Benchmark Test

c.) Screenshot for the Timer Test

d.) Observations - random, ordered, partially-ordered and reverse-ordered arrays

Ordered List: When the list is already sorted, Insertion Sort will complete in O(n) time because each item is inserted into its proper place on the first pass.

Partially-Ordered List: If the list is partially sorted, Insertion Sort will outperform its average-case performance because it will perform only few comparisons and swaps.

Random List : Insertion Sort has an average-case time complexity of O(n^2) for randomly ordered lists, making it efficient for small lists or lists with a few elements already sorted.

Reverse-Ordered List : If the list is sorted in reverse order, Insertion Sort will require the more swaps and comparisons, making it the slowest possible scenario for this algorithm, with a time complexity of O(n^2)

Insertion Sort is a fast sorting algorithm for small lists or lists with a few sorted elements. The algorithm works by iterating through the list and comparing each element to the one before it, swapping them if necessary. When the list is already sorted, Insertion Sort will complete in

O(n) time because each item is inserted into its proper place on the first pass. Insertion Sort performs better than its average-case performance when the list is partially sorted, with fewer comparisons and swaps. When the list is sorted in reverse order, the algorithm requires the most swaps and comparisons, making it the slowest possible scenario with a time complexity of $O(n^2)$.

Therefore, according to my Observation - Order of growth is,
Ordered List < Partially-Ordered List < Random List < Reverse List

e.) Sheet Of Observation

	Benchmark Insertion Sort	

Ordered List			Random Ordered List	
Size	**Elapsed Time**		**Size**	**Elapsed Time**
400	0.0238		400	0.2846
800	0.0225		800	0.7453
1600	0.0399		1600	2.8129
3200	0.0307		3200	10.9375
6400	0.0987		6400	40.4728
12800	0.1326		12800	165.9736

Reverse Ordered List			Partially Ordered List	
Size	**Elapsed Time**		**Size**	**Elapsed Time**
400	0.3667		400	0.1001
800	1.4479		800	0.3778
1600	5.2016		1600	1.2396
3200	20.8523		3200	5.3708
6400	82.065		6400	20.7589
12800	165.9736		12800	84.649