Program Structures and Algorithms
Spring 2023(SEC –03)

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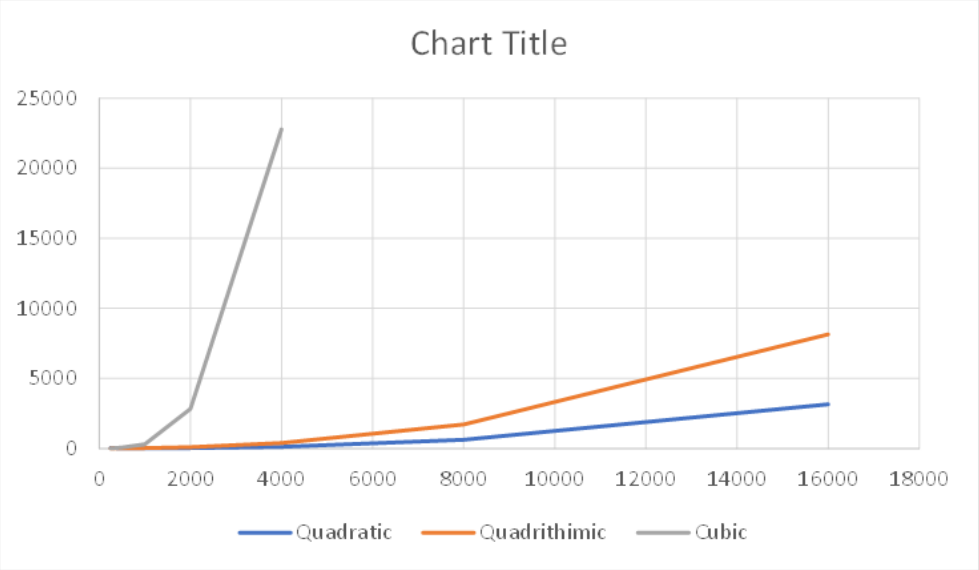
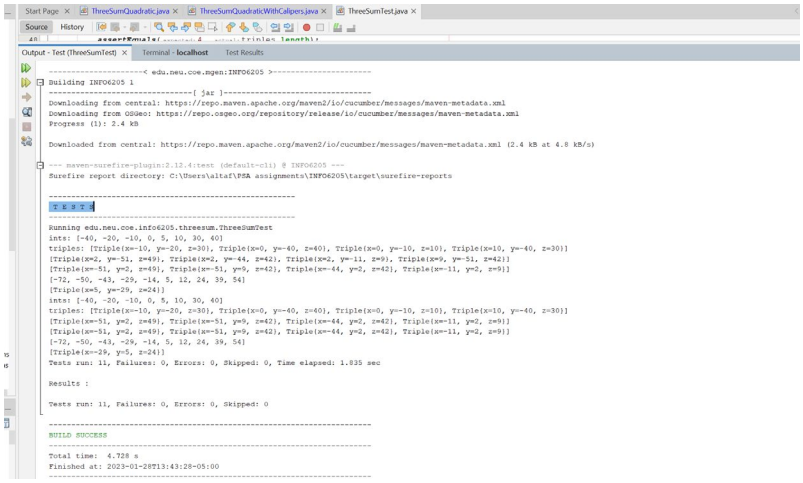
Task: Solve 3-SUM using the Quadrithmic, Quadratic, and (bonus point) quadraticWithCalipers approaches.

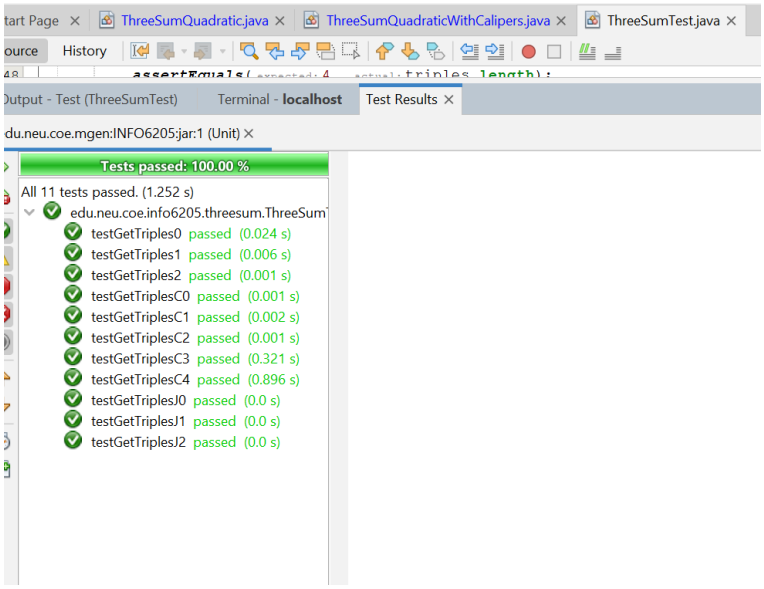
Graphical Representation:
N vs Time comparison of all three approaches

N	Quadratic	Quadrithimic	Cubic
250	49	11	18
500	4	11	73
1000	18	36	312
2000	38	98	2833
4000	133	398	22781
8000	619	1716	
16000	3142	8150	



Unit Test Screenshots:





The code is an implementation of the ThreeSum problem, which is a problem of finding all the unique triplets in an array of integers that add up to zero. The solution uses a quadratic time complexity approach, where the problem space is divided into N sub-spaces, each corresponding to a fixed value for the middle index of the three values. Each sub-space is then solved by expanding the scope of the other two indices outwards from the starting point. The array passed to the constructor must be sorted. The getTriples() method returns a list of unique triplets that add up to zero, and the getTriples(int j) method returns a list of triplets where the middle value has index j in the array. The while loop in the getTriples(int j) method runs two pointers one from left and one from right, and check if the sum of the 3 numbers is 0 and in case it is then adding it to the list of triples and moving the pointers accordingly.
This approach has a time complexity of O(n^2) because it involves nested loops through the array.
Also we can clearly see from the graph that quadratic approach is the better one compared to other two.