**Question 1**

This program add the square of a number to each of the squares of the numbers less than it (except 0).

**Question 5**

**Big O Discussion**

According to the numbers below, each algorithm seemed to match the Big O notation calculated for it. None of the algorithm’s values was larger than any of the worst-case Big O notations assigned to them

**Tables**

**Comparisons Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **Algorithm** | **Random Array** | **Sorted Array** | **Reverse Array** |
| **Selection Sort** | 49995000 | 49995000 | 49995000 |
| **Bubble Sort (Improved)** | 49988784 | 9999 | 49995000 |
| **Insertion Sort** | 24857033 | 9999 | 49995000 |
| **Shell Sort** | 224676 | 110018 | 160696 |
| **Merge Sort** | 19999 | 19999 | 19999 |
| **Quick Sort** | 13331 | 19999 | 19999 |
| **Quick Sort (Improved)** | 11419 | 11809 | 11809 |

**Exchanges Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **Algorithm** | **Random Array** | **Sorted Array** | **Reverse Array** |
| **Selection Sort** | 10000 | 10000 | 10000 |
| **Bubble Sort (Improved)** | 24847044 | 0 | 49995000 |
| **Insertion Sort** | 9999 | 9999 | 9999 |
| **Shell Sort** | 58606 | 0 | 57890 |
| **Merge Sort** | 140383 | 89006 | 84606 |
| **Quick Sort** | 13330 | 19998 | 19998 |
| **Quick Sort (Improved)** | 11418 | 11808 | 11808 |