**PA1 Report**

B09901066 謝承修

1. **The run time and memory of four versions of different input sizes.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Input size | IS | | MS | | QS | | HS | |
|  | CPU time  (ms) | Memory  (KB) | CPU time  (ms) | Memory  (KB) | CPU time  (ms) | Memory  (KB) | CPU time  (ms) | Memory  (KB) |
| 4000.case1 | 7.022 | 5904 | 1.708 | 6040 | 0.867 | 5904 | 0.696 | 5904 |
| 4000.case2 | 0.122 | 5904 | 0.574 | 6040 | 0.774 | 5904 | 0.699 | 5904 |
| 4000.case3 | 10.522 | 5904 | 0.838 | 6040 | 0.842 | 5904 | 0.808 | 5904 |
| 16000.case1 | 37.808 | 6056 | 4.074 | 6056 | 2.254 | 6056 | 1.868 | 6056 |
| 16000.case2 | 0.097 | 6056 | 1.242 | 6056 | 1.974 | 6056 | 1.309 | 6056 |
| 16000.case3 | 72.168 | 6056 | 1.862 | 6056 | 1.918 | 6056 | 1.927 | 6056 |
| 32000.case1 | 147.185 | 6188 | 7.749 | 6188 | 2.929 | 6188 | 3.422 | 6188 |
| 32000.case2 | 0.11 | 6188 | 2.503 | 6188 | 1.854 | 6188 | 3.282 | 6188 |
| 32000.case3 | 274.917 | 6188 | 2.732 | 6188 | 2.874 | 6188 | 3.18 | 6188 |
| 1000000.case1 | 142997 | 12144 | 147.357 | 15956 | 110.202 | 12144 | 152.088 | 12144 |
| 1000000.case2 | 1.011 | 12144 | 53.109 | 15956 | 59.416 | 12144 | 81.175 | 12144 |
| 1000000.case3 | 289491 | 12144 | 65.267 | 15956 | 62.39 | 12144 | 76.078 | 12144 |

We can see that for the same input size, every sorter takes the same memory, no matter which case is.

And four sorters take almost the same memory for the same input size, so we can conclude that the performance of them nearly depend on how much time they take.

To compare the run time they take, I make the following table, using seven different input sizes.

Also, for each case, I draw figures to show the growth of run time as a function of input size.



1. **The growth of run time**

**Analysis:**

The trendline is of the form , take logarithm for both sizes, we get , which tells us that the slope of the trendline () is b, and a means the intercept.

We can see that in the average case and worst case, the MS, QS, HS, have the slope of about 0.8, and the slope of the IS is about 1.75, which is much larger than that of other three sorters. As for the best case, however, IS gives the best performance, which only has the slope of about 0.3, and other three sorters still have the slope about 0.8.

There, however, is an important issue that the slope doesn’t follow the formula in the textbook, where MS, QS, HS do not grow with the input size with the rate of , and IS is O(n). To explain that, I asked TA and search for this problem, and I concluded two reasons. First, we cannot ignore the operations of the machine, since there are more complicated about low-level programming language. Second, the input size is not big enough. I think the less of input size, the more deviation there exists. To sum up, we cannot conclude the time complexity of this PA, but surely it shows us that the different performance of the four sorters under the different input sizes and cases.