Programming Assignment 5

Jayant Agrawal 14282
Shubham Pandey 14679

1 Comparison for group Size

Lets say that the size of the array is n and the group size is 5.
Consider the following table. Each column contains the average no of comparisons for the corresponding group size and array size.

No of iterations : 100

n	k = 3	k =5	k =7	k=9
100	1366	679	638	748
1000	15544	6941	3972	7348
10000	168900	70113	75470	75737
100000	1774663	667720	717316	766793
1000000	182346898	7199322	7786431	7668734

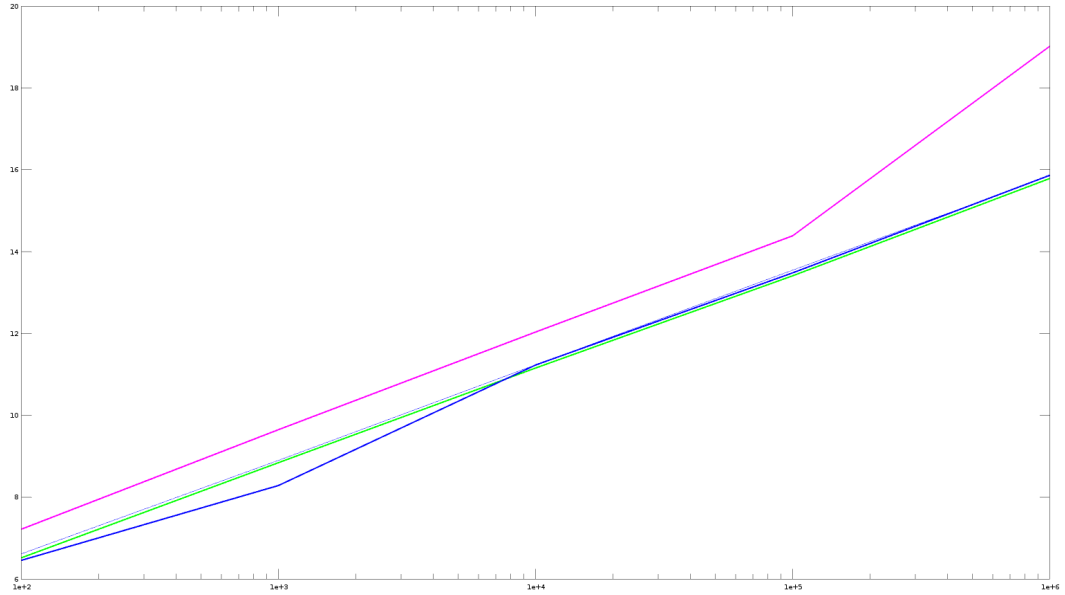

Figure 1: Log of Average comparisons vs Log of n for k = 3(red) ,5(green) ,7(blue),9(light blue)

2 Inference- Time Complexity for k=3

2.1 Time Complexity Analysis for k = 3

Let the Time taken be T(n). Then we have,

$$T(n) = O(n) + T(n/3) + T(2n/3)$$

Thus , since n/3 + 2n/3 is not less than n. Time Taken will not be linear.

2.2 Experimental Analysis

- Clearly, we can see that the slope is increasing in the logarithmic graph. This shows that the complexity is not linear.
- Also, observing the data from the table, the average no of comparisons increases non-linearly with increase in set size.

3 Comparison between k = 5 , k=7 and k =9

3.1 Time Complexity Analysis for k = 5

Let the Time taken be T(n). Then we have,

$$T(n) = O(n) + T(7n/10) + T(n/5)$$

3.2 Time Complexity Analysis for k = 7

Let the Time taken be T(n). Then we have,

$$T(n) = O(n) + T(5n/7) + T(n/7)$$

3.3 Time Complexity Analysis for k = 9

Let the Time taken be T(n). Then we have,

$$T(n) = O(n) + T(13n/18) + T(n/9)$$

3.4 Theoretical Observations

- Clearly , k = 5,7,9 are all O(n) solutions.
- The constants associated with O(n) in each group size depends on the sorting time taken for the smaller sets.
- Since the time taken is of O(nlog(n)) in sorting. So the constant associated with O(n) increases with k.

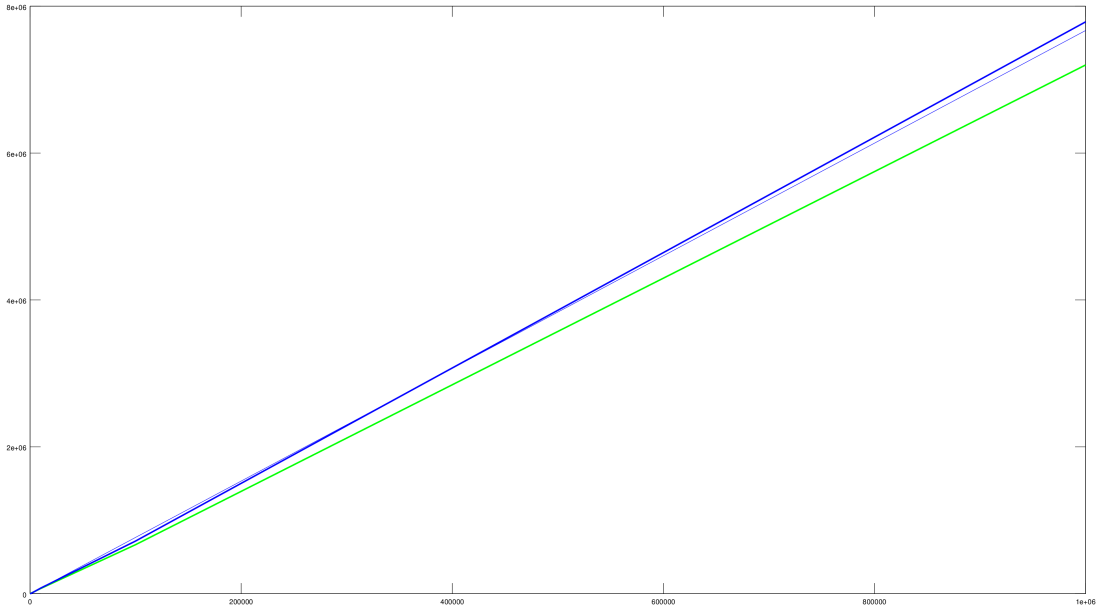

Figure 2: Log of Average comparisons vs Log of n for k = 5(green),7(blue),9(light blue)

3.5 Inference

- For smaller n, group size of 7 seems optimum. Because lesser no of comparisons will be there since the size of the secondary set is smaller as compared to the group size of 5.
- For larger n, group size of 5 is optimum. Clearly, from the table, we can observe that the number of comparisons for group size of 5 is less than that of 7 and 9.
- Also, from the above graph, we can clearly see that the slope of the graph for the group size of 5 is less than that of 7 and 9, this further proves that 5 is the best choice for group size.