REPORT - PROGRAMMING ASSIGNMENT 3

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Question 1

	$n = 10^2$	$n = 10^3$	$n = 10^4$	$n = 10^5$	$n = 10^6$
Average running time of QuickSort	1.1705×10^{-5}	1.4301×10^{-4}	1.6566×10^{-3}	1.8674×10^{-2}	2.245×10^{-1}
Average running time of MergeSort	1.824×10^{-5}	1.978×10^{-4}	1.2943×10^{-3}	2.774×10^{-2}	3.2257×10^{-1}
Average number of comparisons in QuickSort	677.698	11031.96	176492	2142963	26946279
Average number of comparisons in MergeSort	529.824	8767.04	120641	1556366	18674266
No. of times MergeSort had lesser no. of comparisons than QuickSort	996	1000	1000	1000	1000

- Although Quick sort worst time complexity is n^2 in practice it is better than Merge sort whose worst time complexity is $n \log(n)$.
- Average number of comparisons in Quick sort is approx. 1.4 times Average number of comparisons in Merge sort.(Theoretically it can be proved average number of comparisons in Quick sort is $1.39 \times n \log(n)$)
- Average number of comparisons in Merge sort is approx. $n \log(n)$
- Although number of comparisons in Quick sort is more than in Merge sort (about 1.4 times) time taken is less which tells that constant in Quick sort is smaller than constant in Merge sort.

	$n = 10^2$	$n = 10^3$	$n = 10^4$	$n = 10^5$	$n = 10^6$
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Average running time of MergeSort	1.824×10^{-5}	1.978×10^{-4}	1.2943×10^{-3}	2.774×10^{-2}	3.2257×10^{-1}
Percentage of cases when running time of QuickSort exceeds average by 5%	19.8%	24.4%	13.2%	16.9%	14.1%
Percentage of cases when running time of QuickSort exceeds average by 10%	9.7%	13.2%	8.3%	7.8%	6.3%
Percentage of cases when running time of QuickSort exceeds average by 20%	6.0%	7.8%	4.5%	3.4%	2.3%
Percentage of cases when running time of QuickSort exceeds average by 30%	4.1%	1.8%	2.3%	1.5%	0.1%
Percentage of cases when running time of QuickSort exceeds average by 40%	3.6%	0.9%	2.8%	0.6%	0%
Percentage of cases when running time of QuickSort exceeds average by 50%	2.7%	0.5%	1.8%	0.4%	0%
Percentage of cases when running time of QuickSort exceeds average by 100%	1.2%	0%	0%	0.1%	0%

- Only about 20 % of cases exceeds average time by 5% in Quick sort, so the remaining 80% of the cases are very much closer to the average time, hence most of the cases follow about $n \log(n)$ complexity
- Percentage of cases which exceeds average by 20% decreases to about 5%. so very few cases are far from average.
- Almost all except 0.1% lies within $2 \times average$ i.e. within $2 \times n \log(n)$
- As n increases percentage of cases away from average decreases.