CSCI-2725 Assignment 4 Report

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7. (a) **Provide** the total number of comparisons used by each one of the algorithms and explain whether they align with the Big-O time complexity of each algorithm. In the case of quicksort, compare and comment about the number of comparisons and complexity with the other quicksort implementation.

Algorithm	Input Type	#comparisons	Comments
Selection	Ordered	50005000	Aligns with $O(n^2)$.
Merge	Ordered	69008	Aligns with $O(n \log n)$.
Heap	Ordered	244460	Aligns with $O(n \log n)$.
Quick (first)	Ordered	50014998	Aligns with $O(n \log n)$; Performed worse than random.
Quick (rand.)	Ordered	177682	Aligns with $O(n \log n)$; Performed better than first.
Selection	Random	50005000	Aligns with $O(n^2)$.
Merge	Random	120414	Aligns with $O(n \log n)$.
Heap	Random	235430	Aligns with $O(n \log n)$.
Quick (first)	Random	169484	Aligns with $O(n \log n)$; Performed slightly better than random.
Quick (rand.)	Random	170058	Aligns with $O(n \log n)$; Performed slightly worse than first.
Selection	Reversed	50005000	Aligns with $O(n^2)$.
Merge	Reversed	64608	Aligns with $O(n \log n)$.
Heap	Reversed	226682	Aligns with $O(n \log n)$.
Quick (first)	Reversed	50014997	Does not align with $O(n \log n)$; Performed worse than random.
Quick (rand.)	Reversed	169694	Aligns with $O(n \log n)$; Performed better than first.

Table 1: Varying input type

(b) Did i use extra memory or other data structures other than the input array? If so, explain where and why.

Answer: Yes, for the `merge()` function in `merge_sort()`.

Explanation: It was to avoid overriding the original array.

(c) Explain what sorting alorithms work best in what situations based on my experimental results.

Answer: For any input, merge sort performed the best.

Algorithms	100	500	1000	5000	10000	20000	25000	30000
Selection	5050	125250	500500	12502500	50005000	200010000	312512500	450015000
Merge	545	3851	8701	55216	120469	260941	334021	408588
Heap	1029	7430	16837	107699	235351	510753	654760	800764
QuickSort-fp	737	5375	12249	79154	166674	364035	463346	562793
QuickSort-rp	865	5800	13002	80548	176932	377251	486920	595238

Table 2: Varying input size

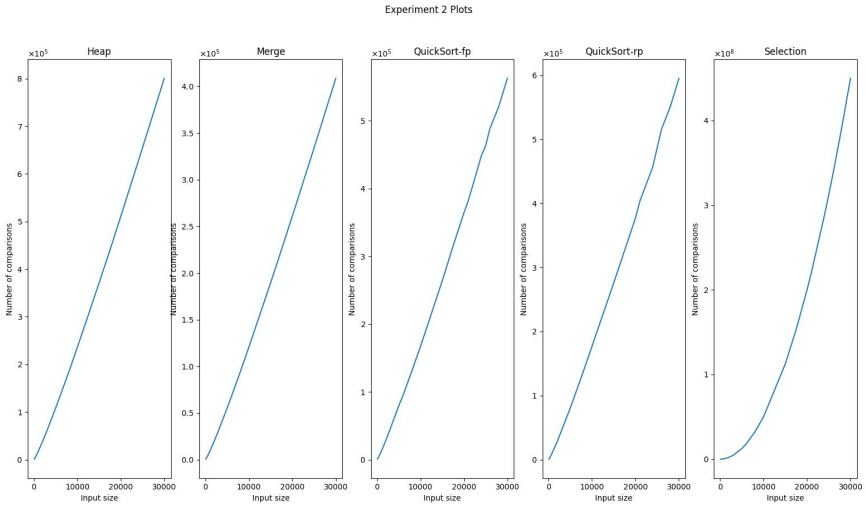

Figure 1: Plots for experiment 2

9. (a)

   (b) Generally the experimental results match the theoretical results. Specifically, the experimental results coincide with the Big-O of the respective algorithms. There does not appear to be any inconsistencies between my plot and what the theoretical plots look like.