CS 4040/5040

Milestone 1

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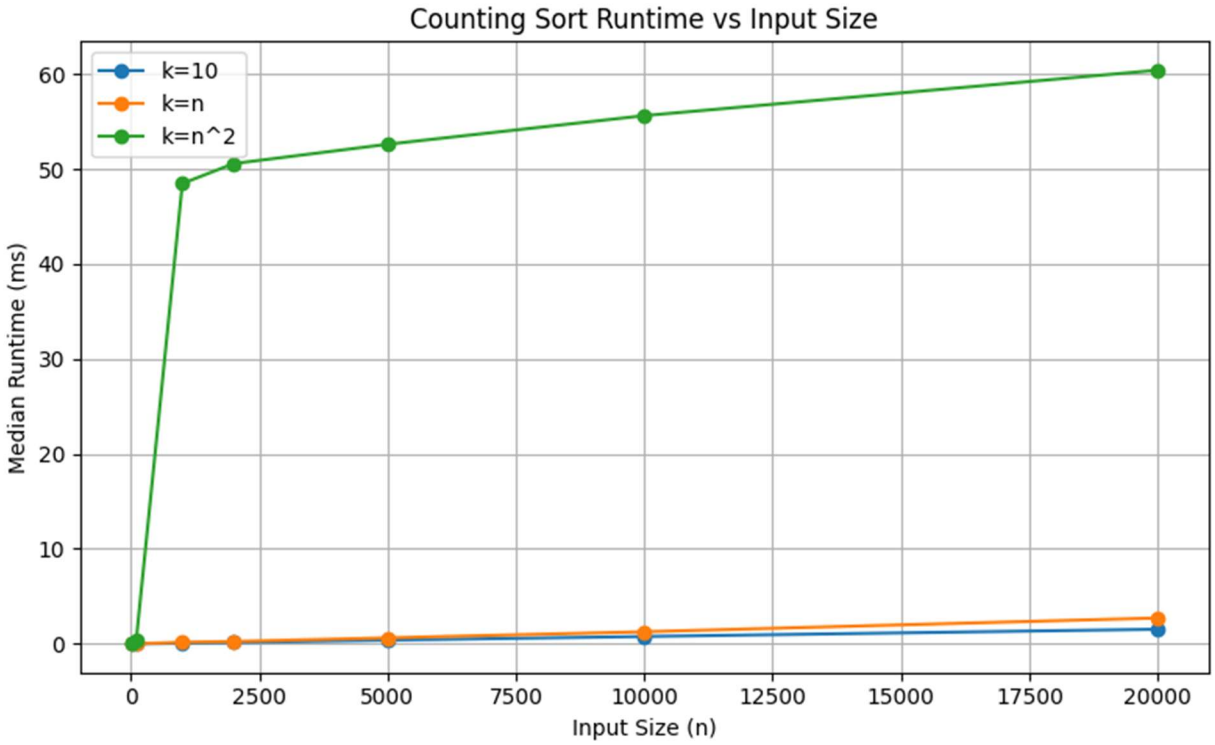
Runtime Table

n	k	Median Time (ms)
10	10	0.002
10	n	0.002
10	n^2	0.005
100	10	0.018
100	n	0.009
100	n^2	0.339
1000	10	0.073
1000	n	0.143
1000	n^2	47.065
2000	10	0.144
2000	n	0.238
2000	n^2	47.503
5000	10	0.381
5000	n	0.597
5000	n^2	48.275
10000	10	0.798
10000	n	1.283
10000	n^2	51.138
20000	10	1.451

20000	**n**	**2.717**
20000	**n^2**	**53.899**

Runtime Plot



Observations

- When k = 10 or k = n, runtime grows linearly with n, showing O(n + k) behavior.
- When k = n^2, runtime increases sharply because the count array becomes very large, increasing both memory and computation time.
- The results align well with the expected linear-time behavior for small k.

Comparison with Milestone 1

Algorithm	Typical Complexity	Runtime Growth	Suitability
Insertion Sort	$O(n^2)$	Very steep; skipped for large n (≥ 10,000)	Small n (< 5,000)
Quick Sort (Randomized)	O(n log n)	Smooth, scalable	Large n (≤ 20,000)
Counting Sort	O(n + k)	Linear for small k, slows for huge k	Integer arrays with small range