

Comparisons of Sorting Algorithms

Conclusions :

1. Insertion Sort performs best for I1 (sorted input). This is not surprising, since it has an excellent best-case running time of $\Theta(n)$. However, for other inputs, Insertion Sort's running times grow much more rapidly than the other algorithms, because it has a $\Theta(n^2)$ running time in the average case and worst case.
2. From the results, Merge Sort, Heap Sort and Randomized Quick Sort have a similar rate of growth. This is in accordance with the fact that they all have a theoretical running time of $O(n \log n)$.
3. Quick Sort (WITHOUT random partitioning) is not viable for I1~I2 (sorted and reversely sorted). If the input is already sorted or reversely sorted, each time of partitioning will put the pivot at the side of the array, which only reduces the problem size by 1. Quick Sort will then have a recursion depth of $O(n)$, which likely leads to Stack Overflow Errors. Adopting a slightly revised version of Quick Sort (WITH random partitioning) will greatly reduce the probability of Stack Overflow Errors, and will still provide a decent running time of $O(n \log n)$.

Results:

Problem Size	Input File	running time(ms)				
		Insertion Sort	Merge Sort	Heap Sort	Randomized Quick Sort	Quick Sort
20,000	I1	3	9	16	49	Stack Overflow
20,000	I2	673	5	9	10	Stack Overflow
20,000	I3	417	8	16	10	8
20,000	I4	356	8	10	8	8
20,000	I5	421	8	8	7	6

Problem Size	Input File	running time(ms)				
		Insertion Sort	Merge Sort	Heap Sort	Randomized Quick Sort	Quick Sort
40,000	I1	3	12	21	25	Stack Overflow
40,000	I2	2,315	10	16	11	Stack Overflow
40,000	I3	1,364	21	25	14	9
40,000	I4	1,427	15	15	9	12
40,000	I5	1,399	13	16	10	13

Problem Size	Input File	running time(ms)				
		Insertion Sort	Merge Sort	Heap Sort	Randomized Quick Sort	Quick Sort
60,000	l1	3	18	27	17	Stack Overflow
60,000	l2	4,708	12	17	11	Stack Overflow
60,000	l3	3,615	21	29	21	12
60,000	l4	4,169	20	29	17	17
60,000	l5	4,232	22	34	14	14

Problem Size	Input File	running time(ms)				
		Insertion Sort	Merge Sort	Heap Sort	Randomized Quick Sort	Quick Sort
80,000	l1	5	37	44	13	Stack Overflow
80,000	l2	8,125	20	27	21	Stack Overflow
80,000	l3	9,174	32	49	30	16
80,000	l4	9,110	32	45	29	16
80,000	l5	9,101	25	40	23	17

Problem Size	Input File	running time(ms)				
		Insertion Sort	Merge Sort	Heap Sort	Randomized Quick Sort	Quick Sort
100,000	l1	6	44	26	16	Stack Overflow
100,000	l2	13,490	18	24	17	Stack Overflow
100,000	l3	15,114	34	56	27	29
100,000	l4	14,170	34	56	27	21
100,000	l5	14,912	29	50	26	20