

Student: Ngo Huu Gia Bao 101163137

## Tables:

### Bubble Sort:

n	sorted_list		reverse sorted list		random list	
	#comparisons	#swaps	#comparisons	#swaps	#comparisons	#swaps
0	0	0	0	0	0	0
2	1	0	1	1	1	1
4	6	0	6	6	6	0
8	28	0	28	28	28	13
16	120	0	120	120	120	35
32	496	0	496	496	496	215
64	2016	0	2016	2016	2016	1078
128	8128	0	8128	8128	8128	4163
256	32640	0	32640	32640	32640	15854
512	130816	0	130816	130816	130816	65723
1024	523776	0	523776	523776	523776	261661

### Selection Sort:

n	sorted_list		reverse sorted list		random list	
	#comparisons	#swaps	#comparisons	#swaps	#comparisons	#swaps
0	0	0	0	0	0	0
2	3	0	3	1	3	1
4	10	0	10	2	10	0
8	36	0	36	4	36	6
16	136	0	136	8	136	10
32	528	0	528	16	528	26
64	2080	0	2080	32	2080	62
128	8256	0	8256	64	8256	118
256	32896	0	32896	128	32896	247
512	131328	0	131328	256	131328	507
1024	524800	0	524800	512	524800	1018
	selection sort table					

### Merge Sort:

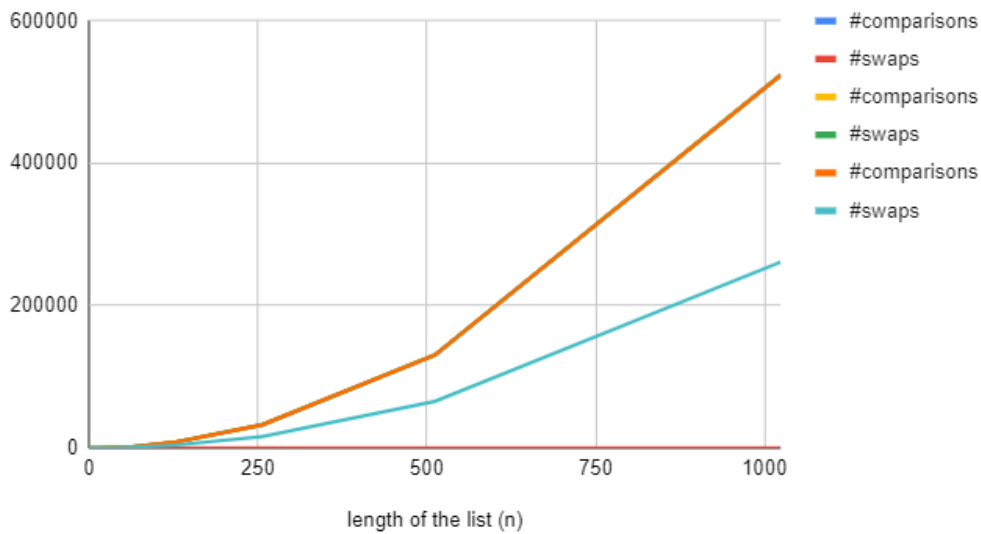
n	sorted_list		reverse sorted list		random list	
	#comparisons	#swaps	#comparisons	#swaps	#comparisons	#swaps
0	0	0	0	0	0	0
2	1	0	1	1	1	0
4	4	0	4	4	5	3
8	12	0	12	12	14	8
16	32	0	32	32	48	22
32	80	0	80	80	122	51
64	192	0	192	192	300	146
128	448	0	448	448	739	367
256	1024	0	1024	1024	1736	868
512	2304	0	2304	2304	3983	2002
1024	5120	0	5120	5120	8915	4462

## Heap Sort:

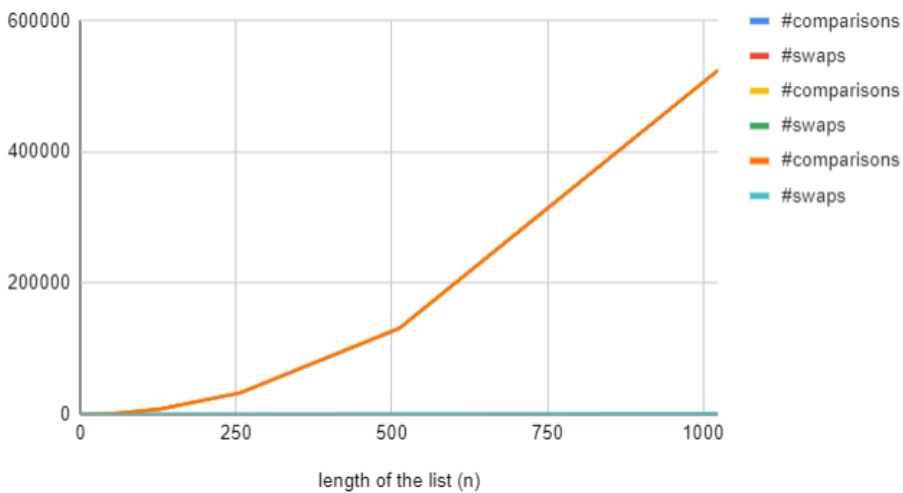
n	sorted_list		reverse sorted list		random list	
	#comparisons	#swaps	#comparisons	#swaps	#comparisons	#swaps
0	0	0	0	0	0	0
2	1	2	1	1	1	1
4	7	8	6	4	6	7
8	27	22	24	16	25	18
16	85	58	72	42	81	52
32	231	146	202	112	226	141
64	593	362	525	288	583	338
128	1459	850	1294	702	1382	774
256	3452	1972	3106	1642	3308	1821
512	7958	4464	7203	3772	7649	4160
1024	18060	9968	16407	8542	17367	9352

## Graphs:

Number of Operations by the list length n for bubble sort

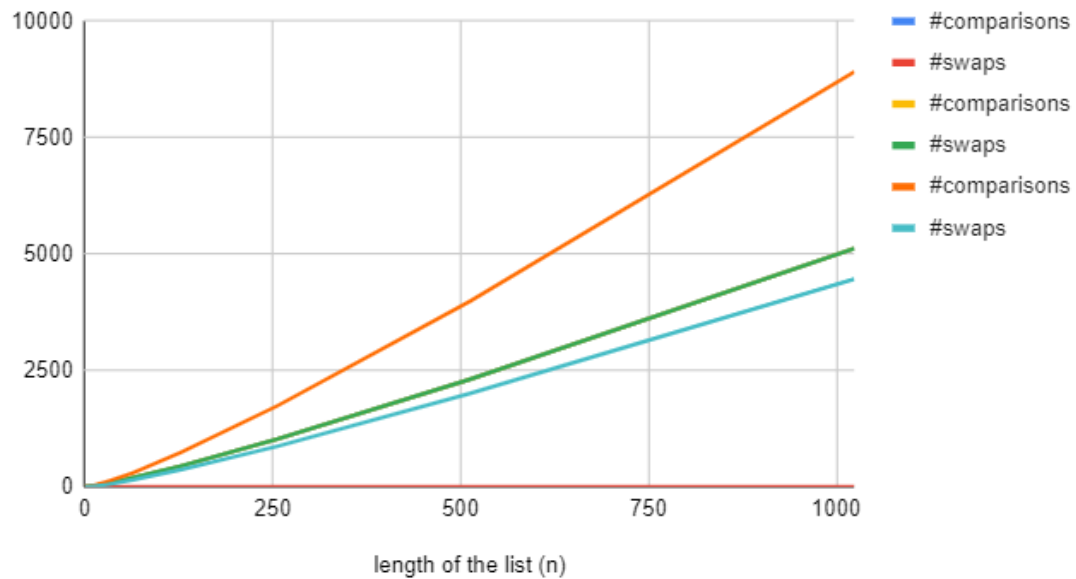


Number of Operations by the list length n for selection sort

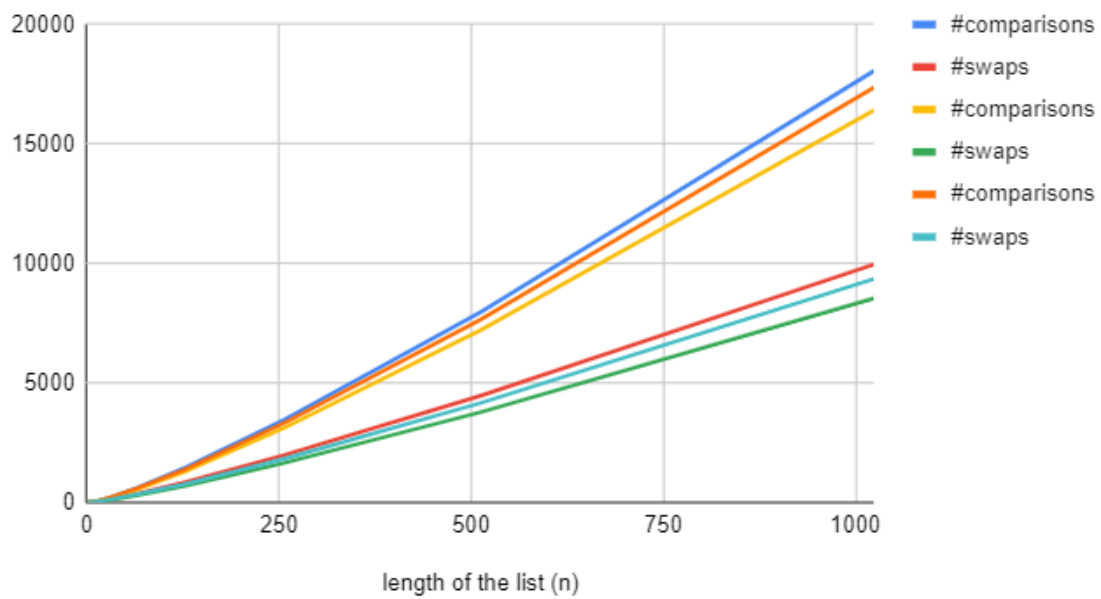


The graphs obtained from bubble\_sort and selection\_sort closely resemble a parabolic curve, which indicates that they are  $O(n^2)$ .

Number of Operations by the list length n for merge sort



Number of Operations by the list length n for heap sort



The merge\_sort and heapsort graphs indicate a curve near  $n = 0$  which gradually becomes more straight as  $n$  becomes very large, which indicates that they are  $O(n \log n)$ .