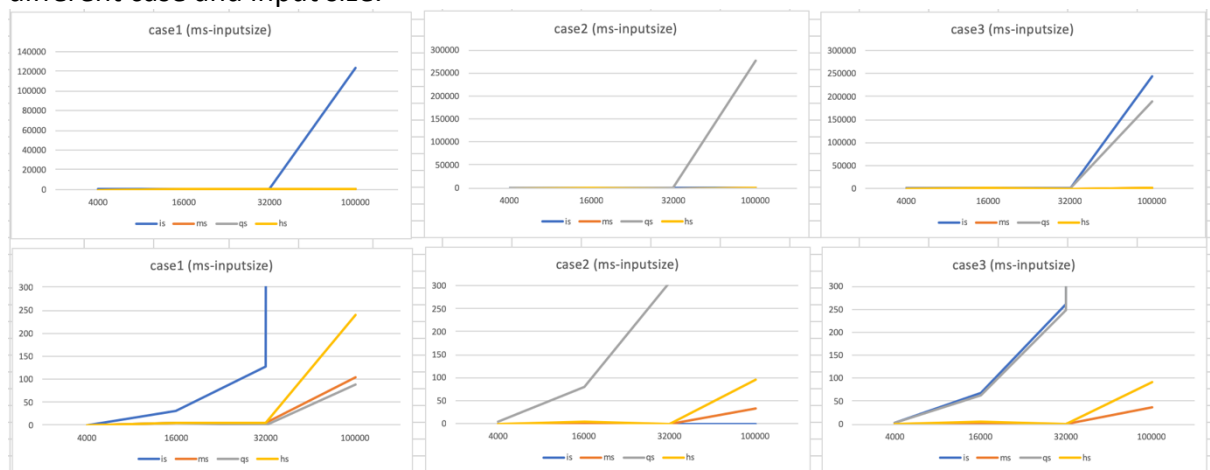


## R07921001 李尚倫 PA#1 Sorting Report

### 1. Comparison table of selection sort, merge sort, quick sort, and heap sort

Input size	IS		MS		QS		HS	
	CPU time(ms)	Memory(KB)	CPU time(ms)	Memory(KB)	CPU time(ms)	Memory(KB)	CPU time(ms)	Memory(KB)
4000.case2	0	13360	0	13360	4	13360	0	13360
4000.case3	4	13360	0	13360	4	13360	0	13360
4000.case1	0	13360	0	13360	0	13360	0	13360
16000.case2	0	13428	0	13428	80	13428	4	13428
16000.case3	68	13428	0	13428	64	13680	4	13428
16000.case1	32	13428	4	13428	4	13428	4	13428
32000.case2	0	13428	0	13432	308	13428	0	13428
32000.case3	260	13428	0	13436	248	14048	0	13428
32000.case1	128	13428	4	13436	0	13428	4	13428
1000000.case2	0	19452	32	21188	275744	19452	96	19352
1000000.case3	244412	19452	36	21188	190212	31308	92	19452
1000000.case1	123392	19452	104	21184	88	19452	240	19452

### 2. Comparison chart of selection sort, merge sort, quick sort, and heap sort CPU time(ms) on different case and input size.



Case1 represents test case in random order, case2 is test case in increasing order, and case3 is test case in reverse order.

For the best case, all the numbers are sorted in increasing order which is case2. 在best case方面，理論上根據下表insertion sort有最好的計算複雜度， $O(n)$ 是線性的，其他三種則都是 $O(n\log n)$ ，而在實際實作後由上圖可知，除了insertion sort較不符合預期的結果外，其餘都和理論相符。推測可能是insertion sort在實作partition時的方法有多種，我所使用的hoare partition並不能達到預期的效果。

For the worst case, all numbers are sorted in descending order which is case3. 在worst case方面，理論上根據下表insertion sort和quick sort的計算複雜度都不太好，是 $O(n^2)$ ，其他兩者都是 $O(n\log n)$ ，而在實際實作後由上圖可知，結果與理論相符。

For the average case, numbers are in random order which is case1. . 在average case方面，理論上根據下表insertion sort的計算複雜度不太好，是 $O(n^2)$ ，其餘都是 $O(n \log n)$ ，而在實際實作後由上圖可知，結果與理論相符。

Algorithm	Runtime			Properties	
	Best case	Average case	Worst case	Stable?	In-place?
Insertion	$O(n)$	$O(n^2)$	$O(n^2)$	Yes	Yes
Merge	$O(n \lg n)$	$O(n \lg n)$	$O(n \lg n)$	Yes	No
Heap	$O(n \lg n)$	$O(n \lg n)$	$O(n \lg n)$	No	Yes
Quicksort	$O(n \lg n)$	$O(n \lg n)$	$O(n^2)$	No	Yes

3. More details of implementation on program and experiment can be found at README.md in my submitted tar file  
or <https://github.com/shannon112/AlgorithMew/blob/master/PA1/README.md>