


Algorithmics	Student information	Date	Number of session
	UO: 299874	24/02/2025	4
	Surname: Puebla	 Escuela de Ingeniería Informática Universidad de Oviedo	
	Name: Álvaro		



## Activity 1. Bubble algorithm

n (10000)	t ordered	t reversed	t random
1	319	1512	1072
2	1271	5962	4252
4	5064	23892	17041
8	20172	96432	67629
16	80878	OoT	OoT

t ordered follows a quadratic  $O(n^2)$  time as each time you double the n, the time increases in  $2^2$

t reversed follows also a quadratic  $O(n^2)$  time

t random follows also a quadratic time

The 3 follows a quadratic time as the bubble algorithm is  $O(n^2)$  for sorted, unsorted, average,...

## Activity 2. Selection algorithm

n (10000)	t ordered	t reversed	t random
1	319	283	310
2	1249	1124	1215
4	4995	4486	4816
8	19915	17867	19242
16	78723	71469	77405

t ordered follows a quadratic  $O(n^2)$  time

t reversed follows also a quadratic  $O(n^2)$  time

t random follows also a quadratic time

The 3 follows a quadratic time as the selection algorithm is  $O(n^2)$  as the bubble, for sorted, unsorted, average,...

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## Activity 3. Insertion algorithm

n (10000)	t ordered	t reversed	t random
1	LoR	295	153
2	LoR	1161	580
4	LoR	4625	2341
8	LoR	18550	9300
16	LoR	75583	37311
32	LoR	OoT	OoT
64	LoR	OoT	OoT
128	LoR	OoT	OoT
256	LoR	OoT	OoT
512	91	OoT	OoT
1024	182	OoT	OoT
1024	361	OoT	OoT
2048	723	OoT	OoT
4096	1442	OoT	OoT
8192	2872	OoT	OoT

t ordered is so fast as this algorithm checks if it is sorted in each iteration so if it is sorted in x iterations it stops

t reversed and t random are as normal with this algorithm  $O(n^2)$

## Activity 4. Quicksort algorithm

n (250000)	t ordered	t reversed	t random
1	LoR	94	95
2	61	189	189
4	125	402	403

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8	256	867	867
16	534	1886	1872
32	1088	4218	4226
64	2245	10276	10276

t ordered is faster than the quicksort as it does not do that much comparisons so it is  $O(n \log n)$ , the rest as we chose a good pivot are also  $O(n \log n)$  for reversed and random.

Time for  $O(n^2)$  algorithms:

$$N_2 = k * N_1 \rightarrow k = N_2 / N_1 \rightarrow (N_2^2 / N_1^2) = k^2$$

$$T_2 = k^2 * T_1$$

$$k = (160 * 10^5 / 8 * 10^5) = 20$$

86400000 milliseconds is a year

#### Bubble:

$$N = 8 * 10^5 \rightarrow t = 67629$$

$$N = 1.6 * 10^7 \rightarrow t = 20^2 * 67629 = 27051600$$

$$\text{In days} = 0.31309722222$$

#### Selection:

$$N = 8 * 10^5 \rightarrow t = 19242$$

$$N = 1.6 * 10^7 \rightarrow t = 20^2 * 19242 = 7696800$$

$$\text{In days} = 0.08908333333$$

#### Insertion:

$$N = 8 * 10^5 \rightarrow t = 9300$$

$$N = 1.6 * 10^7 \rightarrow t = 20^2 * 9300 = 3720000$$

$$\text{In days} = 0.04305555555$$

## Activity 5. Quicksort + Insertion algorithm

n ( $16 * 10^6$ )	t random
Quicksort	11018

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Quicksort+Insertion (k=5)	10770
Quicksort+Insertion (k=10)	10596
Quicksort+Insertion (k=20)	10411
Quicksort+Insertion (k=30)	10167
Quicksort+Insertion (k=50)	9677
Quicksort+Insertion (k=100)	8197
Quicksort+Insertion (k=200)	5338
Quicksort+Insertion (k=500)	4613
Quicksort+Insertion (k=1000)	4378

The thing is that for really large values quicksort is the best algorithm, and for low values the insertion algorithm gets faster and faster, so until a limit (I don't know it), the combination of both algorithms will be faster than only the quicksort algorithm alone