



CS 5012: Foundations of Computer Science

Time Complexity Test for Bubble Sort

Application of big 'O' notation to predict the Execution Time

1	2	3	4	5	6	7
n	n^2	Actual Execution Time	Time predicted by $O(n^2)$	Error (%)	Time in minutes	
					Actual	Predicted
100000	10000000000	23563			0.1	
200000	40000000000	93907	94252	-0.366	1.6	1.6
300000	90000000000	211672	212067	-0.186	3.5	3.5
400000	160000000000	376328	377008	-0.180	6.3	6.3
500000	250000000000	587938	589075	-0.193	9.8	9.8
1 Million	What is the estimated time here ----->					?
2 Million	What is the estimated time here ----->					?
1 Billion	Estimated execution time in YEARS ----->					75

Column 3: Actual execution time was recorded capturing system time, in milliseconds, at the beginning and end of the sorting loops

Column 4: Calculated by this formula: $23563 * n^2$ of the current cell / base n^2

Column 5: $100 * (\text{Col 3} - \text{Col 4}) / \text{Col 4}$ (time difference as percentage of predicted time) Actual execution was slightly faster than the predicted time at all levels. Closeness of the actual and predicted time validates the accuracy of $O(n^2)$

Predicted Time Calculation Example:

For second row ($n = 200k$), the predicted time is calculated as follows:

$$94252 = 23563 * 40000000000 / 10000000000$$

Conceptually, this is how we predict the execution time for 1 Billion data

items: A) Find total milliseconds: $23563 * (1 \text{ billion})^2 / (100000)^2$

B) Convert the above milliseconds to years as follows:

C) Answer from A above / 1000 / 60 / 60 / 24 / 365 gives years