

Running time \propto Input Size

Input size \rightarrow Sorting (Length of the input array)

\rightarrow Multiplication (memory / bits to represent the input)

\rightarrow Graph (# vertices / # edges)

Running time \rightarrow total time taken to execute all the steps

Step \rightarrow Each and every line of pseudocode, $A = \text{Input Array}(n)$

for $j=2$ to $A.\text{length}$

key = $A[j]$

$i = j-1$

while $i > 0$ and $A[i] > \text{key}$

$A[i+1] = A[i]$

$i = i-1$

$A[i+1] = \text{key}$

(n)

C_1

$(n-1)$

C_2

$(n-1)$

C_3

$\sum_{j=2}^n t_j$

C_4

$\sum_{j=2}^n (t_j-1)$

C_5

$\sum_{j=2}^n (t_j-1)$

C_6

$(n-1)$

C_7

$t_j = \#$ of time the

while loop cond

execute for each j

$C_i =$ time taken

to run this line

$$T(n) = C_1 n + C_2 (n-1) + C_3 (n-1) + C_4 \sum_{j=2}^n t_j + C_5 \sum_{j=2}^n (t_j-1) + C_6 \sum_{j=2}^n (t_j-1) + C_7 (n-1)$$

1. Best case \rightarrow Input array will be sorted $t_j = 1$

2. Worst case \rightarrow Input array will be reverse sorted $t_j = j$

$$T_{\text{best}}(n) = C_1 n + C_2 (n-1) + C_3 (n-1) + C_4 (n-1) + C_5 \cdot 0 + C_6 \cdot 0 + C_7 (n-1)$$

$$C_7 (n-1) = \boxed{an+b}$$

$$T_{\text{worst}}(n) = C_1 n + C_2 (n-1) + C_3 (n-1) + C_4 \left(\frac{n(n+1)}{2} - 1 \right) + C_5 \frac{n(n-1)}{2} + C_6 \frac{n(n-1)}{2} + C_7 (n-1)$$

$$= \boxed{an^2 + bn + c}$$

$$\boxed{\Theta(n)} = n^2 \quad (\text{order of growth})$$