Worst-Case Time Complexity of InsertSort

Step 1. Write a formula

$$T_w(n) = T_w(n-1) + O(n)$$

(T_w: worst; n: size of input)

Step 2.

Guess $T_w(n) = O(n^2)$

Need to find $C > 0$ s.t. $\forall_n T_w(n) \leq C \cdot n^2$

Step 3.

Check.

$$T_w(n) = T_w(n-1) + a \cdot n \quad (a: \text{constant})$$
$$\leq C(n-1)^2 + a \cdot n$$
$$\leq C \cdot n^2 \quad \text{by taking } C \ll a \ (\ll: \text{much greater than})$$

Average-Case Time Complexity of InsertSort

Step 1. Write a formula

$$T_{AVG}(n) = T_{AVG}(n-1) + O(n)$$

Steps 2 & 3: Same as Worst-Case.