CUSTO

```
1  INSERTION SORT (A)
2    for j = 2 TO A.comprimento DO                 c2 · n
3      chave = A[j]                                c3 · (n-1)
4      i = j - 1                                   c4 · (n-1)
5      while i > 0 && A[i] > chave                 c5 Σ_{j=2}^{n} t_j
6        A[i+1] = A[i]                             c6 Σ_{j=2}^{n} (t_j - 1)
7        i = i - 1                                 c7 Σ_{j=2}^{n} (t_j - 1)
8      END while
9      A[i+1] = chave                              c9 (n-1)
10   END FOR
11 END
```

t_j é o numero de vezes que a linha 5 vai executar quando p/ dado valor de j ($j \in \{2 \ldots n\}$)

$V = 1\ 2\ 3$ (i, j)

	1	2	3	4	5	6
$V=$	2	4	6	7	3	0
				i	j	

t_4

chave = 6

$$T(n) = C_2 n + C_3(n-1) + C_4(n-1) + C_5 \sum_{j=2}^{n} t_j + C_6 \sum_{j=2}^{n} (t_j - 1) + C_7 \sum_{j=2}^{n} (t_j - 1) + C_9(n-1)$$

Pior caso: o while da linha 5 copia todos os $j-1$ elementos uma posição para frente e, por consequência, a chave é inserida na posição 1. Portanto, qdo $j=2$, a linha 5 executa 2 vezes, qdo $j=3$, a linha 5 executa 3 vezes, e assim por diante. Dessa forma, $t_j = j,\ \forall j$.

$$\sum_{j=2}^{n} j = 2+3+4+5+\dots+n = \frac{n(n+1)}{2} - 1$$

$$\sum_{j=2}^{n} (j-1) = (2-1)+(3-1)+(4-1)+\dots+(n-1) = 1+2+3+\dots+n-1 = \frac{n(n-1)}{2}$$

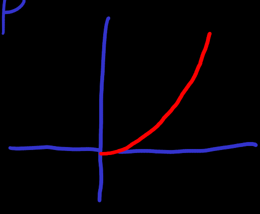
$$T(n) = C_2 n + C_3(n-1) + C_4(n-1) + C_5 \sum_{j=2}^{n} j + C_6 \sum_{j=2}^{n} (j-1) + C_7 \sum_{j=2}^{n} (j-1) + C_9(n-1)$$

$$T(n) = C_2 n + C_3(n-1) + C_4(n-1) + C_5\left(\frac{n(n+1)}{2} - 1\right) + C_6\left(\frac{n(n-1)}{2}\right) + C_7\left(\frac{n(n-1)}{2}\right) + C_9(n-1)$$

$$T(n) = \underbrace{\left(\frac{C_5}{2} + \frac{C_6}{2} + \frac{C_7}{2}\right)}_{\alpha} n^2 + \underbrace{\left(C_2 + C_3 + C_4 + \frac{C_5}{2} - \frac{C_6}{2} - \frac{C_7}{2} + C_9\right)}_{\beta} n - \underbrace{\left(C_3 + C_4 + C_5 + C_9\right)}_{\gamma}$$

$$= \alpha n^2 + \beta n + \gamma$$

$$= \Theta(n^2)$$



$FIM - INI + 1$

$n = 5$ $\quad 3 \,..\, 5$

INI FIM

$3, 4, 5$

INI FIN

$2 \,..\, 5$

$\boxed{2 \quad 3 \quad 4 \quad 5}$

$n - 2 + 1$

$n - 1$

$$V = \begin{array}{ccc|cccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 5 & 6 & 7 & 4 & 3 & 2 & 1 \\ & & i & j & & & \end{array}$$

chave $= 5$

$t_2 = 2$

$t_3 = 3$

$\vdots$

$t_j = j$

$$C_5 \boxed{\sum_{j=2}^{n} t_j}$$

$$C_5(\underbrace{t_2 + t_3 + t_4 + \dots + t_n}_{})$$