2. (25%)

(a)

$j \leftarrow 1$ ▷ 1 time
while $j < n$ **do** ▷ n-1 times
  S_1 ▷ n-2 times
  $k \leftarrow n$ ▷ n-2 times
  while $k > j$ **do** ▷ n-j times
    S_2 ▷ n-j-1 times
    $k--$ ▷ n-j-1 times
  $j++$ ▷ n-2 times

The Sum of these statments can be repesented by $S(n)$:

$$
\begin{aligned}
S(n) &= C_0 + \sum_{i=1}^{n-1}(C_1 + S_1 + \sum_{j=i}^{n-1}(S_2 + C_2)) \\
&= C_0 + \sum_{i=1}^{n-1}(C_1 + S_1 + (n-1-i)(S_2 + C_2)) \\
&= C_0 + (n-2)(C_1 + S_1) + (S_2 + C_2)\sum_{i=1}^{n-1}(n-1-i) \\
&= C_0 + (n-2)(C_1 + S_1) + (S_2 + C_2)\Big(n(n-2) - (n-2) - \frac{n(n-1)}{2}\Big) \\
&= C_0 + (n-2)(C_1 + S_1) + (S_2 + C_2)\Big(\frac{n^2}{2} - \frac{5n}{2} + 2\Big) \\
&= C_0 + (n-2)C_1' + C_2'\Big(\frac{n^2}{2} - \frac{5n}{2} + 2\Big)
\end{aligned}
$$

(b)

$j \leftarrow 0$ ▷ 1 time
while $j \leq n$ **do** ▷ n+1 times
  $k \leftarrow 0$ ▷ n times
  while $k \leq j$ **do** ▷ j+1 times
    S_1 ▷ j times
    $k++$ ▷ j times
  $j++$ ▷ n times

Summing these statements:

$$
\begin{aligned}
S(n) &= 1 + (n+1) + 2n + \sum_{j=0}^{n}(2j + j + 1) \\
&= 3n + 2 + (n+1) + 3\sum_{j=0}^{n} j \\
&= 4n + 3 + \frac{3n(n+1)}{2} \\
&= 4n + 3 + \frac{3}{2}(n^2 + n) \\
&= \frac{11n}{2} + \frac{3n^2}{2} + 3
\end{aligned}
$$