

Complexity for Bubble Sort:

```

void bubble (int a[], int n) {
    int pass, j, flag;
    for (pass = 1; pass < n; pass++) {
        flag = 0;
        for (j = 0; j < (n - pass); j++) {
            if (a[j] > a[j+1]) {
                SWAP (a[j+1], a[j]);
            }
            if (flag == 0) break;
        }
    }
}

```

Annotations for complexity analysis:

- Line 1: 0
- Line 2: 0
- Line 3: $1 + n + (n-1)$
- Line 4: $(n-1)$
- Line 5: $1 \times (n-1)(2) + (y)$
- Line 6: $4y$
- Line 7: $8y$
- Line 8: $(n-1)$

$$x = n + n-1 + n-2 + n-3 + \dots + 2 + 1 = \frac{n(n-1)}{2} - 1$$

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

$$\begin{aligned}
 T(n) &= 2n + n-1 + n-1 + x + y + 4y + 8y + n-1 \\
 &= 5n - 3 + x + 13y \\
 &= 5n - 3 + \frac{n(n-1)}{2} - 1 + 13 \frac{n(n-1)}{2} \\
 &= 5n - 3 + 0.5n^2 + 0.5n - 1 + 6.5n^2 - 6.5n \\
 &= 7n^2 - n - 4
 \end{aligned}$$

$$T(n) \approx 7n^2, \quad n > 0 \quad c = 7 \quad g(n) = n^2$$

So, $T(n)$ is $O(n^2)$.