Bubble Sort

Algorithm

```
1  for i = 1 to n
2      for j = 1 to n-1
3          if v[j] > v[j-1]
4              swap (v[j], v[j-1])
```

(A) lines 2–4, (B) lines 1–4

Analysis

(A) $\Rightarrow \sum_{j=i}^{n-1} c = \underbrace{c + c + \ldots + c}_{n-1-i+1} = c(n-i)$ $\quad i=1,\ n-1$

(B) $\Rightarrow \sum_{i=1}^{n} c(n-i) = c\sum_{i=1}^{n}(n-i) = c\overbrace{\left[(n-1)+(n-2)+\ldots+(1)\right]}^{n-1}$

$= c\left\{\left[(n-1)+1\right]\cdot\frac{(n-1)}{2}\right\} = c\left(\frac{n^2-n}{2}\right) \Rightarrow O(n^2)$

Time complexity

$O(n^2)$

$\Theta(n^2)$

$\Omega(n^2)$

Space complexity

$\Theta(1)$

Number of swaps

best case: 0

worst case: n^2

Average: n^2

Good for nothing

// There are implementations with $\Omega(n)$