Bubble Sort

Pseudocode and Flowchart

```
BubbleSort( int a[], int n)
Begin
    for i = 1 to n-1
        sorted = true
        for j = 0 to n-1-i
            if a[j] > a[j+1]
                temp = a[j]
                a[j] = a[j+1]
                a[j+1] = temp
                sorted = false
        end for
        if sorted
            break from i loop
    end for
End
```

Bubble sort uses a loop (inside j loop) to travel thru' an array comparing adjacent values as it moves along. If an array element a[j] is greater than the element immediately to its right a[j+1], it swaps them. The first time around, this process will move or bubble the largest value to the end of the array. So for instance

5	3	1	9	8	2	4	7

will end up as

3	1	5	8	2	4	7	**9**

This process is repeated, on the second iteration, the second largest value will be moved to the second last array position and so on.

In all, the bubble process (inside j loop) is repeated n-1 times for an array of size n.

Bubble Sort Example

i = 1	j	0	1	2	3	4	5	6	7
	0	5	3	1	9	8	2	4	7
	1	3	5	1	9	8	2	4	7
	2	3	1	5	9	8	2	4	7
	3	3	1	5	9	8	2	4	7
	4	3	1	5	8	9	2	4	7
	5	3	1	5	8	2	9	4	7
	6	3	1	5	8	2	4	9	7
i = 2	0	3	1	5	8	2	4	7	**9**
	1	1	3	5	8	2	4	7	
	2	1	3	5	8	2	4	7	
	3	1	3	5	8	2	4	7	
	4	1	3	5	2	8	4	7	
	5	1	3	5	2	4	8	7	
i = 3	0	1	3	5	2	4	7	**8**	
	1	1	3	5	2	4	7		
	2	1	3	5	2	4	7		
	3	1	3	2	5	4	7		
	4	1	3	2	4	5	7		
i = 4	0	1	3	2	4	5	**7**		
	1	1	3	2	4	5			
	2	1	2	3	4	5			
	3	1	2	3	4	5			
i = 5	0	1	2	3	4	**5**			
	1	1	2	3	4				
	2	1	2	3	4				
i = 6	0	1	2	3	**4**				
	1	1	2	3					
i = 7	0	1	2	**3**					
		1	**2**						

Note for array of size 8, outside i loop repeats 7 times.

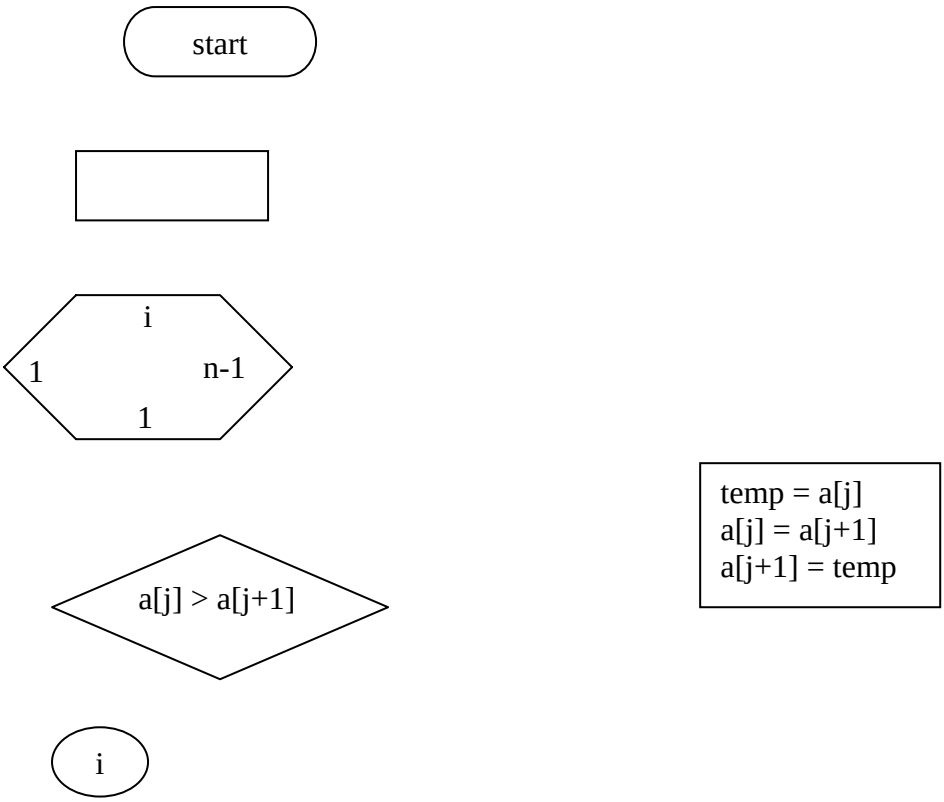
Complexity

Clearly for an array of size n, the outside loop repeats n-1 times.

To begin with the inside loop does n-1 comparisons, next time n-2 and so on. Finally on the last iteration of the outside loop, the inside loop does 1 comparison. So on average the inside loop does $((n-1) + 1) / 2 \approx n/2$ comparisons.

Therefore, the overall number of computation steps is $n * n/2 = n^2/2$

Complexity of bubble sort $= O(n^2)$


start
i
1
n-1
1
temp = a[j]
a[j] = a[j+1]
a[j+1] = temp
a[j] > a[j+1]
i
T