Bubble Sort

Sorting Arrays

- Assume that the items under consideration satisfy the following conditions for any values a, b, c:
  - Exactly one of the possibilities $a < b$, $a = b$, $a > b$ is true (law of trichotomy)
  - If $a < b$ and $b < c$, then $a < c$ (law of transitivity)

- Let’s start by thinking small. Remember lab 2? To sort 3 variables we compared them in a pairwise fashion, if they are out of order, we swapped them.

```
if(A[j]>A[j+1])
        t= A[j]
        A[j] = A[j+1]
        A[j+1] = t
EndIf
```

Loop the pairwise

```
J = 0
While j <N-1
        if(A[j]>A[j+1])
                t= A[j]
                A[j] = A[j+1]
                A[j+1] = t
        EndIf
        j = j+1
EndWhile
```

Version 1 – looping the loop of pairwise comarpisons

```
Program BubbleSort1
        Read A
        N = A.length
        i=0
        While i<N-1
                j=0
                While j <N-1
                        if(A[j]>A[j+1])
                                t= A[j]
                                A[j] = A[j+1]
                                A[j+1] = t
                        EndIf
                        j = j+1
                EndWhile
                i=i+1
        EndWhile
END
```

Original Array	**8**	**9**	**7**	**2**	**6**	**5**	**3**	**4**	**1**
Iteration 1	**8**	**7**	**2**	**6**	**5**	**3**	**4**	**1**	**9**
Iteration 2	**7**	**2**	**6**	**5**	**3**	**4**	**1**	**8**	**9**
Iteration 3	**2**	**6**	**5**	**3**	**4**	**1**	**7**	**8**	**9**
Iteration 4	**2**	**5**	**3**	**4**	**1**	**6**	**7**	**8**	**9**
Iteration 5	**2**	**3**	**4**	**1**	**5**	**6**	**7**	**8**	**9**
Iteration 6	**2**	**3**	**1**	**4**	**5**	**6**	**7**	**8**	**9**
Iteration 7	**2**	**1**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Iteration 8	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Bubble Sort Analysis

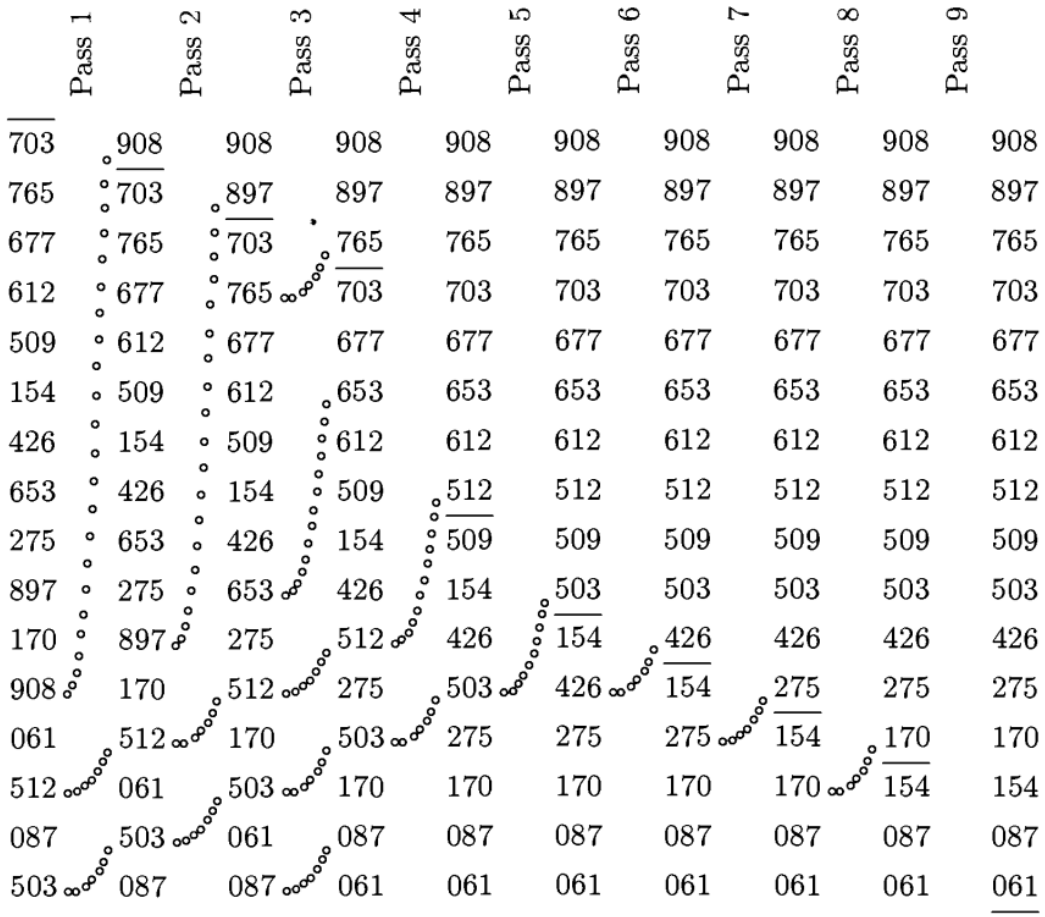
- Larger elements tend to move towards the end of the array
- Repetition of the process will place the appropriate elements into position N-1, N-2, N-3 etc. so that ultimately all elements will be sorted.

Version2

```
Program BubbleSort1
        Read A
        N = A.length
        i=0

        While i<N-1
                j=0
                While j <N-1-i
                        if(A[j]>A[j+1])
                                t= A[j]
                                A[j] = A[j+1]
                                A[j+1] = t
                        EndIf
                        j = j+1
                EndWhile
                i=i+1
        EndWhile
END
```

Bubblesort in Action



- In the unsorted part of the array, the largest element that is not in its final position moves to its final sorted position.
- After each pass all elements above and including the last element to be exchanged must be in their final position. No need for them to be examined on further passes.
- Notice in the above example that after pass 4 five more elements are known to be in their final position.

Pseudocode for Bubble Sort

```
Program BubbleSort
        Read A
        N = A.length
        Bound = N-1
        s=1
        While s>0
                s=0
                j=0
                While j <Bound
                        If(A[j]>A[j+1])
                                t= A[j]
                                A[j] = A[j+1]
                                A[j+1] = t
                                s=j
                        EndIf
                        j=j+1
                EndWhile
                Bound = s
        EndWhile
EndProgram
```

With for loops:

```
For: j = 0; j <N-1; j=j+1
        if(A[j]>A[j+1])
                t= A[j]
                A[j] = A[j+1]
                A[j+1] = t
        EndIf
EndFor
```

Version 1 – looping the loop of pairwise comarpisons

```
Program BubbleSort1
        Read A
        N = A.length

        For i=0; i<N-1; i= i+1

                For j = 0; j <N-1; j = j+1
                        if(A[j]>A[j+1])
                                t= A[j]
                                A[j] = A[j+1]
                                A[j+1] = t
                        EndIf
                EndFor
                i=i+1
        EndFor
END
```

Version2

```
Program BubbleSort1
        Read A
        N = A.length
        i=0
        Bound = N-1
        For i= 0; i<Bound; i = i+1
                For j=0; j <Bound; j = j+1
                        if(A[j]>A[j+1])
                                t= A[j]
                                A[j] = A[j+1]
                                A[j+1] = t
                        EndIf
                EndFor
                Bound = Bound-1
        EndFor
END
```

Pseudocode for Bubble Sort

```
Program BubbleSort
        Read A
        N = A.length
        Bound = N-1
        s=1
        While s>0
                s=0
                For j = 0; j <Bound j = j+1
                        If(A[j]>A[j+1])
                                t= A[j]
                                A[j] = A[j+1]
                                A[j+1] = t
                                s=j
                        EndIf
                EndFor
                Bound = s
        EndWhile
EndProgram
```