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

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765		703	0	897		897		897		897		897		897		897		897
677	0	765	0	703	۰	765		765		765		765		765		765		765
612		677	0	765	~ _%	703		703		703		703		703		703		703
509	0	612	0	677		677		677		677		677		677		677		677
154	0	509	0	612	۰	653		653		653		653		653		653		653
426	0	154	0	509	0	612		612		612		612		612		612		612
653	0	426	0	154	0	509		512		512		512		512		512		512
275	0	653	0	426	0	154	0	_		509		509		509		509		509
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- 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:

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[i+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
```