

C-14 Solutions

1. *Package Design*

Data Structures

- An array of nine integers

Subprograms

- Function to accept 9 integers
- Procedure to display the array in row major order
- Procedure to display the array in column major order
- Procedure to sort the array using the bubble sort algorithm

Algorithms

Accept_Numbers:

```
For I in 1 .. 9
    Accept an integer
    Store it in an array
```

Row_Major_Display:

```
For I in 1 .. 9
    Display Element in Array(I);
    If I mod 3 = 0 then
        New_Line
```

Given the elements are in row-major order, the position locations are sequential.

Column_Major_Display:

```
For I in 1 .. 3
    For J in 1 .. 3
        Location_In_Array := I + (J-1)*3
        Display Element in Array(Location_In_Array)
    New_Line
```

If the elements are in column-major order, the locations in the one-dimensional array have to be computed.

Bubble_Sort:

```
For I in 1 .. Array'Value(1)-1
    For J in I+1 .. Array'Value(1)
        If Array(I) > Array(J)
            Swap the values
```

Note that the algorithm will sort the array in ascending order.

2. Code Listing

Package Listing

Package Specification

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Checking: c:/docume~2/joeb/desktop/16070/codeso~1/my_array_package.ads (source file time stamp: 2003-10-08 13:48:58)

```
1. -----
2. -- Package specification of a package to
3. -- 1. Create an array of 9 integers
4. -- 2. Display the array as a 3x3 matrix
5. --   i. assuming row-major order
6. --   ii. assuming column-major order
7. -- 3. Bubble Sort the 1-D array
8. --
9. -- Specifier : Joe B
10. -- Date Last Modified : 10/07/03
11. -----
12.
13. package My_Array_Package is
14.
15.   type My_Array is array (1 .. 9) of Integer;
16.
17.
18.   function Create_Array return My_Array;
19.
20.   procedure Display_Row_Major(Input_Array : in My_Array);
21.
22.
23.   procedure Display_Column_Major(Input_Array : in My_Array);
24.
25.
26.   procedure Bubble_Sort (Input_Array : in out My_Array);
27. end My_Array_Package;
28.
29.
```

29 lines: No errors

Package Body

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Compiling: c:/docume~2/joeb/desktop/16070/codeso~1/my_array_package.adb (source file time stamp: 2003-10-08 13:54:40)

```
1. -----
2. -- Package implementation of My_Array_Package
3. -- Programmer : Joe B
```

```

4. -- Date Last Modified : 10/07/03
5. -----
6.
7. with Ada.Text_Io;
8. with Ada.Integer_Text_Io;
9.
10. package body My_Array_Package is
11.
12.
13. function Create_Array return My_Array is
14.   Output_Array : My_Array;
15. begin
16.   for I in 1 .. 9 loop
17.     Ada.Text_Io.Put("Please Enter a number : ");
18.     Ada.Integer_Text_Io.Get(Output_Array(I));
19.     Ada.Text_Io.New_Line;
20.   end loop;
21.   return Output_Array;
22. end Create_Array;
23.
24.
25. procedure Display_Row_Major (
26.   Input_Array : in My_Array ) is
27. begin
28.   for I in 1 .. 9 loop
29.     Ada.Text_Io.Put(Integer'Image(Input_Array(I)));
30.     Ada.Text_Io.Put(" ");
31.     if I mod 3 = 0 then
32.       Ada.Text_Io.New_Line;
33.     end if;
34.   end loop;
35. end Display_Row_Major;
36.
37.
38.
39. procedure Display_Column_Major (
40.   Input_Array : in My_Array ) is
41.   Index : Integer;
42. begin
43.   for I in 1 .. 3 loop
44.     for J in 1.. 3 loop
45.       Index := I + (J-1)*3;
46.       Ada.Text_Io.Put(Integer'Image(Input_Array(Index)));
47.       Ada.Text_Io.Put(" ");
48.     end loop;
49.     Ada.Text_Io.New_Line;
50.   end loop;
51. end Display_Column_Major;
52.
53.
54.
55. procedure Bubble_Sort (
56.   Input_Array : in out My_Array ) is
57.   Temp : Integer;
58. begin
59.   for I in 1 .. 8 loop
60.     for J in I+1 .. 9 loop
61.       if Input_Array(I) > Input_Array(J) then

```

```

62.     Temp := Input_Array(I);
63.     Input_Array(I) := Input_Array(J);
64.     Input_Array(J) := Temp;
65.     end if;
66.     end loop;
67. end loop;
68. end Bubble_Sort;
69.
70. end My_Array_Package;
71.
72.

```

72 lines: No errors

Test Program Listing

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Compiling: c:/docume~2/joeb/desktop/16070/codeso~1/test_my_array.adb (source file time stamp: 2003-10-08 14:03:20)

```

1. -----
2. -- Program to test My_Array_Package
3. -- Programmer : Joe B
4. -- Date Last Modified : 10/07/2003
5. -----
6.
7. with My_Array_Package;
8. use My_Array_Package;
9. with Ada.Text_IO;
10.
11. procedure Test_My_Array is
12.   New_Array : My_Array_Package.My_Array;
13. begin
14.   New_Array := Create_Array;
15.
16.   Ada.Text_IO.Put_Line("Displaying unsorted array in Row-Major order");
17.   Display_Row_Major(New_Array);
18.
19.   Ada.Text_IO.Put_Line("Displaying unsorted array in Column-Major order");
20.   Display_Column_Major(New_Array);
21.
22.   Bubble_Sort(New_Array);
23.
24.   Ada.Text_IO.Put_Line("Displaying sorted array in Row-Major order");
25.   Display_Row_Major(New_Array);
26.
27.   Ada.Text_IO.Put_Line("Displaying sorted array in Column-Major order");
28.   Display_Column_Major(New_Array);
29. end Test_My_Array;

```

29 lines: No errors