



Course Title: Data Structure and algorithms  
Date: May 31, 201 (Second term)

Course Code: CSE 153  
Allowed time: 2 hrs

Year: level 100  
No. of Pages: (4)

Remark: Assume any Missing Data.

**Q1-A)** {2 points } What is data structure?

**Q1-B)** {2 points } List out the areas in which data structures are applied extensively?

**Q1-C)** {3 points } Consider A is an array of order  $m \times n$  stored in a Row Major order. If the address of the first element in the array is K which is there at  $A[0, 0]$ , then What is the address of  $A[i, j]$ ?

**Q1-D)** {4 points } There are two sorted lists L1 and L2. Their lengths are  $n_1$  and  $n_2$  respectively. You are asked to design an algorithm to generate a sorted list L3 from L1 and L2. That is, for example, if  $L1=[1,5,30]$  and  $L2=[3,6,12,24,43]$  then  $L3=[1,3,5,6,12,24,30,43]$ . Which of the following methods is the most efficient?

**Q1-E)** {4 points } Assume that variable A is a sorted array of integers of length L. Consider the following code segment. Determine when variable flag is 1 after this code segment executes?

```
int k=1, flag=0;
for ( ; k<L; k++)
{ if (A[k-1] == A[k] ) flag = 1; }
```

**Q1-F)** {3 points } Which boolean expression indicates whether the number in two nodes (p and q) are the same? Assume that neither p nor q is null.

**Q2-A)** {4 points } Sequential search has a time complexity of  $O(n)$ , and binary search has a time complexity of  $O(\log(n))$ . What difference will it make when the size n is 1000?

**Q2-B)** {2 points } Find the output of the following code

```
static void Main()
{
    Queue<string> queue = new Queue<string>();
    queue.Enqueue("Message One ");
    queue.Enqueue("Message Two");
    queue.Enqueue("Message Three");
    queue.Enqueue("Message Four");
    while (queue.Count > 0)
    {
        string message = queue.Dequeue();
        Console.WriteLine(message);
    }
}
```

**Q2-C)** {2 points } State the function of the following code

```
bool isSymmetric = true;
for (int i=0; i<(array.Length+1)/2; i++)
{
    if (array[i] != array[n-i-1])
    {
        isSymmetric = false;
    }
}
```

**Q2-D)** {2 points } A stack of integers a Stack has the following private data: Items: 800 47 10 -34 323 067 823 -789 99; What is the output of the following code? Top = 800

```
int x;
while (!aStack.isEmpty()){
    aStack.pop(x);
    Console.WriteLine( x, " "); }
```

**Q3-A)** {4 points } Write a C# program that accept a 5 elements within a linked list (A,B,C,D,E), then displayed the number of elements and Display the linked list contents

**Q3-B) (6 points) If there is no error, What do the following program segments display**

|   |  |
|---|--|
| <pre>int I, j=0, sum = 0; int[] ar1 = { 2, 6, 9, 5, 6 }; for (i = 0; i &lt; ar1.Length; i=i+3) {     sum = sum + ar1[i];     j = j + j * i;     Console.WriteLine(sum + " " + j + " "); } Console.WriteLine(i);</pre> | <pre>string str = "Another-way-to-kill-a- mockingbird"; int i; string[] sec = new string[33]; for (i = 0; i &lt; str.Length/4; i++)     { sec[i] = str.Substring(i, i % 2 + 1); } for (i = 0; i &lt; str.Length; i++) {     Console.Write(sec[i]); }</pre> |
| <pre>int [] a = new int[3]; a[0] = 5; a[1] = 10; a[2] = 150; Console.WriteLine("{0} {1} {2}", a[0], a[1], a[2]); a[0] += 5; a[1] = 20; a[2] = a[0] + a[1]; Console.WriteLine("{0} {1} {2}", a[0], a[1], [2]);</pre>   | <pre>int [] prices = new int [] {10, 29, 35, 67, 42}; int v = 0; foreach(int p in prices)     if(p &gt; v)         v = p; Console.WriteLine(v);</pre>  |

**Q3-C) (3 points) Given an array scores of doubles, write a C# program that compute the sum of all elements in the array; store the result in variable total. Write one program using while loop; Write another program using for loop**

**Q3-D) (3 points) A stack of integers a Stack has the following private data: Items: 800 47 10 - 34 323 067 823 -789 99; What is the output of the following code? Top = 800**

```
int x;
while (!aStack.isEmpty()){
    aStack.pop(x);
    Console.WriteLine(x, " ");}
```

**Q3-D) (3 points) Write a C# program that accepts a 5 elements within a linked list (A,B,C,D,E), then displays the number of elements and Display the linked list contents**

**Q3-E) (9 points) Select the suitable answer | right selection 0.5 wrong selection -1) Use the attached sheet in the answer**

- (1) How many nodes does a complete binary tree of level 5 have?
  - (a) 16
  - (b) 15
  - (c) 32
  - (d) 31
  - (e) 64.
- (2) The suitable data structure to represent the IDs of employees is
  - (a) Stack
  - (b) Queue
  - (c) Linked List
  - (d) Array
  - (e) Tree.

D - Reason : As the type of all Id for all the employees is same then a simple array is enough to store the values.

(3) Which of following algorithm scans the list by swapping the entries whenever pair of adjacent keys are out of desired order?

- (a) Insertion sort
- (b) Quick sort
- (c) Shell sort
- (d) Bubble sort
- (e) Radix sort.

- (4) Which of the following shows the difference between a queue and a stack?
- (a) Queues require linked lists, but stacks do not
  - (b) Stacks require linked lists, but queues do not
  - (c) Queue is used for complex programs and stack for simple programs
  - (d) Queues use two ends of the structure; stacks use only one
  - (e) Stacks use two ends of the structure, queues use only one

(5) This sort finds location 'pos' of smallest elements in  $a(1), \dots, a(n)$  and then interchange  $a(pos)$  with  $a(i)$  for  $i = 1, \dots, n - 1$ .

- (a) Selection sort
- (b) Quick sort
- (c) Heap sort
- (d) Bubble sort
- (e) Insertion sort.

(6) The direct or random access of element is not possible in

- (a) Array
- (b) String
- (c) Linked List
- (d) Both (a) and (b) above
- (e) Both (b) and (c) above.

(7) If for a given 'Queue' initially  $f=0$  and  $r=-1$ , then  $f = r$  refers to

- (a) Queue is empty
- (b) Queue is full
- (c) Queue has two elements
- (d) Exactly one element is there
- (e) Not possible at all.

(8) In linked list, a node contains atleast

- (a) Node address field, data field
- (b) Node number, data field
- (c) Next address field, information field
- (d) Node number, information field
- (e) Node address field, information field.

(9) Null pointer is used to define

- I. End of linked list.
- II. Empty pointer field of a structure.
- III. The linked list is empty.

- (a) Only (I) above
- (b) Only (II) above
- (c) Only (III) above
- (d) Both (I) and (II) above
- (e) All (I), (II) and (III) above.

(10) Direct or random access of element is not possible in

- (a) Linked list   (b) Array   (c) String   (d) Queue   (e) Double linked list

(11) "Get a node, store new element and insert the new node at the top" refers to insert operation in non empty

- (a) Stack
- (b) Queue
- (c) Array
- (d) Linked list
- (e) Tree.

12) Standard queue operations are

- (a)  $empty()$ ,  $fill()$ ,  $place()$ ,  $remove()$
- (b)  $enqueue()$ ,  $dequeue()$ ,  $isempty()$ ,  $isfull()$
- (c)  $init()$ ,  $delete()$ ,  $add()$
- (d)  $isempty()$ ,  $isfull()$ ,  $fill()$ ,  $remove()$
- (e)  $isempty()$ ,  $isfull()$ ,  $init()$ ,  $delete()$ ,  $add()$ .

(13) A program is required to store and process information about the solar system. Which types of data structure would be most appropriate for storing the following respectively : (i) A list of the names of the planets, (ii) full details of a planet including distance from sun, diameter, atmospheric composition, etc, (iii) a predetermined list of scientific observations made of the planet.

- (a) (i) linked list   (ii) structure   (iii) linked list
- (b) (i) array   (ii) structure   (iii) linked list
- (c) (i) linked list   (ii) array   (iii) array
- (d) (i) linked list   (ii) linked list   (iii) linked list
- (e) (i) array   (ii) structure   (iii) array.

(14) One difference between a queue and a stack is:

- (a) Queues require linked lists, but stacks do not
- (b) Stacks require linked lists, but queues do not
- (c) Queue is used for complex programs and stack is used for simple programs
- (d) Stacks use two ends of the structure, queues use only one
- (e) Queues use two ends of the structure; stacks use only one.

(15) Consider searching for a given value in a large, sorted array. Under which of the following conditions is sequential search slower than binary search?

- (a) Always
- (b) Never
- (c) When the value being searched for is the first element in the array
- (d) When the value being searched for is the second element in the array

(16) When we say an algorithm has a time complexity of  $O(n)$ , what does it mean?

- (a) The algorithm has 'n' nested loops
- (b) The computation time taken by the algorithm is proportional to n
- (c) The algorithm is 'n' times slower than a standard algorithm
- (d) There are 'n' number of statements in the algorithm
- (e) The computation time taken by the algorithm is less than 'n' seconds.

(17) The suitable data structure to represent the data of rainfall of week days in ten cities of three states is \_\_\_\_\_

- (a) Stack
- (b) Queue
- (c) Array
- (d) Multi way tree
- (e) Connected graph.

(18) The value of first linked list address is ?

- (a) 0
- (b) -1
- (c) 1
- (e) None of Above

**Q4-A** {5 points } Sort the array [7, 2, 5, 3, 10, 4, 9, 8, 1, 6] with the iterative merge sort algorithm. Show all steps in determining your answer.

**Q4-B** {4 points } Sort the array [7, 2, 5, 3, 10, 4, 9, 8, 1, 6] with the quick sort algorithm using the median of three rule for pivot selection. Show all steps in determining your answer.

**Q4-C** {4 points } Apply the Merge sort algorithm for the following items - 56,29,35,42,15,41,75,21

**Q4-D** {5 points } Use *Bubble Sort algorithm* for a given string array shown below, then specify the number of (**Sweep, exchanges**) and the **final order**.

("ahmad Adel", "ahmad saad", "Reham Abdo", "basem Ali", Hesham Arafat")

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Best wishes

Prof. Dr Hesham Arafat

| <u>Q</u>  | <u>A</u> | <u>B</u> | <u>C</u> | <u>D</u> | <u>E</u> |
|-----------|----------|----------|----------|----------|----------|
| <u>1</u>  |          |          |          |          |          |
| <u>2</u>  |          |          |          |          |          |
| <u>3</u>  |          |          |          |          |          |
| <u>4</u>  |          |          |          |          |          |
| <u>5</u>  |          |          |          |          |          |
| <u>6</u>  |          |          |          |          |          |
| <u>7</u>  |          |          |          |          |          |
| <u>8</u>  |          |          |          |          |          |
| <u>9</u>  |          |          |          |          |          |
| <u>10</u> |          |          |          |          |          |
| <u>11</u> |          |          |          |          |          |
| <u>12</u> |          |          |          |          |          |
| <u>13</u> |          |          |          |          |          |
| <u>14</u> |          |          |          |          |          |
| <u>15</u> |          |          |          |          |          |
| <u>16</u> |          |          |          |          |          |
| <u>17</u> |          |          |          |          |          |
| <u>18</u> |          |          |          |          |          |

**Q1-A) What is data structure?**

Answer: A data structure is a way of organizing data that considers not only the items stored, but also their relationship to each other. Advance knowledge about the relationship between data items allows designing of efficient algorithms for the manipulation of data.

**Q1-B) List out the areas in which data structures are applied extensively?**

Answer: The name of areas are:

- Compiler Design,
- Operating System,
- Database Management System,
- Statistical analysis package,
- Numerical Analysis,
- Graphics,
- Artificial Intelligence,
- Simulation

**Q1-C) Consider A is an array of order  $m \times n$  stored in a Row Major order. If the address of the first element in the array is K which is there at  $A[0, 0]$ , then What is the address of  $A[i, j]$ ?**

an array of order  $m \times n$  stored in a Row Major order. If the address of the first element in the array is K which is there at  $A[0, 0]$ , then the address of  $A[i, j]$  is  $K + (i-1) * n + j - 1$

**Q1-D) There are two sorted lists L1 and L2. Their lengths are  $n_1$  and  $n_2$  respectively. You are asked to design an algorithm to generate a sorted list L3 from L1 and L2. That is, for example, if  $L1=[1,5,30]$  and  $L2=[3,6,12,24,43]$  then  $L3=[1,3,5,6,12,24,30,43]$ . Which of the following methods is the most efficient?**

Using a merge method that compares two elements at the head of both lists. The smaller one is then taken out and inserted at the end of L3 while the larger one is kept its location unchanged. Repeat this until either L1 or L2 is empty

**Q1-E) Assume that variable A is a sorted array of integers of length L. Consider the following code segment: Determine when variable flag is 1 after this code segment executes?**

```
int k=1, flag=0;
for ( ; k<L; k++)
{ if (A[k-1] == A[k] ) flag = 1; }
```

If and only if array A contains adjacent duplicate values; Because this is an array, and k is the index. So k, k-1 are the adjacent index values.

**Q1-F) Which boolean expression indicates whether the number in two nodes (p and q) are the same? Assume that neither p nor q is null.**

$p.data == q.data$ ; As we are comparing the data of both of the nodes, we have to check for the data, a member of nodes p, q. Also we have to use relational operator( ==).

**Q2-A) Sequential search has a time complexity of  $O(n)$ , and binary search has a time complexity of  $O(\log(n))$ . What difference will it make when the size n is 1000?**

As n is 1000, binary search is 100 times as fast as sequential search  $\log(1024) = 10$ ,  $1000/\log(1000)$  is roughly equal to  $1000/10 = 100$

**Q2-B)** Find the output of the following code

```
static void Main()
{
    Queue<string> queue = new Queue<string>();
    queue.Enqueue("Message One ");
    queue.Enqueue("Message Two");
    queue.Enqueue("Message Three");
    queue.Enqueue("Message Four");
    while (queue.Count > 0)
    {
        string message = queue.Dequeue();
        Console.WriteLine(message);
    }
}
Message One
Message Two
Message Three
Message Four
```

**Q2-C)** State the function of the following code

```
bool isSymmetric = true;
for (int i=0; i<(array.Length+1)/2; i++)
{
    if (array[i] != array[n-i-1])
    {
        isSymmetric = false;
    }
}
Symmetry Check
```

**Q2-D)** A stack of integers a Stack has the following private data: Items: 800 47 10 -34 323 067 823 -789 99; What is the output of the following code? Top = 800

```
int x;
while (!aStack.isEmpty()){
    aStack.pop(x);
    Console.WriteLine( x, " ");
}
800 47 10 -34 323 067 823 -789 99
```

**Q3-A)** Write a C# program that accept a 5 elements within a linked list (A,B,C,D,E) , then displayed the number of elements and Display the linked list contents

```
* using System;
class MainClass {
public static void Main() {
// Create an linked list.
LinkedList<char> ll = new LinkedList<char>();

Console.WriteLine("Adding 5 elements.");
// Add elements to the linked list
ll.AddFirst('A');
ll.AddFirst('B');
```

```
ll.AddFirst('C');
ll.AddFirst('D');
ll.AddFirst('E');
```

```
Console.WriteLine("Number of elements: " + ll.Count);
LinkedListNode<char> node;
Console.Write("Display contents by following links: ");
for(node = ll.First; node != null; node = node.Next)
    Console.Write(node.Value + " ");
}
}
```

**Q1-B) If there is no error, What do the following program segments display**

|   |   |
|---|---|
| <pre>int i, j=0, sum = 0; int[] ar1 = { 2, 6, 9, 5, 6 }; for (i = 0; i &lt; ar1.Length; i=i+3) {     sum = sum + ar1[i];     j = j + j * i;     Console.Write(sum + " " + j + " "); } Console.WriteLine(i);</pre> <p>2 0 7 0 6</p>  | <pre>string str = "Another-way-to-kill-a-mockingbird"; int i; string[] sec = new string[33]; for (i = 0; i &lt; str.Length/4; i++)     { sec[i] = str.Substring(i, i % 2 + 1); } for (i = 0; i &lt; str.Length; i++) {     Console.Write(sec[i]); }</pre> <p>Anoothherr-w</p> |
| <pre>int [] a = new int[3]; a[0] = 5; a[1] = 10; a[2] = 150; Console.WriteLine("{0} {1} {2}", a[0], a[1], a[2]); a[0] += 5; a[1] = 20; a[2] = a[0] + a[1]; Console.WriteLine("{0} {1} {2}", a[0], a[1], [2]);</pre>  | <pre>int [] prices = new int [] {10, 29, 35, 67, 42}; int v = 0; foreach(int p in prices)     if(p &gt; v)         v = p; Console.WriteLine(v);</pre>                                     |

**Q3-C) [6 points] Given an array scores of doubles, write a C# program that compute the sum of all elements in the array; store the result in variable total. Write one program using while loop; Write another program using for loop**

**Q3-D) A stack of integers a Stack has the following private data: Items: 800 47 10 -34 323 067 823 -789 99; What is the output of the following code? Top = 800**

```
int x;
while (!aStack.isEmpty()){
    aStack.pop(x);
    Console.WriteLine( x, " ");}
```

**Q3-D) Write a C# program that accepts a 5 elements within a linked list (A,B,C,D,E) , then displays the number of elements and Display the linked list contents**

Slide 2 = page 19,22

**Q3-E) Select the suitable answer [ right selection 0.5 wrong selection -1 ] Use the attached sheet in the answer**

(1) How many nodes does a complete binary tree of level 5 have?  
(a) 16 (b) 15 (c) 32 (d) 31 (e) 64.

(2) The suitable data structure to represent the IDs of employees is  
(a) Stack  
(b) Queue  
(c) Linked List  
(d) Array  
(e) Tree.

D - Reason : As the type of all Id for all the employees is same then a simple array is enough to store the values.

(3) Which of following algorithm scans the list by swapping the entries whenever pair of adjacent keys are out of desired order?  
(a) Insertion sort  
(b) Quick sort  
(c) Shell sort  
(d) Bubble sort  
(e) Radix sort.

Answer : (d)

Reason: Bubble sort only is the algorithm from the given options which compares the adjacent keys.

(4) Which of the following shows the difference between a queue and a stack?  
(a) Queues require linked lists, but stacks do not  
(b) Stacks require linked lists, but queues do not  
(c) Queue is used for complex programs and stack for simple programs  
(d) Queues use two ends of the structure; stacks use only one  
(e) Stacks use two ends of the structure, queues use only one

Answer : (d)

Reason: Queues use two ends of the structure; stacks use only one show the difference between them

(5) This sort finds location 'pos' of smallest elements in  $a(i), \dots, a(n)$  and then interchange  $a(pos)$  with  $a(i)$  for  $i = 1, \dots, n - 1$ .

(a) Selection sort  
(b) Quick sort  
(c) Heap sort  
(d) Bubble sort  
(e) Insertion sort.

Answer : (a)

Reason: As this process is the key process for the selection sort algorithm

(6) The direct or random access of element is not possible in

(a) Array  
(b) String  
(c) Linked List  
(d) Both (a) and (b) above  
(e) Both (b) and (c) above.

Answer : (c)

Reason : Because, in linked list the elements are always not stored at contiguous memory locations, but are stored at discrete locations. And hence random access is not possible.

(7) If for a given 'Queue' initially  $f=0$  and  $r=-1$ , then  $f = r$  refers to

- (a) Queue is empty
- (b) Queue is full
- (c) Queue has two elements
- (d) Exactly one element is there
- (e) Not possible at all.

Answer : (d)

Reason : If front pointer 'f' and rear pointer 'r' points to same location then there is only one element in the queue.

(8) In linked list, a node contains atleast

- (a) Node address field, data field
- (b) Node number, data field
- (c) Next address field, information field
- (d) Node number, information field
- (e) Node address field, information field.

Answer : (c)

Reason : next address field, information field.

(9) Null pointer is used to define

- I. End of linked list.
  - II. Empty pointer field of a structure.
  - III. The linked list is empty.
- (a) Only (I) above
  - (b) Only (II) above
  - (c) Only (III) above
  - (d) Both (I) and (II) above
  - (e) All (I), (II) and (III) above.

Answer : (e)

Reason : (I), (II), (III) are correct

(10) Direct or random access of element is not possible in

- (a) Linked list
- (b) Array
- (c) String
- (d) Queue
- (e) Double linked list.

Answer : (c)

Reason : string

(11) "Get a node, store new element and insert the new node at the top" refers to insert operation in non empty

- (a) Stack
- (b) Queue
- (c) Array
- (d) Linked list
- (e) Tree.

Answer : (a)

Reason : stack

(12) Standard queue operations are

- (a) empty(), fill(), place(), remove()
- (b) enqueue(), dequeue(), isempty(), isfull()
- (c) init(), delete(), add()
- (d) isempty(), isfull(), fill(), remove()
- (e) isempty(), isfull(), init(), delete(), add().

Answer : (b)

As fill(), place(), add(), empty() are not the standard operations on queue, while enqueue(), dequeue(), isempty(), isfull() are the standard one.

(13) A program is required to store and process information about the solar system. Which types of data structure would be most appropriate for storing the following respectively : (i) A list of the names of the planets, (ii) full details of a planet including distance from sun, diameter, atmospheric composition, etc, (iii) a predetermined list of scientific observations made of the planet.

- |                 |                  |                   |
|-----------------|------------------|-------------------|
| (i) linked list | (ii) structure   | (iii) linked list |
| (i) array       | (ii) structure   | (iii) linked list |
| (i) linked list | (ii) array       | (iii) array       |
| (i) linked list | (ii) linked list | (iii) linked list |
| (i) array       | (ii) structure   | (iii) array.      |

Answer : (e)

To keep track of the planets a fixed size array is enough as the number of planets is finite value. In addition, to keep track of complex information as a single logical unit structure is the best suitable data structure. For predetermined list array is suitable.

(14) One difference between a queue and a stack is:

- (a) Queues require linked lists, but stacks do not
- (b) Stacks require linked lists, but queues do not
- (c) Queue is used for complex programs and stack is used for simple programs
- (d) Stacks use two ends of the structure, queues use only one
- (e) Queues use two ends of the structure; stacks use only one.

Answer : (e)

Reason: As all the other options are meaning less.

(15) Consider searching for a given value in a large, sorted array. Under which of the following conditions is sequential search slower than binary search?

- (a) Always
- (b) Never
- (c) When the value being searched for is the first element in the array
- (d) When the value being searched for is the second element in the array
- (e) When the value being searched for is the last element in the array.

Answer : (a)

As in all the cases the time taken by sequential( linear) search is  $O(n)$  which is greater than the time taken by binary search which is  $O(\log n)$ .

(16) When we say an algorithm has a time complexity of  $O(n)$ , what does it mean?

- (a) The algorithm has 'n' nested loops
- (b) The computation time taken by the algorithm is proportional to n
- (c) The algorithm is 'n' times slower than a standard algorithm
- (d) There are 'n' number of statements in the algorithm
- (e) The computation time taken by the algorithm is less than 'n' seconds.

(17) The suitable data structure to represent the data of rainfall of week days in ten cities of three states is \_\_\_\_\_

- |                    |                      |           |
|--------------------|----------------------|-----------|
| (a) Stack          | (b) Queue            | (c) Array |
| (d) Multi way tree | (e) Connected graph. |           |

: (c)

As the array can keep the data for multiple dimension values which is not possible by using any other data structure given in the question.

(18) The value of first linked list address is ?

- a. 0
- b. -1
- c. 1
- d. None of Above

**Q4-A)** Sort the array [7, 2, 5, 3, 10, 4, 9, 8, 1, 6] with the iterative merge sort algorithm. Show all steps in determining your answer.

[7] [2] [5] [3] [10] [4] [9] [8] [1] [6]  
[2 7] [3 5] [4 10] [8 9] [1 6]  
[2 3 5 7] [4 8 9 10] [1 6]  
[2 3 4 5 7 8 9 10] [1 6]  
[1 2 3 4 5 6 7 8 9 10]

[] denote sorted regions.

**Q4-B)** Sort the array [7, 2, 5, 3, 10, 4, 9, 8, 1, 6] with the quick sort algorithm using the median of three rule for pivot selection. Show all steps in determining your answer.

{ (7) 2 5 3 10 4 9 8 1 6 }  
{ 2 5 (3) 4 1 6 } [ 7 ] { 10 (9) 8 }  
{ (2) 1 } [ 3 ] { (5) 4 6 } [ 7 ] [ 8 ] [ 9 ] [ 10 ]  
[ 1 ] [ 2 ] [ 3 ] [ 4 ] [ 5 ] [ 6 ] [ 7 ] [ 8 ] [ 9 ] [ 10 ]  
[ 1 2 ] [ 3 ] [ 4 5 6 ] [ 7 ] [ 8 9 10 ]  
[ 1 2 3 4 5 6 ] [ 7 ] [ 8 9 10 ]  
[ 1 2 3 4 5 6 7 8 9 10 ]

{...} denote unsorted regions

[...] denote sorted regions

# denotes element considered for pivot of the unsorted region

(#) denotes selected pivot for the unsorted region

**Q4-C)** Apply the Merge sort algorithm for the following items - 56,29,35,42,15,41,75,21

**Q4-D)** Use *Bubble Sort algorithm* for a given string array shown below, then specify the number of (Sweep, exchanges ) and the final order.

("ahmad Adel", "ahmad saad", "Reham Abdo", "basem Ali", Hesham Arafat")

| <u>Q</u>  | <u>A</u> | <u>B</u> | <u>C</u> | <u>D</u> | <u>E</u> |
|-----------|----------|----------|----------|----------|----------|
| <u>1</u>  |          |          |          | <u>X</u> |          |
| <u>2</u>  |          |          |          | <u>X</u> |          |
| <u>3</u>  |          |          |          | <u>X</u> |          |
| <u>4</u>  |          |          |          | <u>X</u> |          |
| <u>5</u>  | <u>X</u> |          |          |          |          |
| <u>6</u>  |          |          | <u>X</u> |          |          |
| <u>7</u>  |          |          |          | <u>X</u> |          |
| <u>8</u>  |          |          | <u>X</u> |          |          |
| <u>9</u>  |          |          |          |          | <u>X</u> |
| <u>10</u> |          |          | <u>X</u> |          |          |
| <u>11</u> | <u>X</u> |          |          |          |          |
| <u>12</u> |          | <u>X</u> |          |          |          |
| <u>13</u> |          |          |          |          | <u>X</u> |
| <u>14</u> |          |          |          |          | <u>X</u> |
| <u>15</u> | <u>X</u> |          |          |          |          |
| <u>16</u> |          | <u>X</u> |          |          |          |
| <u>17</u> |          |          | <u>C</u> |          |          |
| <u>18</u> |          |          |          | <u>X</u> |          |