DS & Algo Assignment

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SUBMITTING TO PROFESSOR
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Department of Computer Science
BS 3rd Semester Morning
Assignment for Data Structure and Algorithms
This is a marked assignment for the government mandated vacations.

Due date: 10 March 2020   **Marks=30**

Complete your assignment (soft copy) no need to print out or in written form, convert it into pdf format and email me till 10th march 2020.

Question No1: Answer the following question.
- a) What is data structure?
- b) What is linear and non-linear data structure?
- c) Give the names of linear data structure?
- d) Give the non-linear data structure?

Question No2:
- a) What is an array?
- b) What is stack?
- c) What is queue?
- d) What is link list?
- e) What is tree?

Question No3:
Define the following operations that can be performed on any data structure?
- a) Insert
- b) Delete
- c) Update
- d) Search
- e) Sort

Question No4:
- a) Write different types of searching operation?
- b) Write different type of sorting operation?

Question No5:
Define an algorithm?
Differentiate between Algorithm, Pseudo-code and computer Program.

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Qno1: Answer the following.

(a) What is data structure?

A data structure is a data organization, management, and storage format that enables efficient access and modification. More precisely, a data structure is a collection of data values, the relationships among them, and the functions or operations that can be applied to the data.

(b) What is linear and non-linear data structure?

- **LINEAR DATA STRUCTURE**: linear data structures arrange data in a sequential manner
- **NON-LINEAR DATA STRUCTURE:** nonlinear data structures arrange data in a hierarchical manner, creating a relationship among the data elements.

(c) Give the names of linear data structure?

Array, Linked List, Stack, and Queue are some common examples of linear data structures.

(d) Give the names of non-linear data structure?

Trees and graphs are the most common nonlinear data structures.

Q.no 2:

(a) Array: An array stores data elements of the same data type

(b) Stack: A stack is an abstract data type that behaves similarly to a real-world stack. It follows LIFO (Last in First Out) order. In other words, the inserted last element is in the top of the stack. Therefore, the element to access the first is the last inserted element. Moreover, inserting elements to the stack is called push operation and removing elements from the stack is called pop operation.

(c) Queue: A queue is also an abstract data structure, but it has two ends to insert elements and to delete elements. Inserting elements is called enqueue and removing elements is called dequeue.

(d) Link List: Linked List is a linear data structure which contains a group of nodes in a sequence. Each node consists of its own data and the address of another node. It can store the address of the next node, or both the next node and the previous node. The elements are linked together and form a structure similar to a chain.

(e) Tree: A tree data structure can be defined recursively as a collection of nodes (starting at a root node), where each node is a data structure consisting of a value, together with a list of references to nodes (the "children"), with the constraints that no reference is duplicated, and none points to the root.

Q.no 3: Define the following operations that can performed on any data structure?

(a) Insert: It is used to add a new data item in the given collection of data items.

(b) Delete: It is used to delete an existing data item from the given collection of data items.

(c) Update: Update operation refers to updating an existing element from the array at a given index.

(d) Search: It is used to find out the location of the data item if it exists in the given collection of data items.

(e) Sort: It is used to arrange the data items in some order i.e. in ascending or descending order in case of numerical data and in dictionary order in case of alphanumeric data.

Q no 4:

(a) Write different kinds of searching operations?:

- **Sequential Search**
1. Sequential search is also called as Linear Search.
2. Sequential search starts at the beginning of the list and checks every element of the list.
3. It is a basic and simple search algorithm.
4. Sequential search compares the element with all the other elements given in the list. If the element is matched, it returns the value index, else it returns -1.
- **Binary Search**
1. Binary Search is used for searching an element in a sorted array.

2. It is a fast search algorithm with run-time complexity of O (log n).
3. Binary search works on the principle of divide and conquer.
4. This searching technique looks for a particular element by comparing the middle most element of the collection.
5. It is useful when there are large number of elements in an array.

(b) Write different kinds of sorting operations?:

- BUBBLE SORT

1. Bubble sort is a type of sorting.

2. It is used for sorting 'n' (number of items) elements.

3. It compares all the elements one by one and sorts them based on their values.

4. The above diagram represents how bubble sort actually works. This sort takes O (n^2) time. It starts with the first two elements and sorts them in ascending order.

5. Bubble sort starts with first two elements. It compares the element to check which one is greater.

- INSERTION SORT

1. Insertion sort is a simple sorting algorithm.

2. This sorting method sorts the array by shifting elements one by one.

3. It builds the final sorted array one item at a time.

4. Insertion sort has one of the simplest implementation.

5. This sort is efficient for smaller data sets but it is insufficient for larger lists.

6. It has less space complexity like bubble sort.

7. It requires single additional memory space.

8. Insertion sort does not change the relative order of elements with equal keys because it is stable.

- **SELECTION SORT**

Selection sort is a simple sorting algorithm which finds the smallest element in the array and exchanges it with the element in the first position. Then finds the second smallest element

and exchanges it with the element in the second position and continues until the entire array is sorted.

- **QUICK SORT**

1. Quick sort is also known as Partition-exchange sort based on the rule of Divide and Conquer.
2. It is a highly efficient sorting algorithm.
3. Quick sort is the quickest comparison-based sorting algorithm.
4. It is very fast and requires less additional space, only O (n log n) space is required.
5. Quick sort picks an element as pivot and partitions the array around the picked pivot.

Algorithm for Quick Sort

Step 1: Choose the highest index value as pivot.

Step 2: Take two variables to point left and right of the list excluding pivot.

Step 3: Left points to the low index.

Step 4: Right points to the high index.

Step 5: While value at left < (Less than) pivot move right.

Step 6: While value at right > (Greater than) pivot move left.

Step 7: If both Step 5 and Step 6 does not match, swap left and right.

Step 8: If left = (Less than or Equal to) right, the point where they met is new pivot.

- **HEAP SORT**

1. Heap sort is a comparison based sorting algorithm.
2. It is a special tree-based data structure.
3. Heap sort is similar to selection sort. The only difference is, it finds largest element and places it at the end.
4. This sort is not a stable sort. It requires a constant space for sorting a list.
5. It is very fast and widely used for sorting.

Q no 5:

(a) Define an algorithm?

In mathematics and computer science, an algorithm is a finite sequence of well-defined, computer-implementable instructions, typically to solve a class of problems or to perform a computation. Algorithms are always unambiguous and are used as specifications for performing calculations, data processing, automated reasoning, and other tasks

(b) Differentiate between algorithm, pseudo code and computer program?:

Difference between algorithm, pseudo code and computer program

Algorithm	Pseudocode	Computer Program
1. Systematic logical approach which is a well-defined, step-by-step procedure that allows a computer to solve a problem.	It is a simpler version of a programming code in plain English which uses short phrases to write code for a program before it is implemented in a specific programming language.	It is exact code written for problem following all the rules of the programming language.

2. Algorithms can be expressed using natural language, flowcharts, etc.	There are several formats which are used to write pseudo-codes and most of them take down the structures from languages such as C, Lisp, FORTRAN, etc.	You can write stuff in a computer language, and then a compiler or interpreter can make it understandable to the computer.

3. Procedure of algorithm is like this
 	
Start from the leftmost element of arr[] and
 	
one by one compare x with each element of arr[].
 	
If x matches with an element, return the index.
 	
If x doesn't match with any of elements, return -1.
	Procedure of pseudocode is like this
	
	FUNCTION linearSearch(list, searchTerm):
	
	   FOR index FROM 0 -> length(list):
	
	     IF list[index] == searchTerm THEN
	
	       RETURN index
	
	     ENDIF
	
	     ENDLOOP
	
	     RETURN -1
	
	END FUNCTION
		Procedure of computer program is like this
		
		``cpp
		// C++ code for linearly search x in arr[]. If x
		// is present then return its location, otherwise
		// return -1
		int search(int arr[], int n, int x)
		{
		   int i;
		   for (i = 0; i < n; i++)
		     if (arr[i] == x)
		      return i;
		   return -1;
		}
		``