Data Structures
Lab Manual

Topic: List

Session: Spring 2023

Faculty of Information Technology

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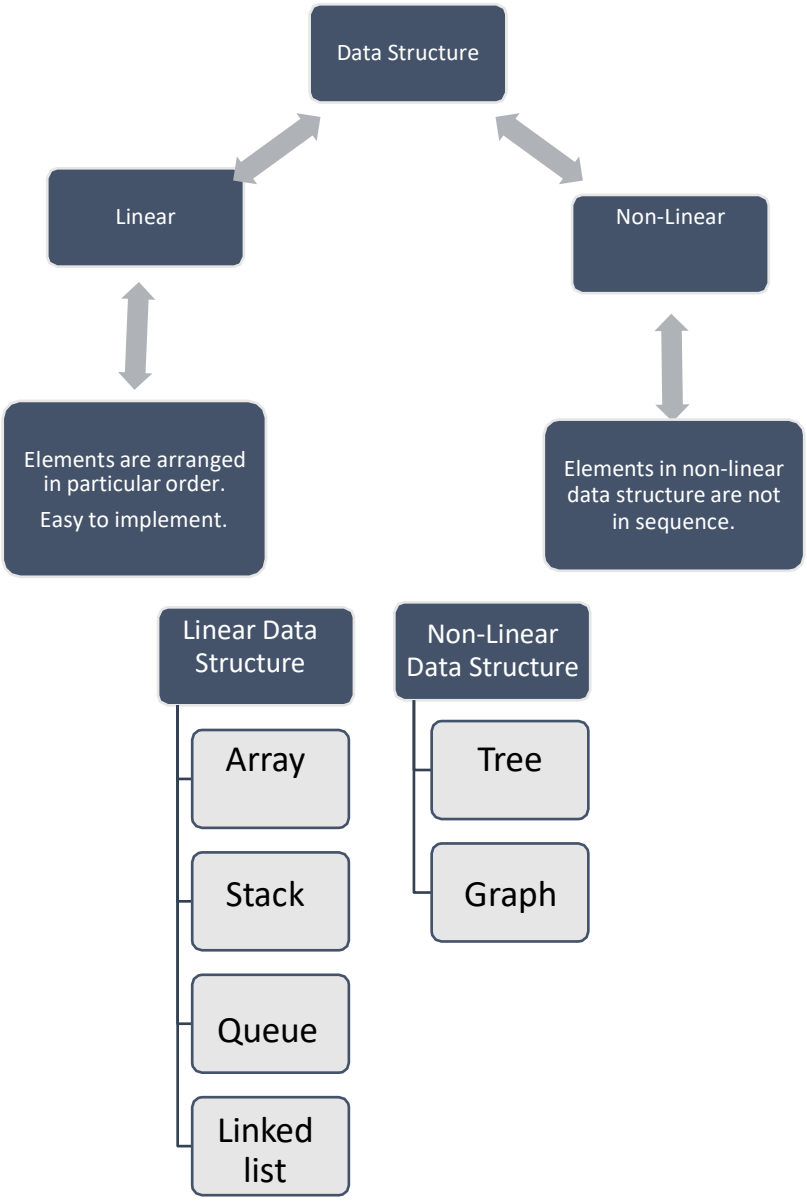
Objectives:

To write a program that implements basic concept of list. The purpose is understanding the first basic concept of Data Structure and Algorithm, basic operations (insertion, deletion, searching) and brining the best of students.



Following are the operations that you can perform

- Insertion
- Deletion
- Sorting
- Searching

Here is an example code for the help.

```
#include <iostream>
using namespace std;

class List {
public :
  List () {  }
  List (int s){size=s; p= new int[size];use=-1;}
  bool isEmpty (){
         if(use==-1)
            return true;
         else
            return false;
  }

  bool isFull (){
         if(use==size-1)
            return true;
         else
            return false;
  }
  int getUse() { return use;}
  bool insert(int data){
use++;
       if (!isEmpty()){
           p[use]=data;
           return true;
       } else
           return false;

  }

 bool deleteValue(int index){
       if ((index>=0)&&(index<=use)){
          for(int j=index;j<use;j++)
              p[j]=p[j+1];
          use=use-1;
          return true;
       } else
           return false;

 }
void print(){ int
   i=0;
   while(i<=use){
      cout<<p[i];
      i++;
   }

}
```

```
        int getValue(int i) { return p[i];}

        private:
        int *p;
        int size;
        int  use;
        };

        int main(){
        List a(3);
        while (!a.isFull()){
           int i;
           cin>>i;
           a.insert(i);
        }
        int k;
        cout<<" Enter index for deletion";
        cin>>k;
        if (a.deleteValue(k))
            cout<<k <<" value  successfully deleted";
        else
            cout<<k <<" index out of bounds ";

        int i=0;
        int value;
        while (i<=a.getUse()){
            value=a.getValue(i);
            cout<<value;
            i++;
        }


        }
```

If you want to insert at first index in the above code. Try implementing this snippet of code in the above code on your own:

```
bool insertAtFirstIndex(int data) {
        if (use == size - 1)
            return false;
        for (int i = use; i >= 0; i--)
            p[i + 1] = p[i];
        p[0] = data;
        use++;
        return true;
    }
```

Instructions:

- Indent your code.
- Comment your code.
- Use meaningful variable names.
- Plan your code carefully on a piece of paper before you implement it.
- Name of the program should be same as the task name. i.e. the first program should be Task_1.cpp

Students are required to complete the following tasks in lab timings.

Task 1

Create a C++ generic abstract class named as **List**, with the following:

Attributes:

1. Type * arr;
2. int maxSize;
3. int currentSize;

Functions:

virtual void addElement (Type) = 0;

- Should add the element on the **List**

virtual void addElementAtFirstIndex(Type) = 0;

- Should add the element at the first position of the **List**

virtual void addElementAtLastIndex(Type) = 0;

- Should add the element at the last position of the **List**

virtual Type removeElement() = 0;

- Should remove the element from the current position of the **List**

virtual Type removeElementFromEnd() = 0;

- Should remove the element from the last position of the **List**

virtual void removeElementFromStart() = 0;

- Should remove the element from the first position of the **List**

- Write parameterized constructor with default arguments for the above class.
- Write Copy constructor for the above class.
- Write Destructor for the above class.

Sample Code snippets regarding Task 1 for virtual void addElement and virtual void addElementAtFirstIndex

```
template <typename Type>
class ArrayList {
public:
    ArrayList(int maxSize) {
        this->maxSize = maxSize;
        arr = new Type[maxSize];
        currentSize = 0;
    }
    virtual ~ArrayList() {
        delete[] arr;
    }
    virtual void addElement(Type element) {
        if (currentSize == maxSize) {
            cout << "List is full!" << endl;
            return;
        }
        arr[currentSize++] = element;
    }
    virtual void addElementAtFirstIndex(Type element) {
        if (currentSize == maxSize) {
            cout << "List is full!" << endl;
            return;
        }
        for (int i = currentSize; i > 0; --i) {
            arr[i] = arr[i-1];
        }
        arr[0] = element;
        ++currentSize;
    }
```

Task 2

Create a menu based program for the following functions, using the class made in task 1, make a class named as **MyList**, having following additional functionalities:

bool empty() : Returns whether the MyList is empty or not

bool full() : Returns whether the MyList is full or not
int size() : Returns the current size of the MyList

bool insertAt(int index, T value): Adds a value at the index passed to the function, returns true if the index is present and value is added else returns false.
Type last() : Returns the last element of the MyList

bool search(Type): Returns true if the searched value is present in the list else returns false

- Write parameterized constructor with default arguments for the above class.
- Write Copy constructor for the above class.
- Write Destructor for the above class.