Lab 6: Structure in C++ and Singly Linked Lists (Part 1 – insertion and View)

A structure is a ***user-defined data type*** in C/C++. A structure creates a data type that can be used to group items of possibly different types into a single type. The 'struct' keyword is used to create a structure.

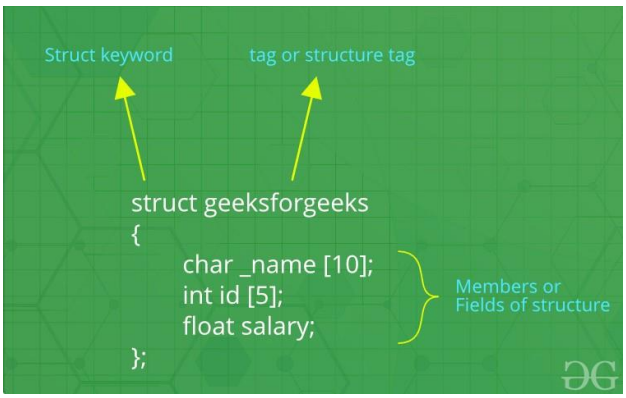

Figure 1: structure in C++

Like primitive types, we can have pointer to a structure. If we have a pointer to structure, members are accessed using arrow (->) operator instead of the dot (.) operator.

Part A: Learn how to use the pointer to access the structure members

1.

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

struct Point {
	int x, y;
};

int main()
{
	//p1 is a pointer to a new Point structure
	Point * p1 = new Point;

	//To access the new structure members using pointer
	p1->x = 3; //insert value
	p1->y = 4;

	cout << p1->x << " " << p1->y; // to display
	return 0;
}
```

[Estimate Finish Time: 5 minutes]

A linked list is a linear data structure, in which the elements are not stored at contiguous memory locations. The elements in a linked list are linked using pointers as shown in the below image:

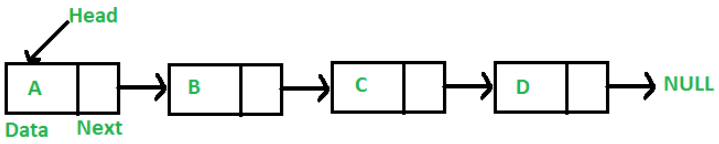

Figure 2: Linked list sample

Part B: Understand the concept of linked-list

1. Learn how to connect two independent structures to become a short linked-list.

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

struct Point {
	int x, y;
	Point * nextaddress;
};

int main()
{
	//first structure
	Point * p1 = new Point;
	p1->x = 3;
	p1->y = 4;
	p1->nextaddress = NULL;

	//second structure
	Point * p2 = new Point;
	p2->x = 7;
	p2->y = 16;
	p2->nextaddress = NULL;

	//to link the first structure with second structure
	p1->nextaddress = p2;

	//display the p1 information
	cout << "P1 info : \n ----------------\n";
	cout << "P1 Address : " << p1 << endl;
	cout << "P1 x value : " << p1->x << endl;
	cout << "P1 y value : " << p1->y << endl;
	cout << "P1 nextaddress value : " << p1->nextaddress << endl <<
endl;

	////display the p2 information
	cout << "P2 info : \n ----------------\n";
	cout << "P2 Address : " << p2 << endl;
	cout << "P2 x value : " << p2->x << endl;
	cout << "P2 y value : " << p2->y << endl;
	cout << "P2 nextaddress value : " << p2->nextaddress << endl <<
endl;
}
```

[Estimate Finish Time: 15 minutes]

2. Learn how to display the linked structures using a structure pointer.

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

struct Point {
	int x, y;
	Point * nextaddress;
};

int main()
{
	//first structure
	Point * p1 = new Point;
	p1->x = 3;
	p1->y = 4;
	p1->nextaddress = NULL;

	//second structure
	Point * p2 = new Point;
	p2->x = 7;
	p2->y = 16;
	p2->nextaddress = NULL;

	//to link the first structure with second structure
	p1->nextaddress = p2;

	//display the p1 information
	cout << "P1 info : \n ----------------\n";
	cout << "P1 Address : " << p1 << endl;
	cout << "P1 x value : " << p1->x << endl;
	cout << "P1 y value : " << p1->y << endl;
	cout << "P1 nextaddress value : " << p1->nextaddress << endl << endl;

	////display the p2 information
	cout << "P2 info : \n ----------------\n";
	cout << "P2 Address : " << p2 << endl;
	cout << "P2 x value : " << p2->x << endl;
	cout << "P2 y value : " << p2->y << endl;
	cout << "P2 nextaddress value : " << p2->nextaddress << endl << endl;

	//to display: create a new pointer 'head' to follow the list from p1
to p2
	Point * head = NULL;
	head = p1;

	while (head != NULL)
	{
		cout << head->x << " , ";
		cout << head->y << " , ";
		cout << head->nextaddress << endl;
		head = head->nextaddress;
	}

}
```

[Estimate Finish Time: 15 minutes]

Part C: Learn how to create a singly linked-list and view a singly linked-list

1. Write a struct declaration for a linked list. Your structure should contain the following data members: an integer data containing a student id and a next pointer variable which points to the structure. In the main function, you will need to assign a value to student id, assign next to NULL (or 0), and finally display the contents of the data members.

   [Estimate Finish Time: 10 minutes]

2. Using the program that your wrote in question 1, write an insert function that will insert a new student at the front of the linked list. Then, write a display function to display the values in the linked list.

   [Estimate Finish Time: 15 minutes]

3. Using the program that your wrote in question 2, write an insert function that will insert a new student at the end of the linked list. Then, write a display function to display the values in the linked list.

   [Estimate Finish Time: 15 minutes]

4. Modify Question 4 to include two other data members – *student name* and *student age* into the Student structure. Modify the insert and display functions accordingly.

   [Estimate Finish Time: 20 minutes]

Part D: **Homework.**

Submit your answer (*in doc / pdf*) to the Moodle. Your answer should include your code and your program screenshot. Submission due date: _____**.**

1. Create a music player system that having the current song list:

No	Artist	Song	Released	Genre	Length
1.	Celine Dion	Just Walk Away	1993	Pop	4.58
2.	Taylor Swift	You Belong With Me	2008	Pop	3.48
3.	The Cranberries	Promises	1999	Rock	4.30

The functionality of the music player system as below:

- Insert to the beginning of song list
  - User able to insert a new song in the front of the list

Example output:

No	Artist	Song	Released	Genre	Length
4.	Maria Carey	All I Want For Christmas Is You	1994	Seasonal	3.55
1.	Celine Dion	Just Walk Away	1993	Pop	4.58
2.	Taylor Swift	You Belong With Me	2008	Pop	3.48
3.	The Cranberries	Promises	1999	Rock	4.30

- Insert to the end of song list
  - User able to insert a new song at the end of the list

Example output:

No	Artist	Song	Released	Genre	Length
4.	Maria Carey	All I Want For Christmas Is You	1994	Seasonal	3.55
1.	Celine Dion	Just Walk Away	1993	Pop	4.58
2.	Taylor Swift	You Belong With Me	2008	Pop	3.48
3.	The Cranberries	Promises	1999	Rock	4.30
5.	Selena Gomez, Kygo	It Ain't Me	2017	Dance-pop	

- View the list without any sorting
    - User able to view the original song list after the insertion process.

Example output:

No	Artist	Song	Released	Genre	Length
4.	Maria Carey	All I Want For Christmas Is You	1994	Seasonal	3.55
1.	Celine Dion	Just Walk Away	1993	Pop	4.58
2.	Taylor Swift	You Belong With Me	2008	Pop	3.48
3.	The Cranberries	Promises	1999	Rock	4.30
5.	Selena Gomez, Kygo	It Ain't Me	2017	Dance-pop	3.41