CL1002 – Programming Fundamentals Lab

Lab # 5

Structures

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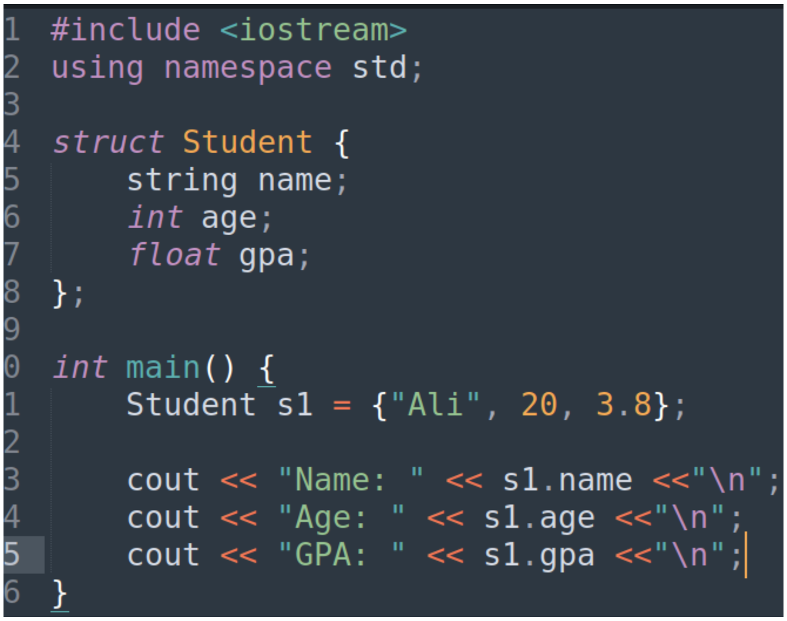
1. **Basic Syntax:**

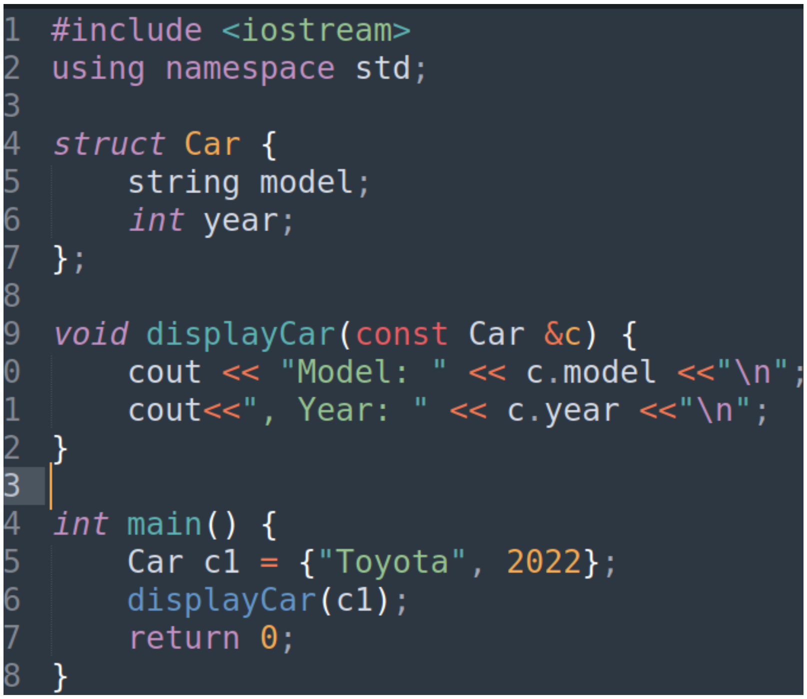
Example 1:



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

struct Student {
    string name;
    int age;
    float gpa;
};

int main() {
    Student s1 = {"Ali", 20, 3.8};

    cout << "Name: " << s1.name <<"\n";
    cout << "Age: " << s1.age <<"\n";
    cout << "GPA: " << s1.gpa <<"\n";
}
```

2. **Structure as function Parameters:**
    - Structures can be passed to functions by **value** or **reference**.

Example 2:

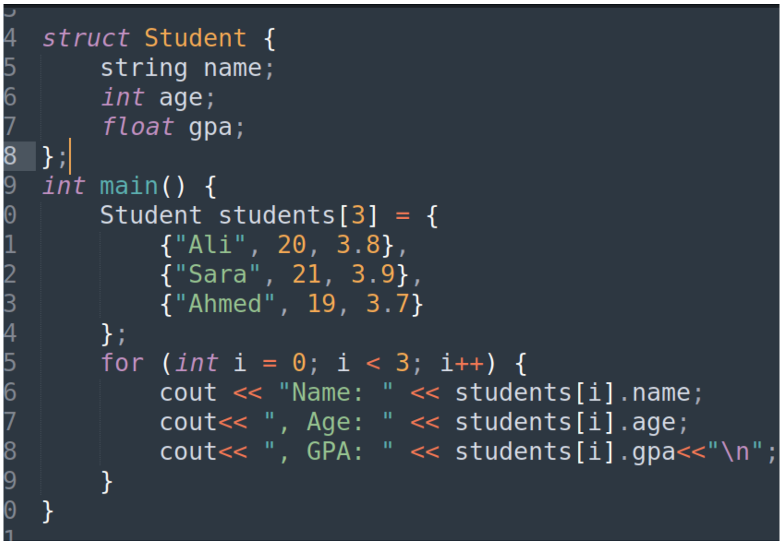


```cpp
#include <iostream>
using namespace std;

struct Car {
    string model;
    int year;
};

void displayCar(const Car &c) {
    cout << "Model: " << c.model <<"\n";
    cout<<", Year: " << c.year <<"\n";
}

int main() {
    Car c1 = {"Toyota", 2022};
    displayCar(c1);
    return 0;
}
```

3. Arrays of Structure:

- An array of structures allows you to store multiple structure variables in a single array.
- This is useful when dealing with multiple objects of the same type, such as a list of students, employees, or products.

Example 3:

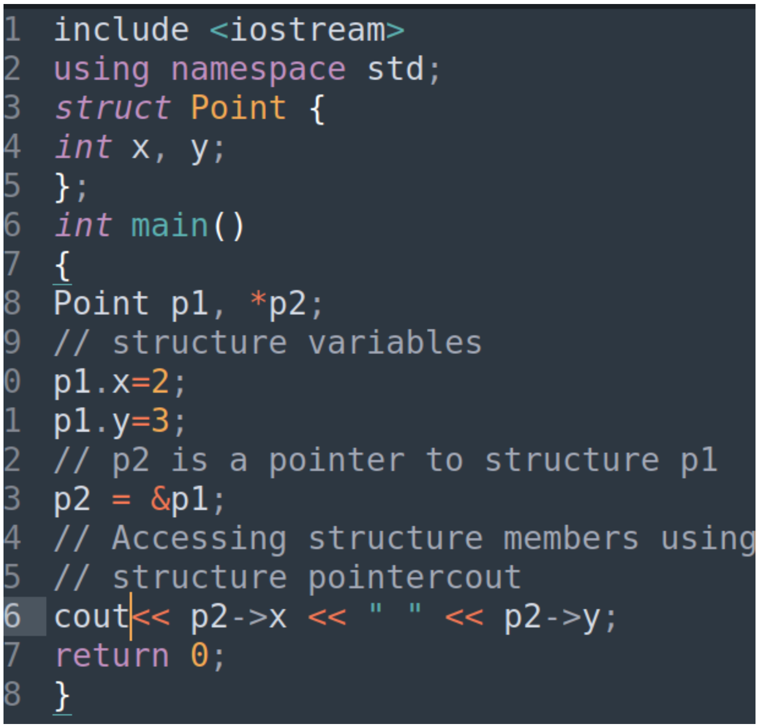


```
struct Student {
    string name;
    int age;
    float gpa;
};
int main() {
    Student students[3] = {
        {"Ali", 20, 3.8},
        {"Sara", 21, 3.9},
        {"Ahmed", 19, 3.7}
    };
    for (int i = 0; i < 3; i++) {
        cout << "Name: " << students[i].name;
        cout<< ", Age: " << students[i].age;
        cout<< ", GPA: " << students[i].gpa<<"\n";
    }
}
```

4. What is structure pointer?

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.

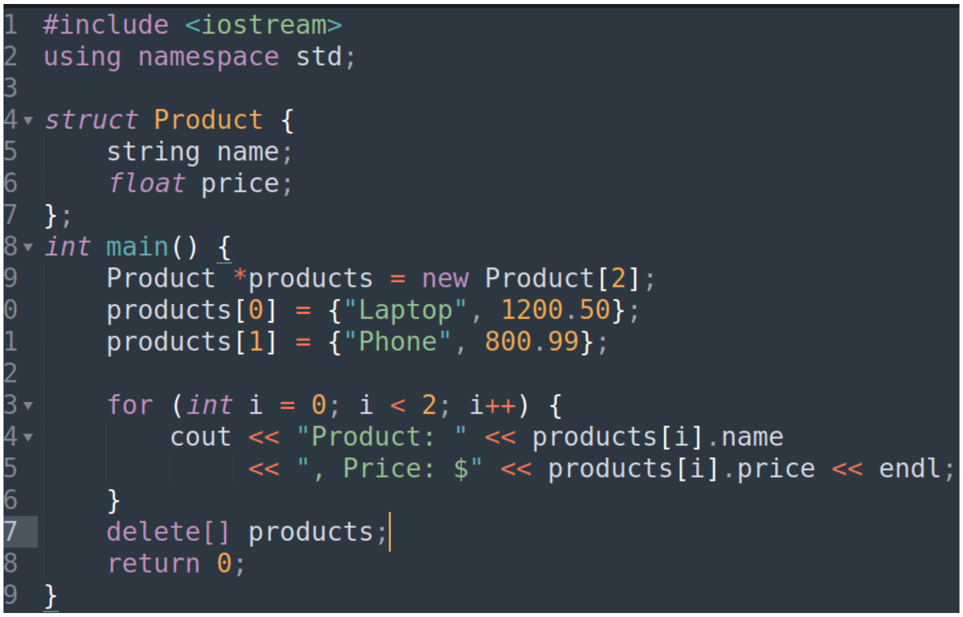
Example 4:



```cpp
include <iostream>
using namespace std;
struct Point {
int x, y;
};
int main()
{
Point p1, *p2;
// structure variables
p1.x=2;
p1.y=3;
// p2 is a pointer to structure p1
p2 = &p1;
// Accessing structure members using
// structure pointercout
cout<< p2->x << " " << p2->y;
return 0;
}
```

5. Arrays of Structure using pointer (DMA):

Example 5:

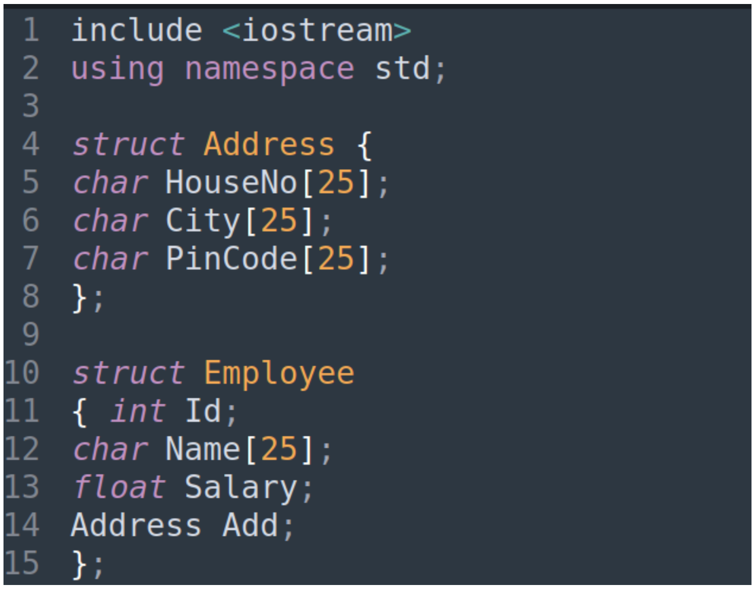


```cpp
#include <iostream>
using namespace std;

struct Product {
    string name;
    float price;
};
int main() {
    Product *products = new Product[2];
    products[0] = {"Laptop", 1200.50};
    products[1] = {"Phone", 800.99};

    for (int i = 0; i < 2; i++) {
        cout << "Product: " << products[i].name
             << ", Price: $" << products[i].price << endl;
    }
    delete[] products;
    return 0;
}
```

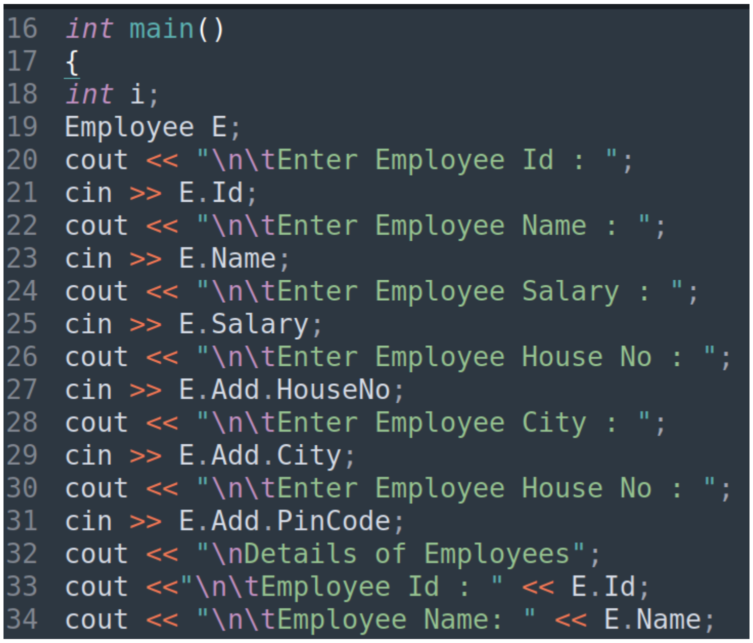
6. **Nested Structures:**

When a structure contains another structure, it is called nested structure.
For example, we have two structures named Address and Employee.
To make Address nested to Employee, we have to define Address structure before and outside Employee structure and create an object of Address structure inside Employee structure.

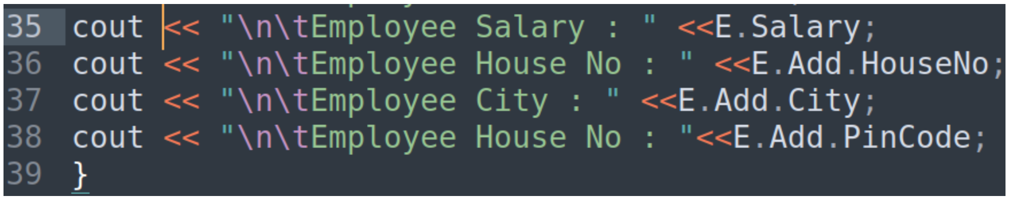
Example 6:



```
include <iostream>
using namespace std;

struct Address {
char HouseNo[25];
char City[25];
char PinCode[25];
};

struct Employee
{ int Id;
char Name[25];
float Salary;
Address Add;
};
```



```
int main()
{
int i;
Employee E;
cout << "\n\tEnter Employee Id : ";
cin >> E.Id;
cout << "\n\tEnter Employee Name : ";
cin >> E.Name;
cout << "\n\tEnter Employee Salary : ";
cin >> E.Salary;
cout << "\n\tEnter Employee House No : ";
cin >> E.Add.HouseNo;
cout << "\n\tEnter Employee City : ";
cin >> E.Add.City;
cout << "\n\tEnter Employee House No : ";
cin >> E.Add.PinCode;
cout << "\nDetails of Employees";
cout <<"\n\tEmployee Id : " << E.Id;
cout << "\n\tEmployee Name: " << E.Name;
```



```
cout << "\n\tEmployee Salary : " <<E.Salary;
cout << "\n\tEmployee House No : " <<E.Add.HouseNo;
cout << "\n\tEmployee City : " <<E.Add.City;
cout << "\n\tEmployee House No : "<<E.Add.PinCode;
}
```

TASKS:

1. **Write a program that defines a structure Rectangle with length and width as members. Create a function calculateArea(Rectangle r) that takes a structure as a parameter and returns the area. In main(), take user input for length and width, pass the structure to the function, and print the area.**
2. **Create a program that defines a structure Book with members title, author, and price. Store details of 5 books in an array of structures. Use a loop to display all books with a price greater than $500.**
3. **Define a structure Employee with name, id, and salary. In main(), create a structure variable and a pointer to it. Use the pointer to assign values and print them.**
4. **Create a structure Student with members name, rollNo, and marks. Use dynamic memory allocation to create an array of n students, where n is input by the user. Take details of n students, then print them.**
5. **Write a c++ code for structure named book that contains following elements title (a string), author(a string), price (a floating point number) dynamically allocate an array of N books, input book details from the user using a function display all the books using a function. find and display the most expensive book using a function sort books by publication.**
6. **Define a structure Company that contains a nested structure Address with city and zip. The Company structure should also have name and revenue. Create an array of 3 companies, initialize their data, and display the company details along with their city and zip code.**
7. **Define a structure Car with members brand, year, and price. Write a function updatePrice(Car *c, float discount) that reduces the price by the given discount percentage. In main(), take user input for a car, apply a discount, and print the updated price.**
8. **Create a structure Hospital that contains a nested structure Doctor with name and specialization. Store an array of n hospitals using DMA. Each hospital should have a name and at most 3 doctors. Take input for**

hospitals and doctors, and display them using a function that takes a structure pointer as an argument.