



Institute of Geographical Information Systems

CS-212 - Object Oriented Programming LAB

Semester: Fall 2025

Class: SCEE-IGIS - 2024

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Due Date: Oct 15, 2025

LAB 06: Compositions

CLO Alignment

CLO	Description	Domain	Taxonomy Level	PLO
CLO3	Develop programs using OOP concepts such as encapsulation, composition, and abstraction.	Cognitive	3 (Application)	PLO3

Task # 1: Department → Faculty → University

Objective: To demonstrate multi-level composition and object interaction.

Requirements:

1. Create class Faculty with attributes:
 - `string facultyName`, `string designation`, `int publications`

Function: `void showFaculty()`

2. Create class Department with attributes:
 - `string deptName`
 - An array of Faculty objects (size 3)

Functions:

- `void inputFaculty()` to input details for all faculty
 - `void showDepartment()` to display all faculty in the department
3. Create class University with:
 - `string uniName`, `string location`
 - One Department object

Functions:

- `void showUniversity()` to display full info (University → Department → Faculty)

Challenge:

Implement hierarchical display using indentation:

University: NUST

Location: Islamabad

Department: IGIS

Faculty 1: Dr. Ayesha (Professor) - Publications: 25

Faculty 2: Mr. Bilal (Lecturer) - Publications: 10

Faculty 3: Ms. Sara (Assistant Professor) - Publications: 18

Screenshot:

```
1 #include <iostream>
2 using namespace std;
3
4 class Faculty
5 {
6 public:
7     string facultyName, designation;
8     int publications;
9     void showFaculty()
10    {
11        cout << facultyName << " (" << designation << ") - Publications: " << publications << endl;
12    }
13 };
14
15 class Department
16 {
17 public:
18     string deptName;
19     Faculty faculty[3];
20     void inputFaculty()
21     {
22         for (int i = 0; i < 3; i++)
23         {
24             cout << "Enter Faculty " << i + 1 << " Name: ";
25             getline(cin, faculty[i].facultyName);
26             cout << "Enter Designation: ";
27             getline(cin, faculty[i].designation);
28             cout << "Enter Publications: ";
29             cin >> faculty[i].publications;
30             cin.ignore();
31         }
32     }
33     void showDepartment()
34     {
35         inputFaculty();
36         for (int i = 0; i < 3; i++)
37         {
38             cout << "Faculty " << i + 1 << ": " << faculty[i].facultyName << " (" << faculty[i].designation << ") - Publications: " << faculty[i].publications << endl;
39         }
40     }
41 };
42
43 int main()
44 {
45     Department dept;
46     dept.showDepartment();
47     return 0;
48 }
```

PROBLEMS 3 OUTPUT DEBUG CONSOLE TERMINAL PORTS SPELL CHECKER 3

```
source /Users/alinawaz/Developer/Development/.venv/bin/activate
alinawaz@Alis-MacBook-Air Development % cd "/Users/alinawaz/Developer/Development/00P/Week-06/" && g++ Problem1.cpp -o Problem1 && ./Problem1
University: NUST
Location: Islamabad
Department: IGIS
Faculty 1: Dr. Ayesha (Professor) - Publications: 25
Faculty 2: Mr. Bilal (Lecturer) - Publications: 10
Faculty 3: Ms. Sara (Assistant Professor) - Publications: 18
alinawaz@Alis-MacBook-Air Week-06 % source /Users/alinawaz/Developer/Development/.venv/bin/activate
(.venv) alinawaz@Alis-MacBook-Air Week-06 %
```

Output:

```
source /Users/alinawaz/Developer/Development/.venv/bin/activate
alinawaz@Alis-MacBook-Air Development % cd "/Users/alinawaz/Developer/Development/00P/Week-06/" && g++
University: NUST
Location: Islamabad
Department: IGIS
Faculty 1: Dr. Ayesha (Professor) - Publications: 25
Faculty 2: Mr. Bilal (Lecturer) - Publications: 10
Faculty 3: Ms. Sara (Assistant Professor) - Publications: 18
alinawaz@Alis-MacBook-Air Week-06 % source /Users/alinawaz/Developer/Development/.venv/bin/activate
(.venv) alinawaz@Alis-MacBook-Air Week-06 %
```

Task # 2:

Objective:

To simulate object behavior and data dependency using composition.

Requirements:

1. **Create class Engine with attributes:**
 - int horsepower, string type
 - Function: void startEngine()

2. **Create class FuelTank with attributes:**
 - float capacity, float fuelLevel

Functions:

- void refuel(float liters)
 - bool consumeFuel(float amount) → returns false if insufficient fuel
-
3. **Create class Car with:**
 - string model
 - One Engine and one FuelTank

Functions:

- void startCar() → check if enough fuel, then start engine
- void drive(float distance) → consumes 0.1L/km
- void showStatus()

Sample Output:

Car: Civic 2023

Fuel Level: 20L

Engine started!

Driving 50 km...

Fuel left: 15L

Challenge:

Add fuel efficiency calculation and warning when fuel < 10%.

Screenshot:

The screenshot shows a Visual Studio Code editor with a C++ file named `Problem2.cpp` open. The code defines two classes: `Engine` and `FuelTank`. The `Engine` class has attributes `horsepower` and `type`, and a method `startEngine()` that prints "Engine started!". The `FuelTank` class has attributes `capacity` and `fuelLevel`, and methods `refuel()` and `consumeFuel()`. The `refuel()` method checks if the fuel level plus the amount added is less than or equal to the capacity, and if so, it updates the fuel level. The `consumeFuel()` method checks if the fuel level is greater than or equal to the amount consumed, and if so, it updates the fuel level and returns true. The `main` function in `Problem2.cpp` creates an `Engine` object and a `FuelTank` object, and calls their methods to simulate a car's operation.

```
1 #include <iostream>
2 using namespace std;
3
4 class Engine
5 {
6 public:
7     int horsepower;
8     string type;
9     void startEngine()
10    {
11        cout << "Engine started!" << endl;
12    }
13 };
14
15 class FuelTank
16 {
17 public:
18     float capacity, fuelLevel;
19     void refuel(float liters)
20     {
21         if (fuelLevel + liters <= capacity)
22             fuelLevel += liters;
23         else
24             fuelLevel = capacity;
25     }
26     bool consumeFuel(float amount)
27     {
28         if (fuelLevel >= amount)
29         {
30             fuelLevel -= amount;
31             return true;
32         }
33         return false;
34     }
35 }
```

The terminal output shows the execution of the program:

```
alinawaz@Alis-MacBook-Air Week-06 % source /Users/alinawaz/Developer/Development/.venv/bin/activate
(.venv) alinawaz@Alis-MacBook-Air Week-06 % cd "/Users/alinawaz/Developer/Development/OOP/Week-06/" && g++ Problem2.cpp -o Problem2 && ./Problem2
Car: Civic 2023
Fuel Level: 20L
Engine started!
Driving 50 km...
Fuel left: 15L
Fuel Efficiency: 10 km/L
(.venv) alinawaz@Alis-MacBook-Air Week-06 %
```

Output:

The terminal output shows the execution of the program, including the command to run it and the resulting output:

```
alinawaz@Alis-MacBook-Air Week-06 % source /Users/alinawaz/Developer/Development/.venv/bin/activate
(.venv) alinawaz@Alis-MacBook-Air Week-06 % cd "/Users/alinawaz/Developer/Development/OOP/Week-06/" && g++ Problem2.cpp -o Problem2 && ./Problem2
Car: Civic 2023
Fuel Level: 20L
Engine started!
Driving 50 km...
Fuel left: 15L
Fuel Efficiency: 10 km/L
(.venv) alinawaz@Alis-MacBook-Air Week-06 %
```

Task # 3: GIS Mapping System (Nested Composition with Arrays)

Objective: To design a real-world composite GIS model using nested class composition.

Requirements:

1. Class Coordinate:

- Attributes: float latitude, float longitude
- Function: void showCoordinate()

2. Class Location:

- Attributes: string name, one Coordinate
- Function: void showLocation()

3. Class MapFeature:

- Attributes: string featureType
- Array of Location objects (size 3)
- Function: void showFeature()

4. Class Map:

- Attribute: string mapName
- Array of MapFeature objects (size 2)
- Function: void displayMap()

Expected Output:

Map: Islamabad City Map

Feature: Educational Institutes

Location: NUST (33.643, 72.991)

Location: COMSATS (33.736, 73.093)

Location: Air University (33.718, 73.049)

Feature: Hospitals

Location: PIMS (33.716, 73.066)

Location: Shifa (33.694, 73.035)

Location: CDA Hospital (33.684, 73.048)

Challenge:

Allow user input for coordinates and dynamically count total locations on the map.

Submission Instructions

- Submit .cpp files for each task.
- Include a header comment block:

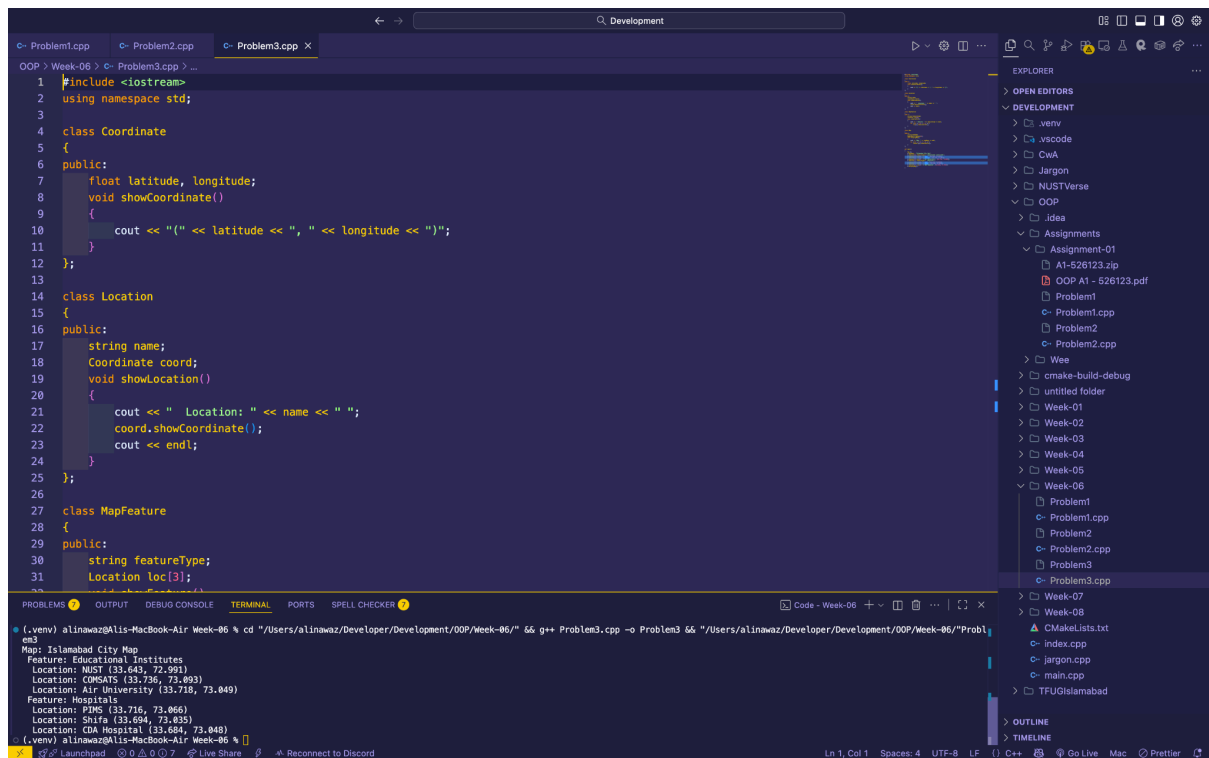
// Name: _____

// Reg. No: _____

// Section: _____

// Lab 09: Composition

Screenshot:

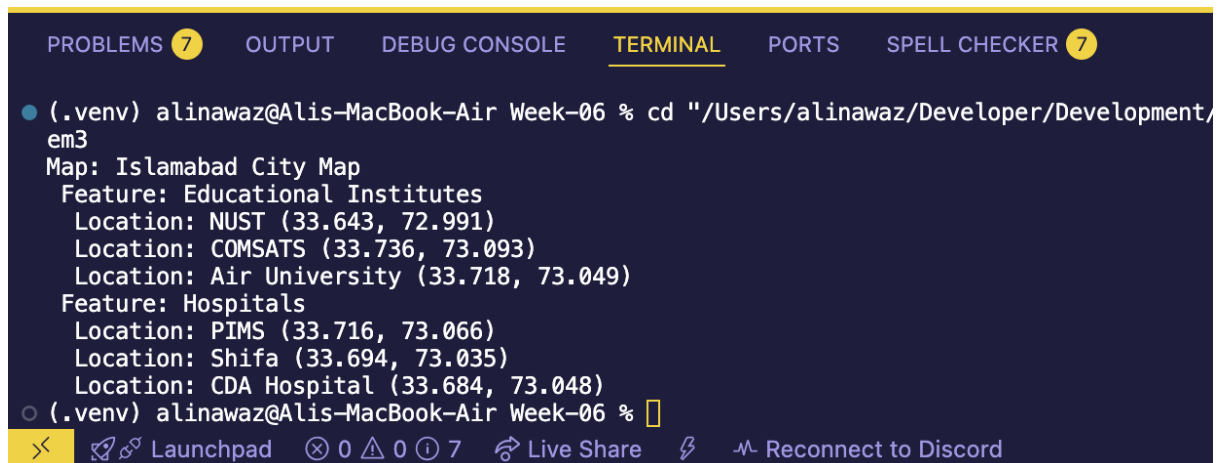


```
1 #include <iostream>
2 using namespace std;
3
4 class Coordinate
5 {
6 public:
7     float latitude, longitude;
8     void showCoordinate()
9     {
10         cout << "(" << latitude << ", " << longitude << ")";
11     }
12 };
13
14 class Location
15 {
16 public:
17     string name;
18     Coordinate coord;
19     void showLocation()
20     {
21         cout << "  Locations: " << name << " ";
22         coord.showCoordinate();
23         cout << endl;
24     }
25 };
26
27 class MapFeature
28 {
29 public:
30     string featureType;
31     Location loc[3];
32 };
33
34 int main()
35 {
36     MapFeature map;
37     map.featureType = "Educational Institutes";
38     map.loc[0].name = "NUST";
39     map.loc[0].latitude = 33.643;
40     map.loc[0].longitude = 72.991;
41     map.loc[1].name = "COMSATS";
42     map.loc[1].latitude = 33.736;
43     map.loc[1].longitude = 73.093;
44     map.loc[2].name = "Air University";
45     map.loc[2].latitude = 33.718;
46     map.loc[2].longitude = 73.049;
47
48     map.featureType = "Hospitals";
49     map.loc[0].name = "PIMS";
50     map.loc[0].latitude = 33.716;
51     map.loc[0].longitude = 73.066;
52     map.loc[1].name = "Shifa";
53     map.loc[1].latitude = 33.694;
54     map.loc[1].longitude = 73.035;
55     map.loc[2].name = "CDA Hospital";
56     map.loc[2].latitude = 33.684;
57     map.loc[2].longitude = 73.048;
58
59     map.showLocation();
60
61     return 0;
62 }
```

PROBLEMS 7 OUTPUT DEBUG CONSOLE **TERMINAL** PORTS SPELL CHECKER 7

```
(.venv) alinawaz@Alis-MacBook-Air Week-06 % cd "/Users/alinawaz/Developer/Development/em3"
Map: Islamabad City Map
Feature: Educational Institutes
Location: NUST (33.643, 72.991)
Location: COMSATS (33.736, 73.093)
Location: Air University (33.718, 73.049)
Feature: Hospitals
Location: PIMS (33.716, 73.066)
Location: Shifa (33.694, 73.035)
Location: CDA Hospital (33.684, 73.048)
(.venv) alinawaz@Alis-MacBook-Air Week-06 %
```

Output:



```
PROBLEMS 7 OUTPUT DEBUG CONSOLE TERMINAL PORTS SPELL CHECKER 7

(.venv) alinawaz@Alis-MacBook-Air Week-06 % cd "/Users/alinawaz/Developer/Development/em3"
Map: Islamabad City Map
Feature: Educational Institutes
Location: NUST (33.643, 72.991)
Location: COMSATS (33.736, 73.093)
Location: Air University (33.718, 73.049)
Feature: Hospitals
Location: PIMS (33.716, 73.066)
Location: Shifa (33.694, 73.035)
Location: CDA Hospital (33.684, 73.048)
(.venv) alinawaz@Alis-MacBook-Air Week-06 %
```