Programming with C and C++

CSC-101 (Lecture 31)

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- Difference between Static Array and Dynamic Array

Two Dimensional Arrays

- In C++

Static Array: `int  arr_2d[10][12];`

Dynamic Array:

```
  int **A;
A= new int*[rows];
 for (int i=0; i<rows; i++)
  A[i]=new int [cols];
```

- Two-dimensional arrays need not be rectangular. Each row can be a different length. Here's an example:

```
int **A;
A= new int*[rows];
A[0] = new int [1]; // A's first row has 1 column
A[1] = new int [2];  // A's second row has 2 columns
A[2] = new int [3];  // A's third row has 3 columns
A[3] = new int [5];  // A's fourth row has 5 columns
A[4] = new int [5];  // A's fifth row also has 5 columns
```

Classes and Objects in C++

- In object-oriented programming technique, we design a program using objects and classes.
  - object is an entity that has state and behavior. Here, state means data and behavior means functionality.
  - Object is created during run time.

Objects in C++

- Object is an instance of a class. All the members of the class can be accessed through object.

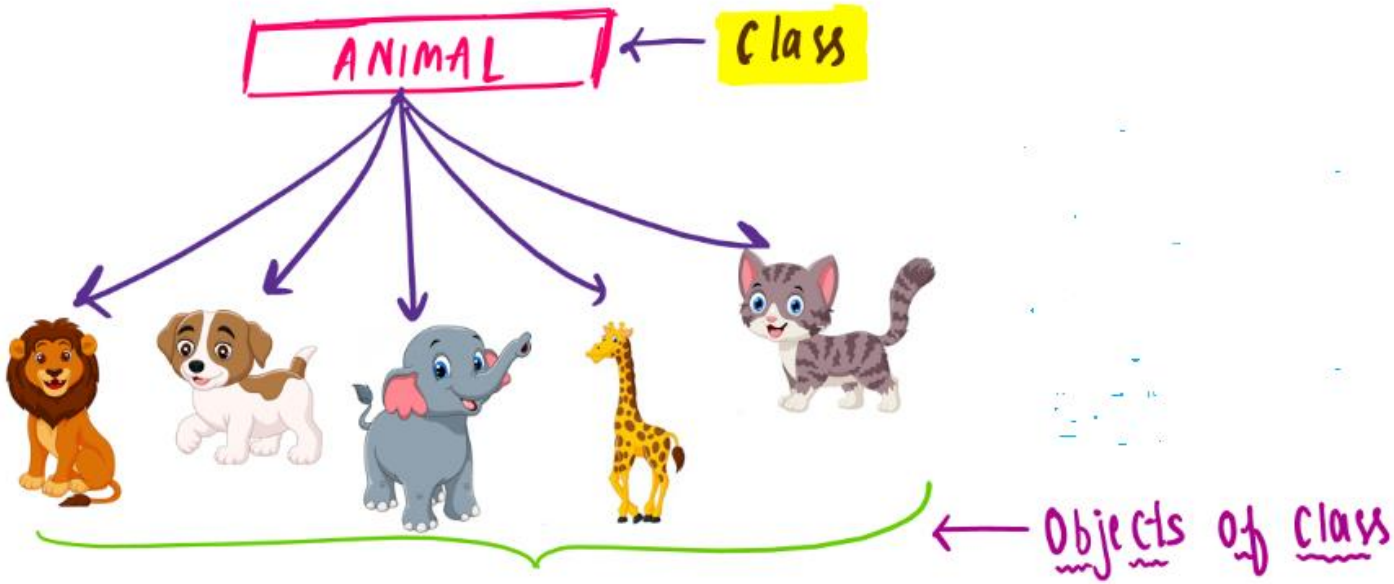
```
Time T1;
```

- Objects can be used to represent physical objects in the world, such as chair, bike, marker, pen, table, car etc.
- Objects can be physical or logical (tangible and intangible).
- Banking system is the example of intangible object.

An object has three characteristics

- **state:** represents data (value) of an object.
- **behavior:** represents the behavior (functionality) of an object such as deposit, withdraw etc.
- **identity:** Object identity is typically implemented via a unique ID.

- For Example: Pen is an object. Its name is Parker, color is Golden etc. known as its state. It is used to write, so writing is its behavior.
- **Object is an instance of a class.** Class is a template or blueprint from which objects are created. So object is the instance(result) of a class.



C++ Class

- Class is a group of similar objects.
- It is a template from which objects are created.
- It can have fields, functions, constructors etc.

A class in C++ can contain:

- Member data
- Member functions
- constructor
- block
- class

C++ Class

```
class <class_name>{
    member data; //field
    member function();
};
```

Example,

```
class Student
 {
     public:
     int id;  //field or data member
     float salary; //field or data member
     String name;//field or data member
 }
```

Class and Objects, Example 1

https://ideone.com/YySMvp

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

class Student {
   public:
      int id;//data member (also instance variable)
      string name;//data member(also instance variable)
};

int main() {
    Student s1; //creating an object of Student
    s1.id = 18;
    s1.name = "Virat Kohli";
    cout<<s1.id<<endl;
    cout<<s1.name<<endl;
    return 0;
}
```

stdout

```
18
Virat Kohli
```

Example 2

```cpp
#include <iostream>

using namespace std;

class Box {
   public:
      double length;   // Length of a box
      double breadth;  // Breadth of a box
      double height;   // Height of a box
};

int main() {
   Box Box1;        // Declare Box1 of type Box
   Box Box2;        // Declare Box2 of type Box
   double volume = 0.0;     // Store the volume of a box here

```

https://ideone.com/B3fnpz

```
    // box 1 specification
    Box1.height = 5.0;
    Box1.length = 6.0;
    Box1.breadth = 7.0;

    // box 2 specification
    Box2.height = 10.0;
    Box2.length = 12.0;
    Box2.breadth = 13.0;

    // volume of box 1
    volume = Box1.height * Box1.length * Box1.breadth;
    cout << "Volume of Box1 : " << volume <<endl;

    // volume of box 2
    volume = Box2.height * Box2.length * Box2.breadth;
    cout << "Volume of Box2 : " << volume <<endl;
    return 0;
}
```

stdout

```
Volume of Box1 : 210
Volume of Box2 : 1560
```

Initialize and Display data through member function

https://ideone.com/SMO06J

```
#include <iostream>
using namespace std;
class Student {
    public:
        int id;//data member (also instance variable)
        string name;//data member(also instance variable)
        void insert(int i, string n)
         {
            id = i;
            name = n;
         }
        void display()
         {
            cout<<id<<"  "<<name<<endl;
         }
};

```

```
int main(void) {
    Student s1; //creating an object of Student
    Student s2; //creating an object of Student
    s1.insert(18, "Virat");
    s2.insert(45, "Rohit");
    s1.display();
    s2.display();
    return 0;
}
```

stdout

```
18   Virat
45   Rohit
```

Storing and displaying employee information using method.

https://ideone.com/TFhgqS

```
#include <iostream>
using namespace std;
class Employee {
   public:
       int id;//data member (also instance variable)
       string name;//data member(also instance variable)
       float salary;
       void insert(int i, string n, float s)
        {
            id = i;
            name = n;
            salary = s;
        }
       void display()
        {
            cout<<id<<"  "<<name<<"  "<<salary<<endl;
        }
};

```

```
19
20 int main(void) {
21     Employee e1; //creating an object of Employee
22     Employee e2; //creating an object of Employee
23     e1.insert(8, "Ravindra",5000000);
24     e2.insert(99, "Ashwin", 7500000);
25     e1.display();
26     e2.display();
27     return 0;
28 }
29
```

Success #stdin #stdout 0.01s 5508KB

```
8   Ravindra   500000
99  Ashwin   750000
```

Example 1

- Design a C++ class for basic geometry calculations. You can have methods for calculating area, perimeter, and other geometric properties of shapes.

https://ideone.com/35HNjD

```cpp
#include <iostream>
#include <cmath>

using namespace std;

class GeometryCalculator {
public:
    // Calculate the area of a rectangle
    static double calculateRectangleArea(double length, double width) {
        return length * width;
    }

    // Calculate the perimeter of a rectangle
    static double calculateRectanglePerimeter(double length, double width) {
        return 2 * (length + width);
    }

```

```
    // Calculate the area of a circle
    static double calculateCircleArea(double radius) {
        return M_PI * radius * radius;
    }

    // Calculate the circumference of a circle
    static double calculateCircleCircumference(double radius) {
        return 2 * M_PI * radius;
    }

    // Calculate the area of a triangle using Heron's formula
    static double calculateTriangleArea(double sideA, double sideB, double sideC) {
        double s = (sideA + sideB + sideC) / 2.0;
        return sqrt(s * (s - sideA) * (s - sideB) * (s - sideC));
    }
};

```

```
int main() {
    double length = 5.0;
    double width = 3.0;
    double radius = 4.0;
    double sideA = 7.0;
    double sideB = 24.0;
    double sideC = 25.0;

    GeometryCalculator G1;


    // Calculate and display rectangle area and perimeter
    cout << "Rectangle Area: " << G1.calculateRectangleArea(length, width) << endl;
    cout << "Rectangle Perimeter: " << G1.calculateRectanglePerimeter(length, width)
    << endl;
```

```
    // Calculate and display circle area and circumference
    cout << "Circle Area: " << G1.calculateCircleArea(radius) << endl;
    cout << "Circle Circumference: " << G1.calculateCircleCircumference(radius)
    << endl;

    // Calculate and display triangle area
    cout << "Triangle Area: " << G1.calculateTriangleArea(sideA, sideB, sideC)
    << endl;

    return 0;
}
```

stdout

```
Rectangle Area: 15
Rectangle Perimeter: 16
Circle Area: 50.2655
Circle Circumference: 25.1327
Triangle Area: 84
```

Example 2

- write a C++ program using class and objects to add two distances given in meter and centimeter

```cpp
#include <iostream>

using namespace std;

class Distance {
private:
    int meters;
    int centimeters;

public:
    void getDistance() {
        cout << "Enter meters: ";
        cin >> meters;
        cout << "Enter centimeters: ";
        cin >> centimeters;
    }

```

https://ideone.com/ECT4fj

```
    void displayDistance() {
        cout << "Distance: " << meters << " meters " << centimeters
        << " centimeters" << endl;
    }

    Distance addDistances(const Distance& d1, const Distance& d2) {
        Distance result;
        result.meters = d1.meters + d2.meters;
        result.centimeters = d1.centimeters + d2.centimeters;

        if (result.centimeters >= 100) {
            result.meters += result.centimeters / 100;
            result.centimeters = result.centimeters % 100;
        }

        return result;
    }
};
```

```
}

int main() {
    Distance distance1, distance2, result;

    cout << "Enter the first distance:" << endl;
    distance1.getDistance();
    cout << "Enter the second distance:" << endl;
    distance2.getDistance();

    result = result.addDistances(distance1, distance2);

    cout << "Sum of the distances:" << endl;
    result.displayDistance();

    return 0;
}
```

stdin

```
10 95
20 85
```

stdout

```
Enter the first distance:
Enter meters: Enter centimeters: Enter the second distance:
Enter meters: Enter centimeters: Sum of the distances:
Distance: 31 meters 80 centimeters
```

Thank You!