



Module 21

Instructors: Abir
Das and
Sourangshu
Bhattacharya

Objectives &
Outline

ISA Relationship

Inheritance in
C++

Phones
Semantics

Module Summary

Module 21: Programming in C++

Inheritance (Part 1)

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Slides taken from NPTEL course on Programming in Modern C++

by **Prof. Partha Pratim Das**



Module Objectives

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Module Summary

- Understand ISA Relationship in OOAD and understand how hierarchy can be created in C++ with Inheritance



Module Outline

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Module Summary

1 ISA Relationship

2 Inheritance in C++

- Phones
- Semantics

3 Module Summary



ISA Relationship

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Module Summary

- We often find one object is a *specialization* / *generalization* of another
- OOAD models this using **ISA** relationship
- C++ models **ISA** relationship by *Inheritance* of classes



ISA Relationship

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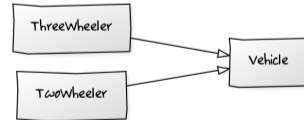
- **Rose ISA Flower**

- Rose has the properties of Flower – like fragrance, having petals etc.
- Rose has some additional properties – like rosy fragrance
- Rose is a *specialization* of Flower
- Flower is a *generalization* of Rose

- **Red Rose ISA Rose**

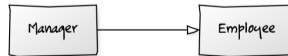
- Red Rose has the properties of Rose – like rosy fragrance etc.
- Red Rose has some additional properties – like it is red
- Red Rose is a *specialization* of Rose

- Rose is a *generalization* of Red Rose



- **TwoWheeler ISA Vehicle; ThreeWheeler ISA Vehicle**

- **Manager ISA Employee**





Inheritance in C++: Hierarchy

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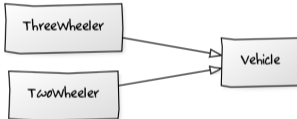
Module Summary

- **Manager ISA Employee [Single Inheritance]**



```
class Employee; // Base Class = Employee
class Manager: public Employee; // Derived Class = Manager; Base Class = Employee
```

- **TwoWheeler ISA Vehicle; ThreeWheeler ISA Vehicle [Hybrid Inheritance]**



```
class Vehicle; // Base Class = Vehicle -- Root
class TwoWheeler: public Vehicle; // Derived Class = TwoWheeler; Base Class = Vehicle
class ThreeWheeler: public Vehicle; // Derived Class = ThreeWheeler; Base Class = Vehicle
```

- **Red Rose ISA Rose ISA Flower [Multi-Level Inheritance]**



```
class Flower; // Base Class = Flower -- Root
class Rose: public Flower; // Derived Class = Rose; Base Class = Flower
class RedRose: public Rose; // Derived Class = RedRose; Base Class = Rose
```



Inheritance in C++: Phones

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Module Summary

- **Landline Phone**
 - Call: By dial / keyboard
 - Answer
 - Caller ID (with special attached device)
- **Mobile Phone**
 - Call: By keyboard – shows number
 - ▷ By Number
 - ▷ By Name
 - Answer
 - Caller ID
 - Redial
 - Set Ring Tone
 - Add Contact
 - ▷ Number
 - ▷ Name
- **Smart Phone**
 - Call: By touchscreen – shows number & photo
 - ▷ By Number
 - ▷ By Name
 - Answer
 - Caller ID
 - Redial
 - Set Ring Tone
 - Add Contact
 - ▷ Number
 - ▷ Name
 - ▷ Photo

- There exists a substantial overlap between the functionality of the phones
- A mobile phone is more capable than a land line phone and can perform (almost) all its functions
- A smart phone is more capable than a mobile phone and can perform (almost) all its functions
- **These phones belong to a Specialization / Generalization Hierarchy**



Inheritance in C++: Semantics

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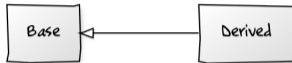
ISA Relationship

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Module Summary

- **Derived ISA Base**



```
class Base; // Base Class = Base
class Derived: public Base; // Derived Class = Derived
```

- Use keyword **public** after class name to denote inheritance
- Name of the Base class follow the keyword

Public inheritance means "is-a." Everything that applies to base classes must also apply to derived classes, because every derived class object is a base class object

– *Scott Meyers in Item 32, Effective C++ (3rd. Edition)*



Inheritance in C++: Semantics

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Module Summary

- **Derived ISA Base**
- **Data Members**
 - **Derived** class *inherits* all data members of **Base** class
 - **Derived** class may *add* data members of its own
- **Member Functions**
 - **Derived** class *inherits* all member functions of **Base** class
 - **Derived** class may *override* a member function of **Base** class by *redefining* it with the *same signature*
 - **Derived** class may *overload* a member function of **Base** class by *redefining* it with the *same name*; but *different signature*
 - **Derived** class *may add* new member functions
- **Access Specification**
 - **Derived** class *cannot access private* members of **Base** class
 - **Derived** class *can access protected* members of **Base** class
- **Construction-Destruction**
 - A *constructor* of the **Derived** class *must first* call a *constructor* of the **Base** class to construct the **Base** class instance of the **Derived** class
 - The *destructor* of the **Derived** class *must* call the *destructor* of the **Base** class to destruct the **Base** class instance of the **Derived** class



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Module Summary

- Understood Hierarchy or ISA Relationship in OOAD
- Introduced the Semantics of Inheritance in C++