Object Oriented Analysis and Design

Nirman Kaur

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INTRODUCTION

Object-Oriented Modeling (OOM) is an advance and fast growing area that provides a structured way of thinking about problems using models. Object- oriented models are useful for understanding problems, communicating with experts, preparing documentations and designing programs. The graphical notations are used to express object-oriented models. The object modeling technique covers object-oriented analysis and design and provides an object-oriented software development methodology. This technique is used to design a solution to the problem, and then implement the solution in a programming language. Objects, classes, links, association, generalisation, and inheritance are the fundamental concepts of object-oriented modeling technique.

CHAPTER AT A GLANCE

OBJECT-ORIENTED MODELING

The object-oriented modeling is one of the suitable techniques for handling a complex system. Using OOM, first an analysis model is built to take out the essential aspects of the application domain without regard to its implementation. This model contains objects related to the application domain and includes a description of the properties of the object. After which design decisions are made and details are added to the model and finally, the design model is implemented in a programming language. The modeling technique passes through the following process:

- System Analysis
- System Design
- Object Design
- Final Implementation

System Analysis: It is an initial stage where the problem is analysed and a model is built by the analysts.

System Design: At this stage, on the basis of system analysis model, the whole system is divided into subsystems to design system architecture.

Object Design: This is the stage where the design model is developed. The object design decides the data structure and algorithms to be implemented.

Final Implementation: At this stage, the final implementation of object design takes place in a programming language.

The object modeling technique combines three kinds of models:

- Object model
- Dynamic model
- Functional model

Object Model: The object model describes the objects in a system and their identity, their relationship and their operations. It provides a framework into which the dynamic and functional models can be placed. This model is represented graphically with object diagrams.

Dynamic Model: The dynamic model used to express the system behaviour with time and the sequence of operations. This model is represented graphically with state diagrams.

Functional Model: This model describes the aspects of data transformation in the system. It is represented with data flow diagrams.

BASIC PHILOSOPHY OF OBJECT-ORIENTATION

Following are the fundamental concepts that supported in object-oriented systems:

(i) **Abstraction:** *Abstraction* facilitates to extract out essential information of an object. It defines the conceptual boundaries of an object. It focusing on what an object is and what can it does before deciding how it should be implemented. During analysis, abstraction deals with the concepts of application domain rather than making designs.

(ii) **Encapsulation:** The term *encapsulation* referred to as data hiding where the implementation details of a class are kept hidden from the user. It has the ability to combine data structure and behaviour in a single entity.

(iii) **Polymorphism:** *Polymorphism* means having multiple forms. Using polymorphism the same operation may behave differently on different classes.

(iv) **Inheritance:** *Inheritance* is one of the popular concepts of object-oriented technique. A main class is broadly defined and then its subclasses are developed. Each subclass inherits all the properties of its main class i.e. super class.

CHARACTERISITCS OF OBJECT- ORIENTED MODELING

The purpose of object modeling is to describe objects and their characteristics. Following are the main characteristics of object-oriented modeling:

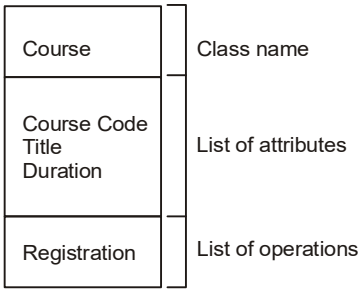
(i) Class and Objects

(ii) Links and Association

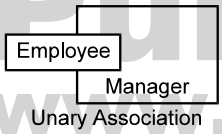
(iii) Generalisation and Inheritance

(i) **Class and Objects:** A class is a group of things having similar properties and characteristics. Classes and objects are the basic approach of data modeling. A class describes the attributes and operations of objects. Objects correspond to real world things and have state, behaviour and identity. State expresses the attribute types and values; behaviour express how an object acts and reacts and identity express a unique identity of objects. The structure and behaviour of similar objects are defined in their common class. When an object sends data to another object is known as

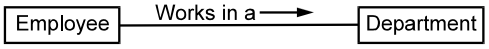
message passing. As shown in the following figure. Course is a class name, its list of attributes are Course Code, Title and Duration and the list of Operations of the course is Registration.



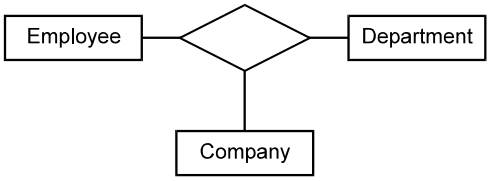
***(ii)* Links and Association:** A link shows a physical connection between objects and association which is a group of links having common structure. In other words, we can say that links in an association connect objects from the same class. The Association may be unary, binary or ternary. The ternary association cannot be converted into binary association.



Unary Association



Binary Association

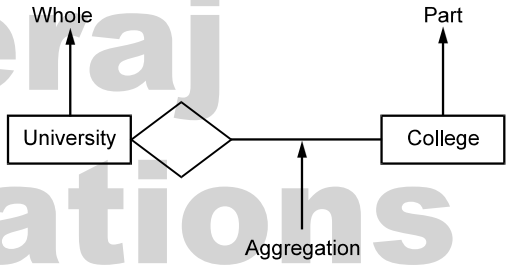


Ternary Association

Multiplicity: Multiplicity specifies how many instances of one class may relate to a single instance of an associated class. It could be one or many but it would be indicated by below indicators:

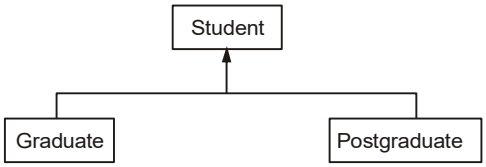
Indicator	Meaning
0..1	Zero or one
1	One only
0..	Zero or more
1..	One or more
N	Only n (where n>1)
0..n	Zero to n(where n>1)
1..n	One to n(wheren>1)

Aggregation: An aggregation is a special form of association between classes that represents the concept of "Whole-Part". The object from one class is composed of objects of the other component class. The composed class is called "whole" and the component class is called "parts". Aggregation is represented by placing a diamond next to the whole class. For example, College is a part of University.



***(iii)* Generalization and Inheritance**

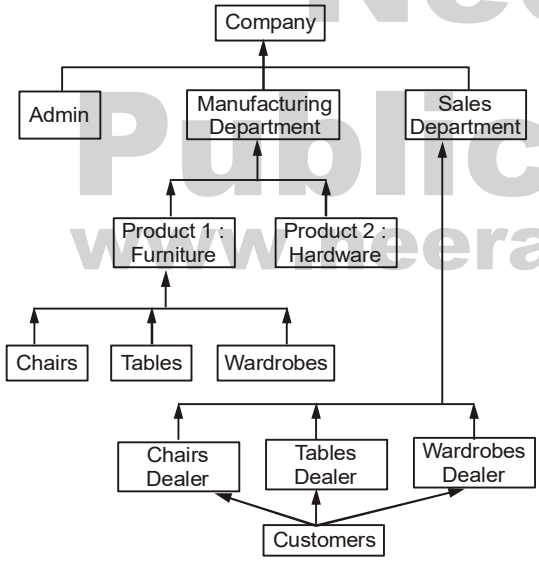
Generalization: Generalization is a concept to show similar objects. It is also called "a kind of relationship". In generalisation one class is super class and the other is subclass. The subclass is a specific case of super class. The generalisation graphically represented by a triangle which is connecting to super class to its subclass. The super class is connected by a line to the top of the triangle. The subclasses are connected by horizontal line. For example, a student could be a graduate or postgraduate.



Inheritance: Inheritance is one of the fundamental concepts of Object-Oriented Modeling. It helps to reuse the data and behaviour of existing class to other classes. When creating a class, instead of writing new data members, the new class could inherit the members of existing class. During Inheritance, we may also use the name of super class with subclass. This feature is known as overriding.

When one subclass inherits from only one super class, it is known as single inheritance. Whereas, when one subclass is inherited from more than one super class, is known as Multiple Inheritance.

An Object Model: The main function of an object model is to establish relationship among different classes.



It is an object model of a company having three departments: Admin, Manufacturing department and Sales department. The Manufacturing unit produces two products, namely Furniture and Hardware. In furniture it produces chairs, tables and wardrobes. The Sales department deals with dealers. Dealers used to get order from customers and place the order to sales department. The sales department further places the order to manufacturing department to produce the items.

Benefits of Object-oriented Modeling

OOM has several benefits. Few of them are enlisted below:

1. It is a very vast and fast development.
2. The Inheritance property of OOM makes the framework and designs reusable.
3. Using OOM technique, the quality of software development may be increased.
4. OOM also helps to reduce the development risks.

INRODUCTION TO OBJECT-ORIENTED ANALYSIS AND DESIGN: TOOLS

One of the most accepted language for Object-Oriented Analysis and Design is UML (Unified Modeling Language). The basic use of UML is for visualizing, specifying and final documentation. UML emphasizes the concepts of BOOCH, Object Modeling Technique and Object-Oriented Software Engineering. Most of the modern applications are based on object-oriented principles as classes, methods and inheritance. The CASE tools offer various benefits for the development of such applications. The CASE tools provide support for object-oriented modeling notations and methodologies. Following is a list of a few of the UML modeling tools that may keep on changing:

Action Semantics: This is used to define the action semantics for UML.

Argo UML: It is a design environment that provides support of object-oriented analysis.

ARTiSAN Software: It provides various UML-based CASE tools.

Bridge Point: It provides feature of UML modeling tool.

Magic Draw UML: It supports UML diagrams to convert into Magic draw–activity, class,