UML - Overview

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UML is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems.

UML was created by the Object Management Group (OMG) and UML 1.0 specification draft was proposed to the OMG in January 1997.

OMG is continuously making efforts to create a truly industry standard.

UML stands for **Unified Modeling Language**.

UML is different from the other common programming languages such as C++, Java, COBOL, etc.

UML is a pictorial language used to make software blueprints.

UML can be described as a general purpose visual modeling language to visualize, specify, construct, and document software system.

Although UML is generally used to model software systems, it is not limited within this boundary. It is also used to model non-software systems as well. For example, the process flow in a manufacturing unit, etc.

UML is not a programming language but tools can be used to generate code in various languages using UML diagrams. UML has a direct relation with object oriented analysis and design. After some standardization, UML has become an OMG standard.

Goals of UML

A picture is worth a thousand words, this idiom absolutely fits describing UML. Object-oriented concepts were introduced much earlier than UML. At that point of time, there were no standard methodologies to organize and consolidate the object-oriented development. It was then that UML came into picture.

There are a number of goals for developing UML but the most important is to define some general purpose modeling language, which all modelers can use and it also needs to be made simple to understand and use.

UML diagrams are not only made for developers but also for business users, common people, and anybody interested to understand the system. The system can be a software or non-software system. Thus it must be clear that UML is not a development method rather it accompanies with processes to make it a successful system.

In conclusion, the goal of UML can be defined as a simple modeling mechanism to model all possible practical systems in today’s complex environment.

A Conceptual Model of UML

To understand the conceptual model of UML, first we need to clarify what is a conceptual model? and why a conceptual model is required?

> A conceptual model can be defined as a model which is made of concepts and their relationships.
>
> A conceptual model is the first step before drawing a UML diagram. It helps to understand the entities in the real world and how they interact with each other.

As UML describes the real-time systems, it is very important to make a conceptual model and then proceed gradually. The conceptual model of UML can be mastered by learning the following three major elements −

- UML building blocks
- Rules to connect the building blocks
- Common mechanisms of UML

Object-Oriented Concepts

UML can be described as the successor of object-oriented (OO) analysis and design.

An object contains both data and methods that control the data. The data represents the state of the object. A class describes an object and they also form a hierarchy to model the real-world system. The hierarchy is represented as inheritance and the classes can also be associated in different ways as per the requirement.

Objects are the real-world entities that exist around us and the basic concepts such as abstraction, encapsulation, inheritance, and polymorphism all can be represented using UML.

UML is powerful enough to represent all the concepts that exist in object-oriented analysis and design. UML diagrams are representation of object-oriented concepts only. Thus, before learning UML, it becomes important to understand OO concept in detail.

Following are some fundamental concepts of the object-oriented world −

- **Objects** − Objects represent an entity and the basic building block.
- **Class** − Class is the blue print of an object.
- **Abstraction** − Abstraction represents the behavior of an real world entity.
- **Encapsulation** − Encapsulation is the mechanism of binding the data together and hiding them from the outside world.
- **Inheritance** − Inheritance is the mechanism of making new classes from existing ones.
- **Polymorphism** − It defines the mechanism to exists in different forms.

OO Analysis and Design

OO can be defined as an investigation and to be more specific, it is the investigation of objects. Design means collaboration of identified objects.

Thus, it is important to understand the OO analysis and design concepts. The most important purpose of OO analysis is to identify objects of a system to be designed. This analysis is also done for an existing system. Now an efficient analysis is only possible when we are able to start thinking in a way where objects can be identified. After identifying the objects, their relationships are identified and finally the design is produced.

The purpose of OO analysis and design can described as −

- Identifying the objects of a system.
- Identifying their relationships.
- Making a design, which can be converted to executables using OO languages.

There are three basic steps where the OO concepts are applied and implemented. The steps can be defined as

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OO Analysis → OO Design → OO implementation using OO languages
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The above three points can be described in detail as −

- During OO analysis, the most important purpose is to identify objects and describe them in a proper way. If these objects are identified efficiently, then the next job of design is easy. The objects should be identified with responsibilities. Responsibilities are the functions performed by the object. Each and every object has some type of responsibilities to be performed. When these responsibilities are collaborated, the purpose of the system is fulfilled.

The second phase is OO design. During this phase, emphasis is placed on the requirements and their fulfilment. In this stage, the objects are collaborated according to their intended association. After the association is complete, the design is also complete.

The third phase is OO implementation. In this phase, the design is implemented using OO languages such as Java, C++, etc.

Role of UML in OO Design

UML is a modeling language used to model software and non-software systems. Although UML is used for non-software systems, the emphasis is on modeling OO software applications. Most of the UML diagrams discussed so far are used to model different aspects such as static, dynamic, etc. Now whatever be the aspect, the artifacts are nothing but objects.

If we look into class diagram, object diagram, collaboration diagram, interaction diagrams all would basically be designed based on the objects.

Hence, the relation between OO design and UML is very important to understand. The OO design is transformed into UML diagrams according to the requirement. Before understanding the UML in detail, the OO concept should be learned properly. Once the OO analysis and design is done, the next step is very easy. The input from OO analysis and design is the input to UML diagrams.

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