**5. System Design:**

**5.2. UML DIAGRAMS**

The System Design Document describes the system requirements, operating environment, system and subsystem architecture, files and database design, input formats, output layouts, human-machine interfaces, detailed design, processing logic, and external interfaces.

**Global Use Case Diagrams:**

Identification of actors:

**Actor:** Actor represents the role a user plays with respect to the system. An actor interacts with, but has no control over the use cases.

Graphical representation:



<<Actor name>>

An actor is someone or something that:

Interacts with or uses the system.

* Provides input to and receives information from the system.
* Is external to the system and has no control over the use cases.

Actors are discovered by examining:

* Who directly uses the system?
* Who is responsible for maintaining the system?
* External hardware used by the system.
* Other systems that need to interact with the system.

Questions to identify actors:

* + Who is using the system? Or, who is affected by the system? Or, which groups need help from the system to perform a task?
  + Who affects the system? Or, which user groups are needed by the system to perform its functions? These functions can be both main functions and secondary functions such as administration.
  + Which external hardware or systems (if any) use the system to perform tasks?
  + What problems does this application solve (that is, for whom)?
  + And, finally, how do users use the system (use case)? What are they doing with the system?

The actors identified in this system are:

1. **System Administrator**
2. **Customer**
3. **Customer Care**

Identification of usecases:

**Usecase:** A use case can be described as a specific way of using the system from a user’s (actor’s) perspective.

**Graphical representation:**



A more detailed description might characterize a use case as:

* Pattern of behavior the system exhibits
* A sequence of related transactions performed by an actor and the system
* Delivering something of value to the actor

Use cases provide a means to:

* capture system requirements
* communicate with the end users and domain experts
* test the system

Use cases are best discovered by examining the actors and defining what the actor will be able to do with the system.

Guide lines for identifying use cases:

* For each actor, find the tasks and functions that the actor should be able to perform or that the system needs the actor to perform. The use case should represent a course of events that leads to clear goal
* Name the use cases.
* Describe the use cases briefly by applying terms with which the user is familiar.

This makes the description less ambiguous

Questions to identify use cases:

* What are the tasks of each actor?
* Will any actor create, store, change, remove or read information in the system?
* What use case will store, change, remove or read this information?
* Will any actor need to inform the system about sudden external changes?
* Does any actor need to inform about certain occurrences in the system?
* What usecases will support and maintains the system?

**Flow of Events**

A flow of events is a sequence of transactions (or events) performed by the system. They typically contain very detailed information, written in terms of what the system should do, not how the system accomplishes the task. Flow of events are created as separate files or documents in your favorite text editor and then attached or linked to a use case using the Files tab of a model element.

A flow of events should include:

* When and how the use case starts and ends
* Use case/actor interactions
* Data needed by the use case
* Normal sequence of events for the use case
* Alternate or exceptional flows

Construction of Usecase diagrams:

Use-case diagrams graphically depict system behavior (use cases). These diagrams present a high level view of how the system is used as viewed from an outsider’s (actor’s) perspective. A use-case diagram may depict all or some of the use cases of a system.

A use-case diagram can contain:

* actors ("things" outside the system)
* use cases (system boundaries identifying what the system should do)
* Interactions or relationships between actors and use cases in the system including the associations, dependencies, and generalizations.

Relationships in use cases:

**1. Communication:**

The communication relationship of an actor in a usecase is shown by connecting the actor symbol to the usecase symbol with a solid path. The actor is said to communicate with the usecase.

**2. Uses:**

A Uses relationship between the usecases is shown by generalization arrow from the usecase.

**3. Extends:**

The extend relationship is used when we have one usecase that is similar to another usecase but does a bit more. In essence it is like subclass.

**SEQUENCE DIAGRAMS**

A sequence diagram is a graphical view of a scenario that shows object interaction in a time-based sequence what happens first, what happens next. Sequence diagrams establish the roles of objects and help provide essential information to determine class responsibilities and interfaces.

There are two main differences between sequence and collaboration diagrams: sequence diagrams show time-based object interaction while collaboration diagrams show how objects associate with each other. A sequence diagram has two dimensions: typically, vertical placement represents time and horizontal placement represents different objects.

**Object:**

An object has state, behavior, and identity. The structure and behavior of similar objects are defined in their common class. Each object in a diagram indicates some instance of a class. An object that is not named is referred to as a class instance.

The object icon is similar to a class icon except that the name is underlined:

An object's concurrency is defined by the concurrency of its class.

**Message:**

A message is the communication carried between two objects that trigger an event. A message carries information from the source focus of control to the destination focus of control. The synchronization of a message can be modified through the message specification. Synchronization means a message where the sending object pauses to wait for results.

**Link:**

A link should exist between two objects, including class utilities, only if there is a relationship between their corresponding classes. The existence of a relationship between two classes symbolizes a path of communication between instances of the classes: one object may send messages to another. The link is depicted as a straight line between objects or objects and class instances in a collaboration diagram. If an object links to itself, use the loop version of the icon.

**CLASS DIAGRAM:**

Identification of analysis classes:

A class is a set of objects that share a common structure and common behavior (the same attributes, operations, relationships and semantics). A class is an abstraction of real-world items.

There are 4 approaches for identifying classes:

1. Noun phrase approach:
2. Common class pattern approach.
3. Use case Driven Sequence or Collaboration approach.
4. Classes , Responsibilities and collaborators Approach
5. **Noun Phrase Approach:**

The guidelines for identifying the classes:

* + Look for nouns and noun phrases in the usecases.
  + Some classes are implicit or taken from general knowledge.
  + All classes must make sense in the application domain; Avoid computer

implementation classes – defer them to the design stage.

* + Carefully choose and define the class names After identifying the classes we have to eliminate the following types of classes:
* Adjective classes.

1. **Common class pattern approach:**

The following are the patterns for finding the candidate classes:

* + Concept class.
  + Events class.
  + Organization class
  + Peoples class
  + Places class
  + Tangible things and devices class.

1. **Use case driven approach:**

We have to draw the sequence diagram or collaboration diagram. If there is need for some classes to represent some functionality then add new classes which perform those functionalities.

1. **CRC approach:**

The process consists of the following steps:

* + Identify classes’ responsibilities ( and identify the classes )
  + Assign the responsibilities
  + Identify the collaborators.

Identification of responsibilities of each class:

The questions that should be answered to identify the attributes and methods of a class respectively are:

1. What information about an object should we keep track of?
2. What services must a class provide?

Identification of relationships among the classes:

Three types of relationships among the objects are:

Association: How objects are associated?

Super-sub structure: How are objects organized into super classes and sub classes?

Aggregation: What is the composition of the complex classes?

Association:

The **questions** that will help us to identify the associations are:

1. Is the class capable of fulfilling the required task by itself?
2. If not, what does it need?
3. From what other classes can it acquire what it needs?

Guidelines for identifying the tentative associations:

* A dependency between two or more classes may be an association. Association often corresponds to a verb or prepositional phrase.
* A reference from one class to another is an association. Some associations are implicit or taken from general knowledge.

Some common association patterns are:

Location association like part of, next to, contained in…..

Communication association like talk to, order to ……

We have to eliminate the unnecessary association like implementation associations, ternary or n-ary associations and derived associations.

Super-sub class relationships:

Super-sub class hierarchy is a relationship between classes where one class is the parent class of another class (derived class).This is based on inheritance.

Guidelines for identifying the super-sub relationship, a generalization are

1***.* Top-down*:***

Look for noun phrases composed of various adjectives in a class name. Avoid excessive refinement. Specialize only when the sub classes have significant behavior.

2.**Bottom-up*:***

Look for classes with similar attributes or methods. Group them by moving the common attributes and methods to an abstract class. You may have to alter the definitions a bit.

3.**Reusability*:***

Move the attributes and methods as high as possible in the hierarchy.

4. **Multiple inheritances*:***

Avoid excessive use of multiple inheritances. One way of getting benefits of multiple inheritances is to inherit from the most appropriate class and add an object of another class as an attribute.

**Aggregation or a-part-of relationship:**

It represents the situation where a class consists of several component classes. A class that is composed of other classes doesn’t behave like its parts. It behaves very difficultly. The major properties of this relationship are transitivity and anti symmetry.

The **questions** whose answers will determine the distinction between the part and whole relationships are:

* Does the part class belong to the problem domain?
* Is the part class within the system’s responsibilities?
* Does the part class capture more than a single value?( If not then simply include it as an attribute of the whole class)
* Does it provide a useful abstraction in dealing with the problem domain?

There are three types of aggregation relationships. They are:

**Assembly:**

It is constructed from its parts and an assembly-partsituation physically exists.

**Container:**

A physical whole encompasses but is not constructed from physical parts.

**Collection member:**

A conceptual whole encompasses parts that may be physical or conceptual. The container and collection are represented by hollow diamonds but composition is represented by solid diamond.

**Class**

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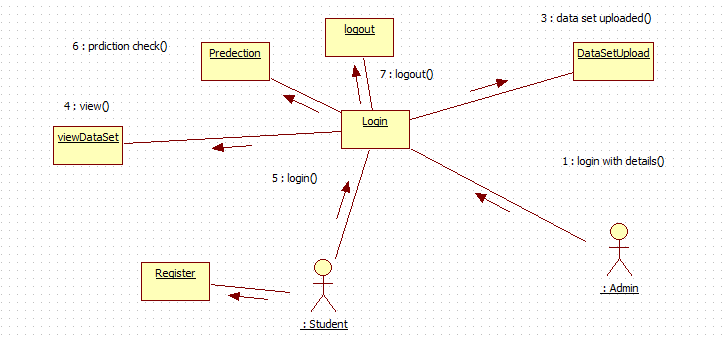
**Usecase**

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**Seq**

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**Collabrotion**

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**State**

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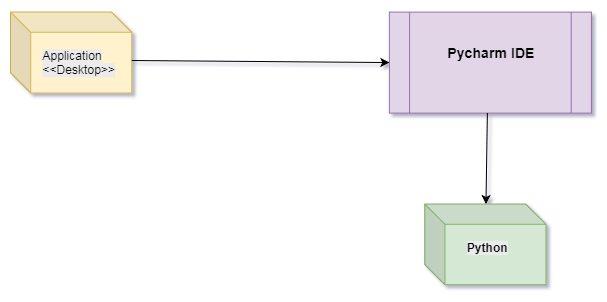
**Activity**

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**Component**

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**Deployment:**

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