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- In this session, you will learn to:
  - Identify relationships between classes

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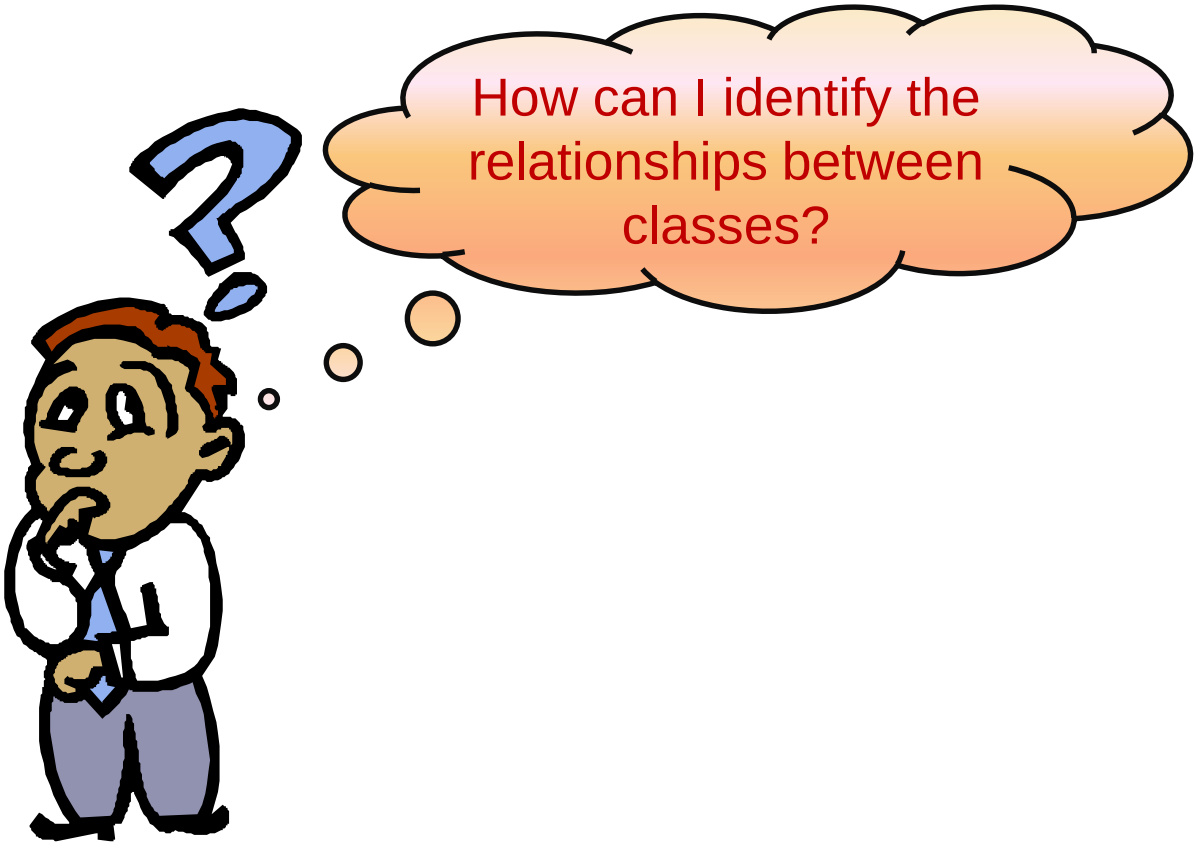

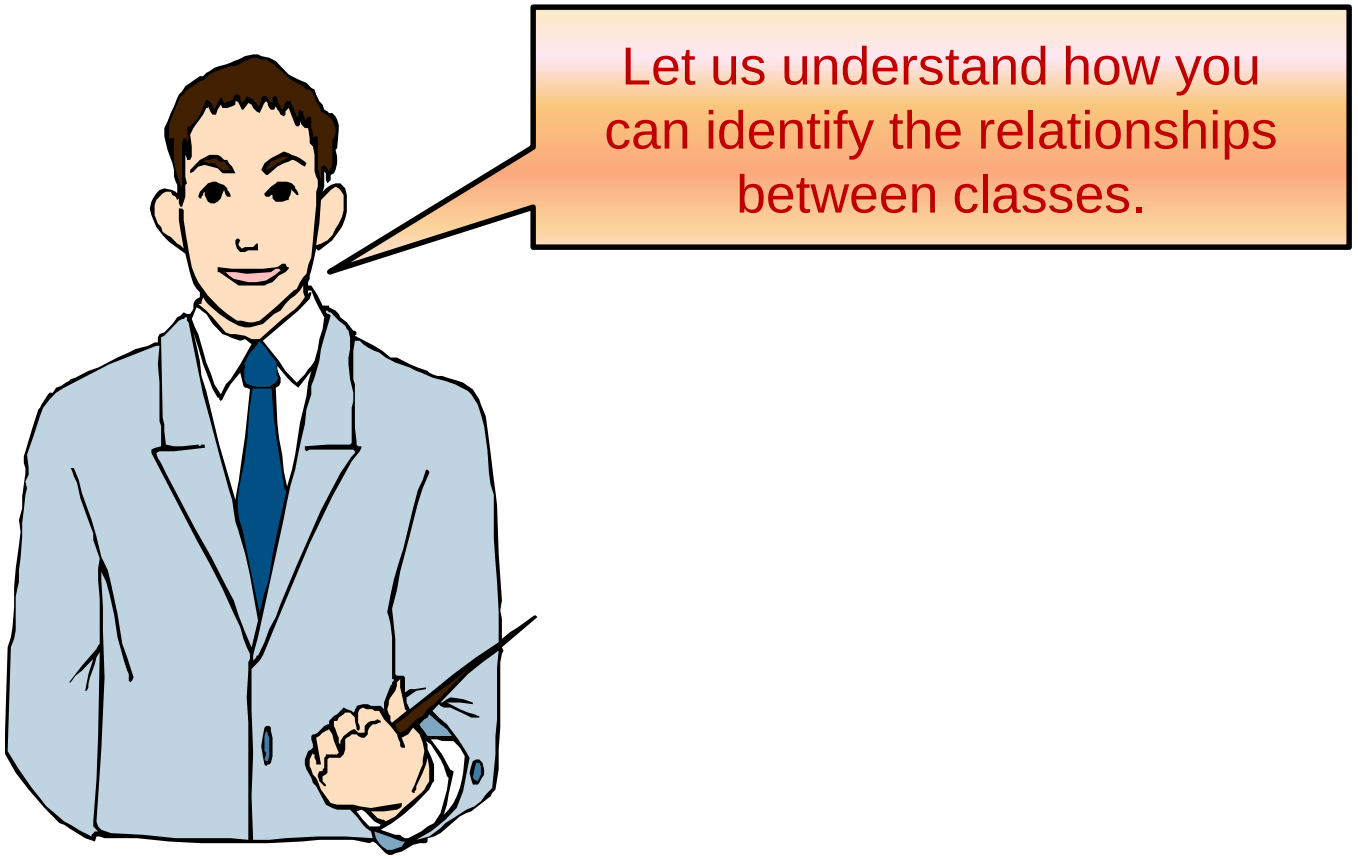
Let us understand how you can identify the relationships between classes.

- In OOP, classes and objects are related to each other.
- An object's behavior is shown by the action it performs in response to the message sent by another object.
- This behavior can be used to find out the relationship between the objects and classes.

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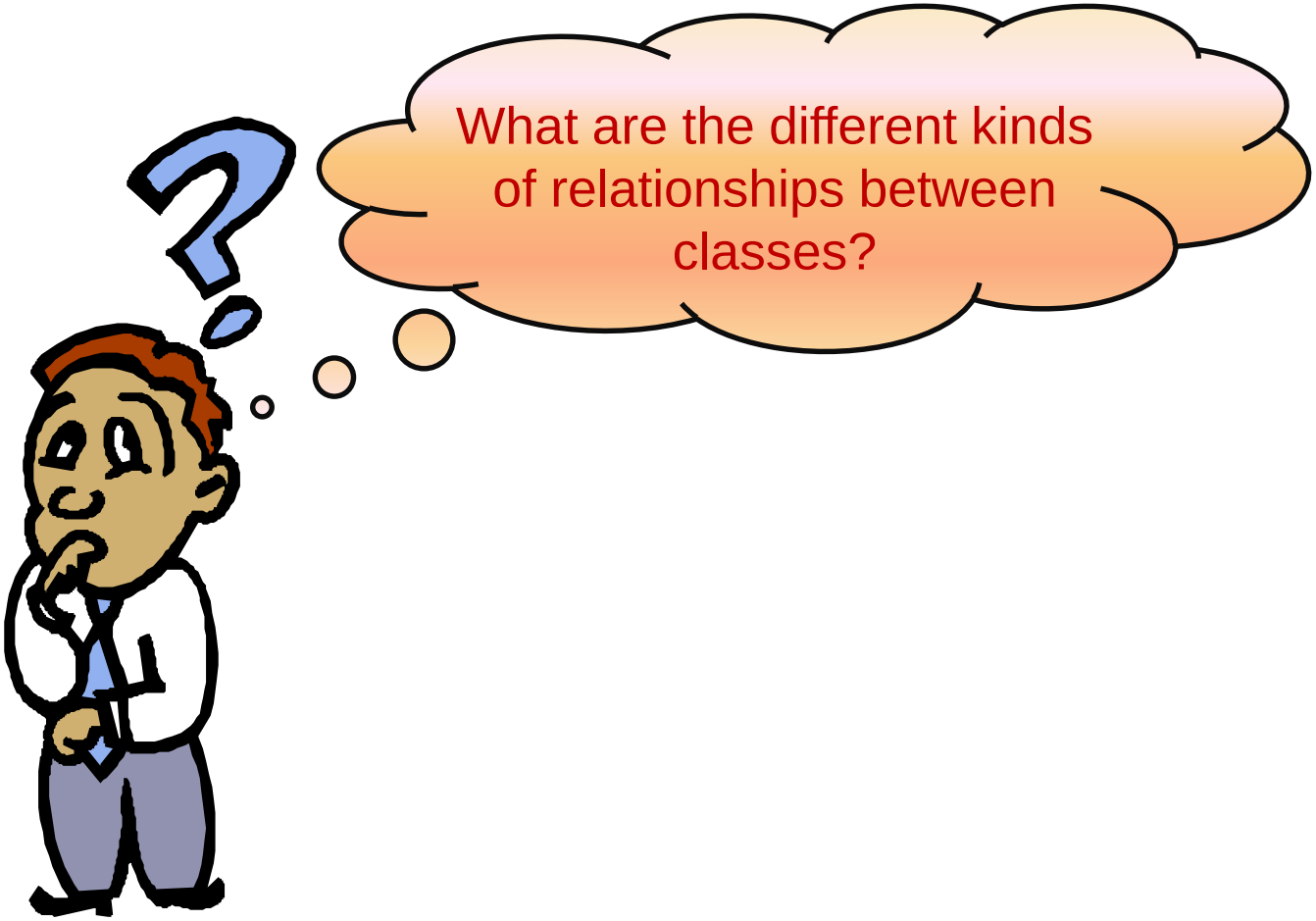
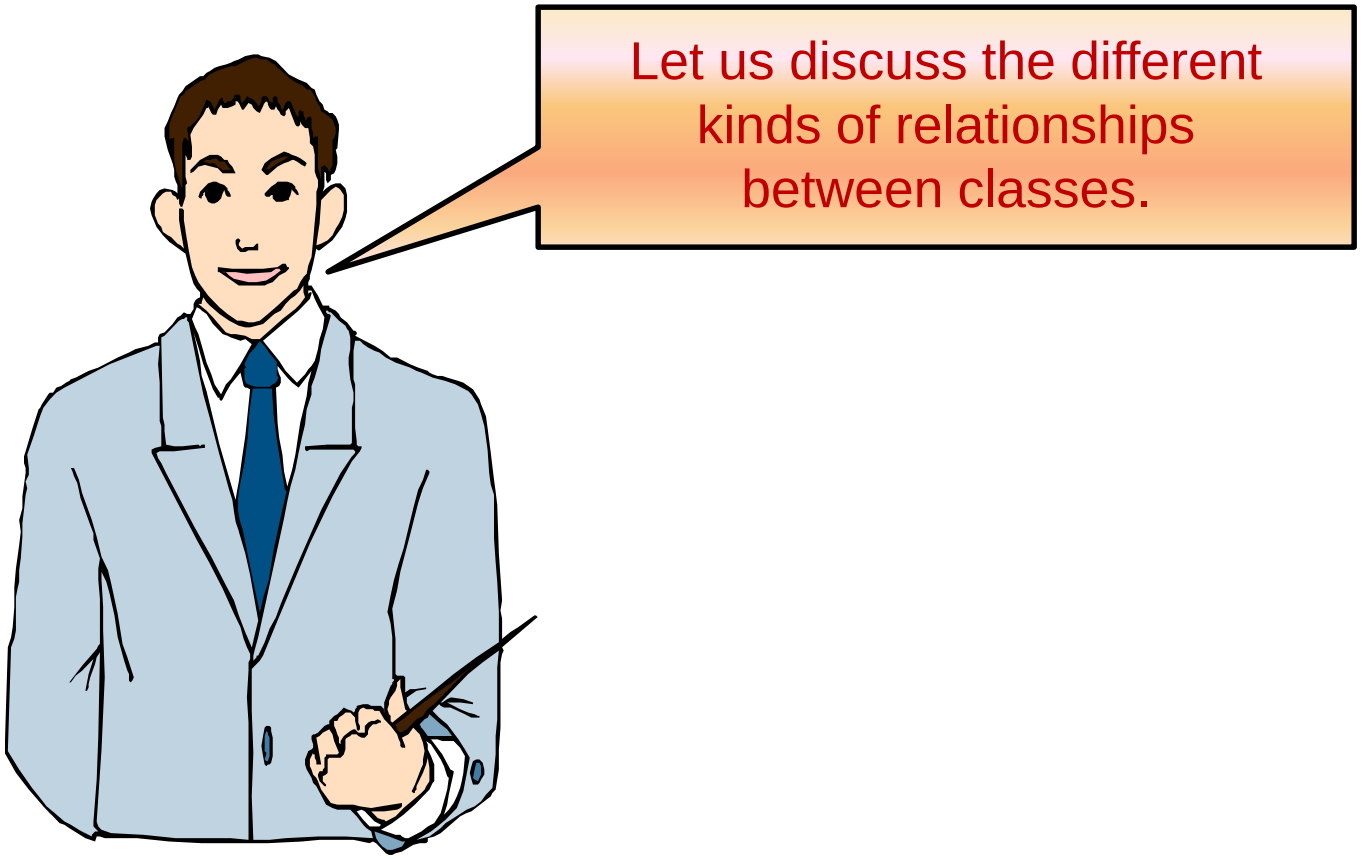
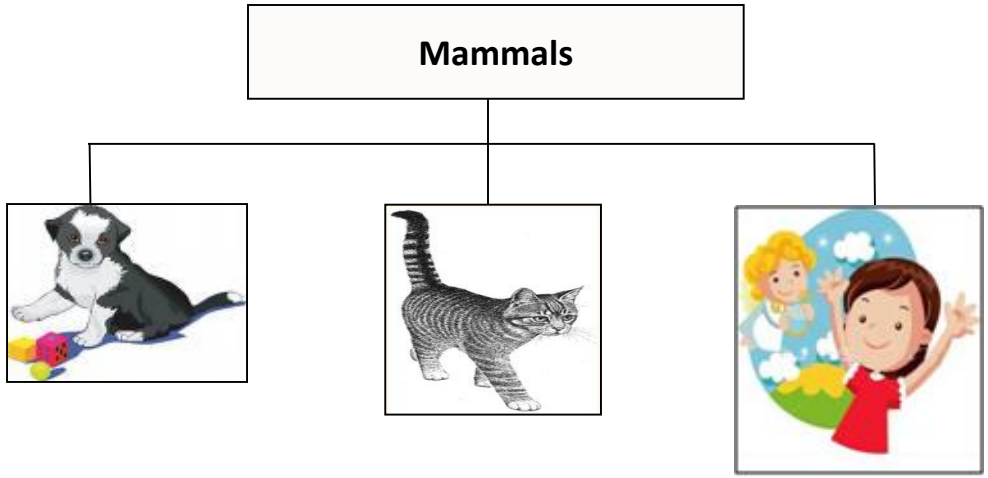

What are the different kinds of relationships between classes?


Let us discuss the different kinds of relationships between classes.

- The following relationships can be established between the objects of different classes:
  - Inheritance relationship
  - Composition relationship
  - Utilization relationship
  - Instantiation relationship

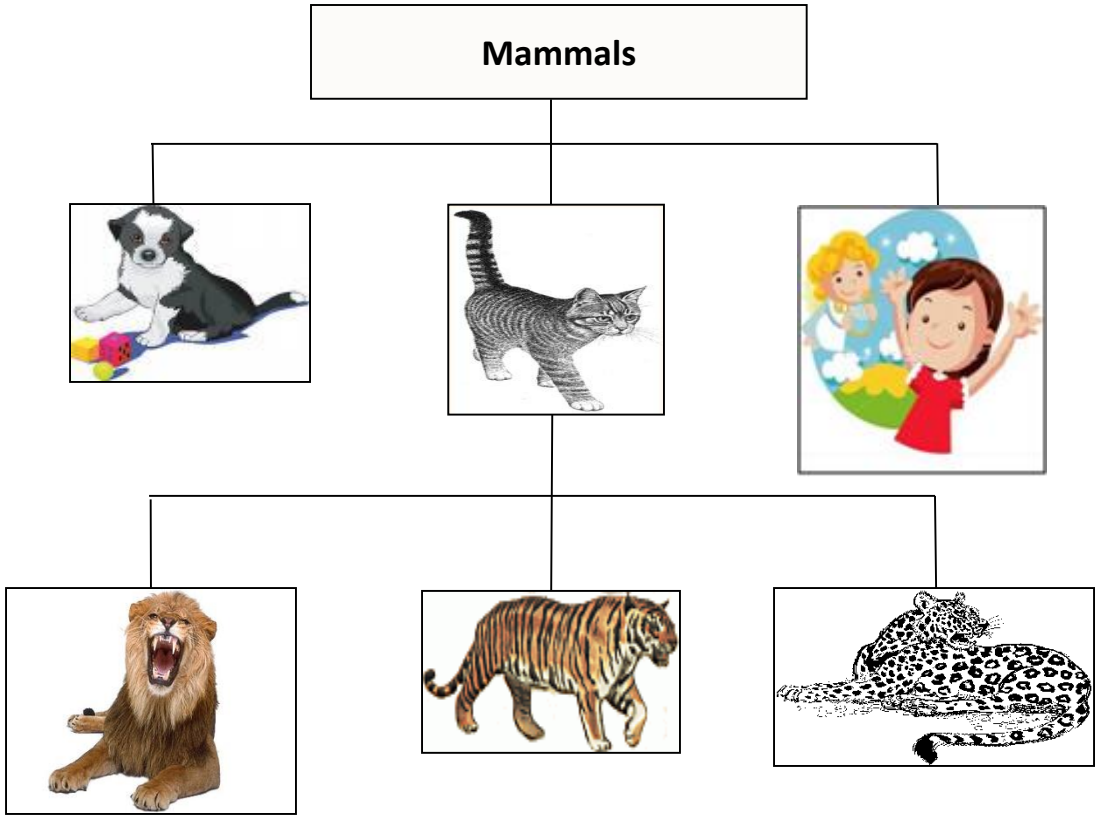
- In OOP, you use classes to inherit commonly used state and behavior from other classes.
- In C#, each class is allowed to inherit from one class and each class can be inherited by unlimited number of classes.

- The following figure shows the hierarchy of the inheritance relationship between the `Mammals` class and other classes.



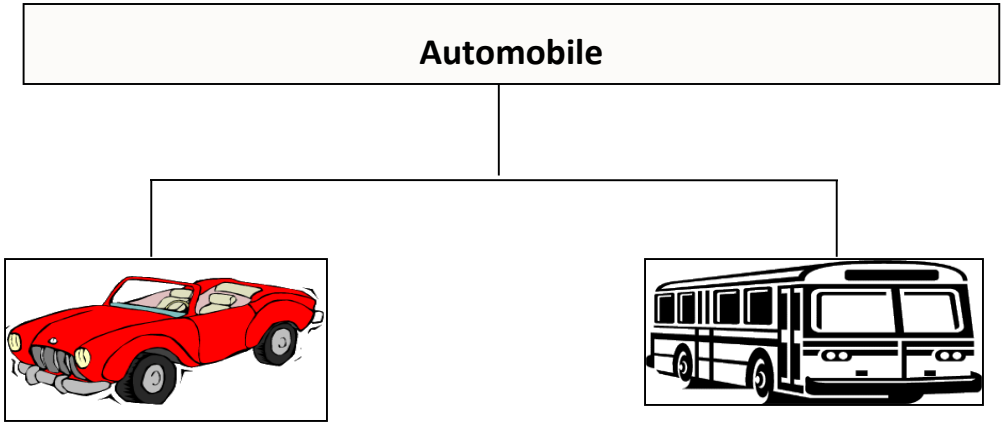
The `Dogs`, `Cats`, and `Human` classes have similar characteristics and they have inherited these attributes from the `Mammals` class.

- The following figure shows the hierarchy of the inheritance relationship between the `Mammals` class and other classes.



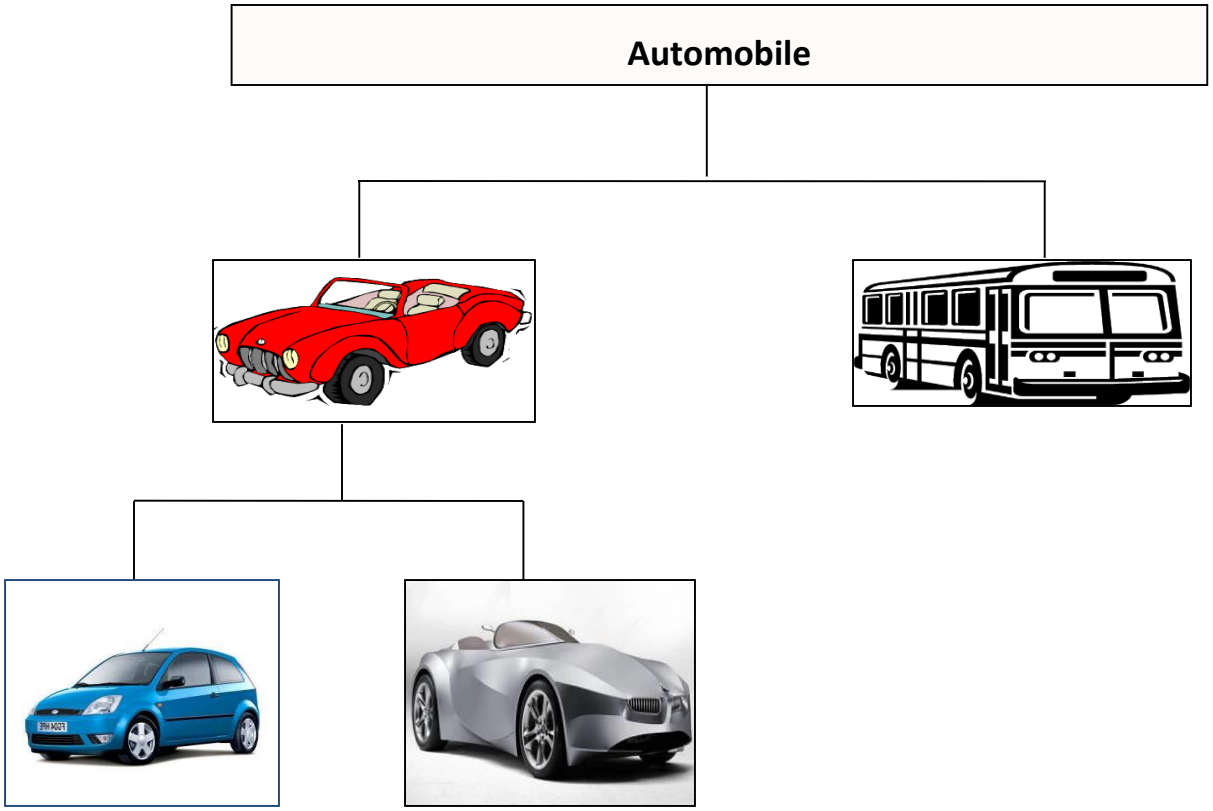
`Lion`, `Tiger`, and `Leopard` classes have similar characteristics and they have inherited these attributes from the `Cats` class.

- The following figure shows hierarchy of the subclasses of a superclass.



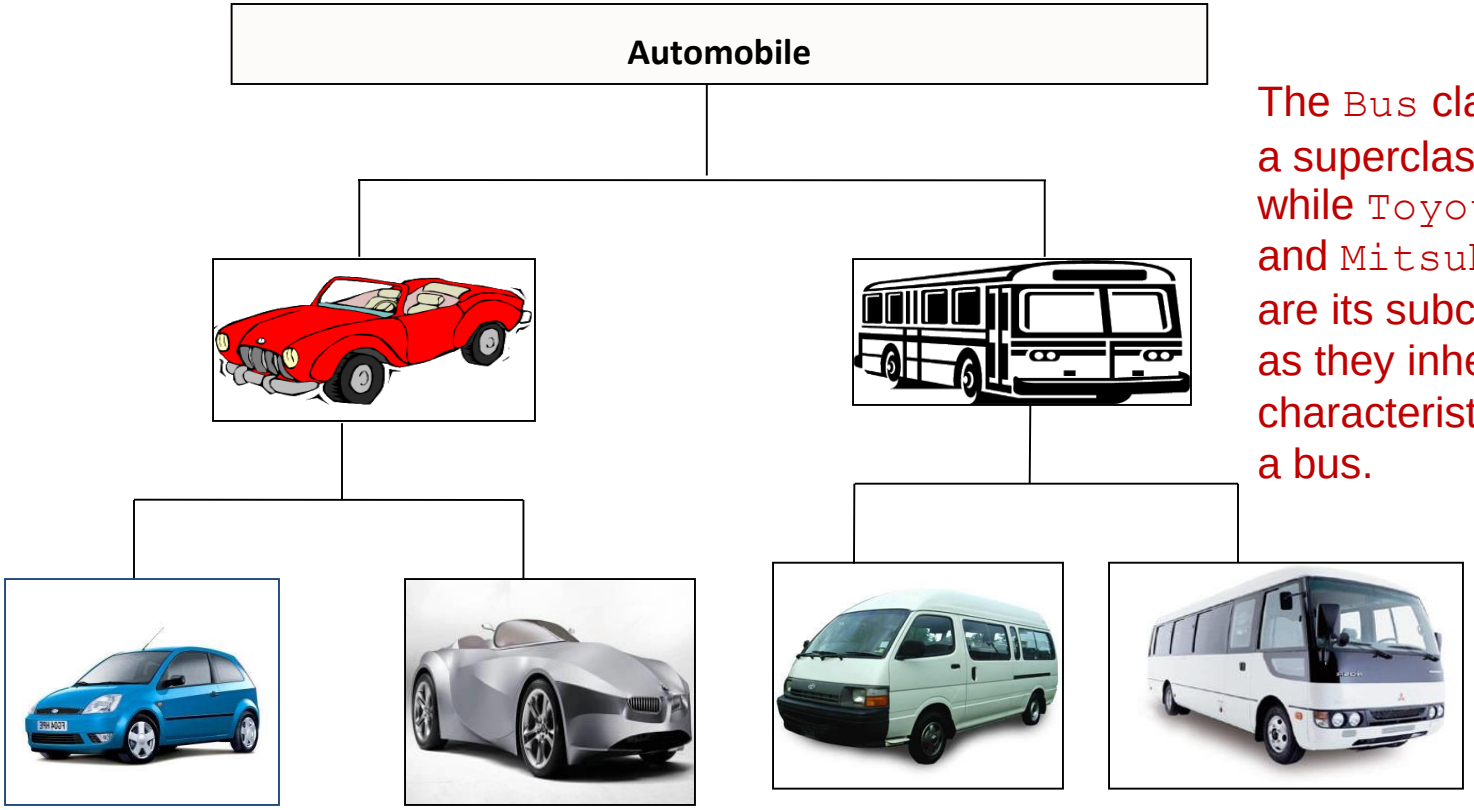
The `Automobile` class is a superclass while `Bus` and `Car` are its subclasses.

- The following figure shows the hierarchy of the subclasses of a superclass.



The `Car` class is a superclass while `Ford` and `BMW` are its subclasses as they inherit the characteristics of a car.

- The following figure shows the hierarchy of the subclasses of a superclass.



The `Bus` class is a superclass while `Toyota` and `Mitsubishi` are its subclasses as they inherit the characteristics of a bus.

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- The superclass is normally a generalized (common) class.
- Generalization means that multiple classes can inherit certain attributes from the same superclass.
- Generalization is needed to create programs that can be customized in accordance with new requirements.
- The superclass represents generalization, and the subclass represents specialization, where attributes and methods from the superclass are added, modified, or hidden in the subclasses.
- The process where the subclasses redefine the function of the superclass is called overriding.

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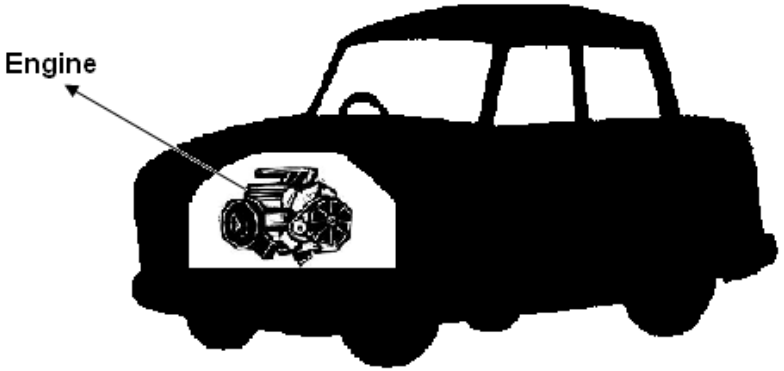
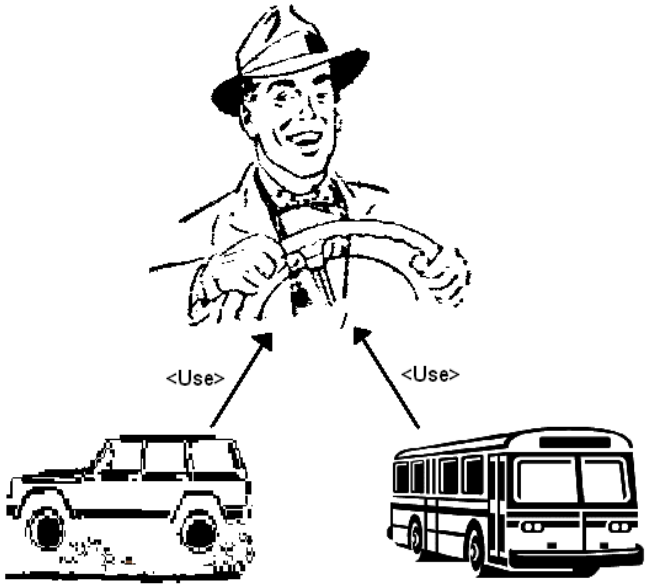
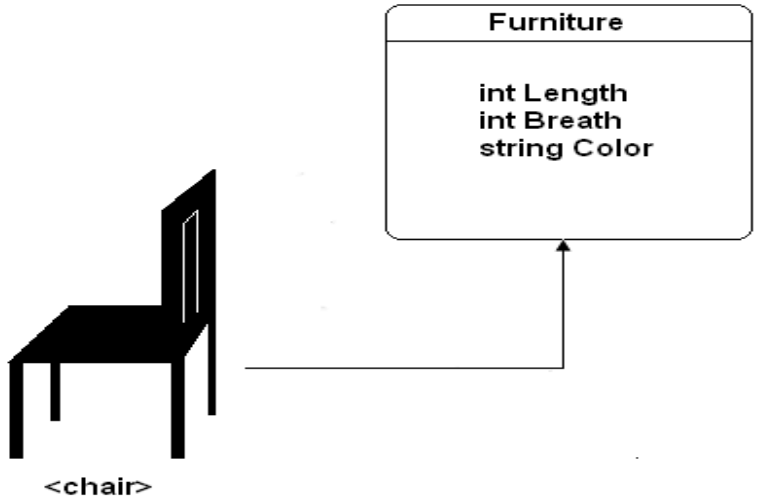
- Composition relationship: OOP allows you to form an object, which includes another object as its part. This mechanism of forming an object is called composition.
- Composition is used for objects that have a “has-a” relationship to each other.
- The following figure shows the composition relationship between a car and an engine.



- Utilization relationship: OOP allows a class to make use of another class. This kind of relationship is called utilization relationship.
- The following figure shows the utilization relationship between a car and a driver; and a bus and a driver.

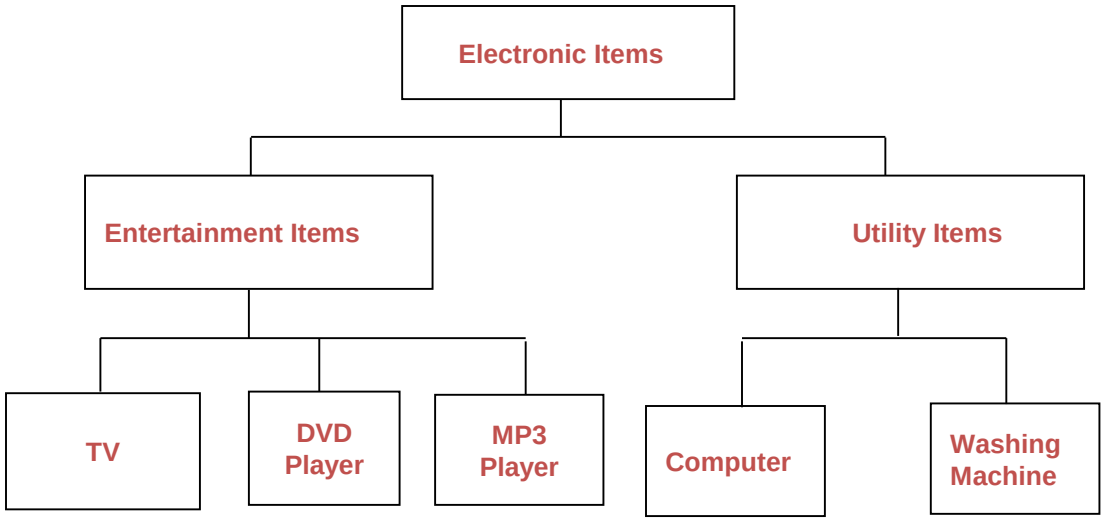


- Instantiation relationship: An instantiation relationship is a relationship between a class and an instance of that class.
- The following figure shows the instantiation relationship between a `chair` object and the `Furniture` class.



- Build the hierarchy of TV, Computer, DVD Player, MP3 Player, and washing machine. You can generalize wherever possible based on the usage.

- Answer:
  - The following figure shows the hierarchy of the class objects.



- Identify the relationship between the following class pairs:
  1. Television - Speaker
  2. Mammal -Tiger
  3. Garment - Shirt
  4. Cup - Tea
  5. Computer - Microprocessor

- Answer:

  The following relationship exist between the preceding class pairs:
  - 5 and 1 are examples of composition relationships.
  - 3 and 2 are examples of inheritance relationships.
  - 4 does not exhibit any relationship. Tea is not an attribute of cup.

- Consider a scenario, where a secretary has been asked by his boss to type and send a document to the director of the company. The secretary types the document on the typewriter and sends it to the director.

  Identify the relationship between the secretary and the typewriter.

- Answer:
  - The utilization relationship exists between the secretary and the typewriter as the secretary uses the typewriter to type the document.

- In this session, you learned that:
  - The four kinds of relationships that exist among classes are:
    - Inheritance relationship
    - Composition relationship
    - Utilization relationship
    - Instantiation relationship
  - OOP enables classes to inherit commonly used state and behavior from other classes.
  - Generalization means that multiple classes can inherit from the same superclass.
  - The composition relationship exists when one class is made up of another class.
  - The utilization relationship exists between two or more unrelated classes if one class uses the other.
  - An instantiation relationship is a relationship between a class and an instance of that class.