

Aggregation: Classes Within Classes

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- If a class B is derived by inheritance from a class A, we can say that “B is a kind of A.”
- This is because B has all the characteristics of A, and in addition some of its own.
- It's like saying that a `eagle` is a kind of `bird`:
- An `eagle` has the characteristics shared by all `birds` (wings, feathers, and so on) but has some distinctive characteristics of its own as well.
- For this reason inheritance is often called a “kind of” relationship.
- Aggregation is called a “has a” relationship.
- We say a `library` has a `book` or an `invoice` has an `item` line.
- Aggregation is also called a “part-whole” relationship: the `book` is part of the `library`.

- In object-oriented programming, aggregation may occur when one object is an attribute of another.
- Here's a case where an object of class A is an attribute of class B:

```
class A {  
};  
class B  
{  
  A objA; // define objA as an object of class A  
};
```

- In the UML, aggregation is considered a special kind of association.
- Sometimes it's hard to tell when an association is also an aggregation.
- It's always safe to call a relationship an association
- but if class A contains objects of class B, and is organizationally superior to class B, it's a good candidate for aggregation.

- A company might have an aggregation of employees, or a stamp collection might have an aggregation of stamps.
- Aggregation is shown in the same way as association in UML class diagrams, except that the “whole” end of the association line has an open diamond-shaped arrowhead.

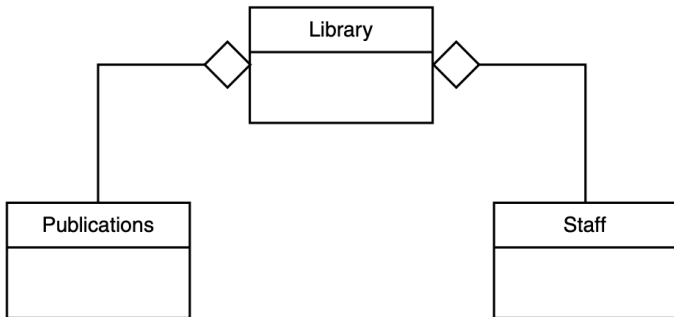


Figure 1: UML class diagram showing aggregation.

- Rearrange the EMPMULT program to use aggregation instead of inheritance.
- In EMPMULT the manager and scientist classes are derived from the employee and student classes using the inheritance relationship.
- In our new program, EMPCONT, the manager and scientist classes contain instances of the employee and student classes as attributes.

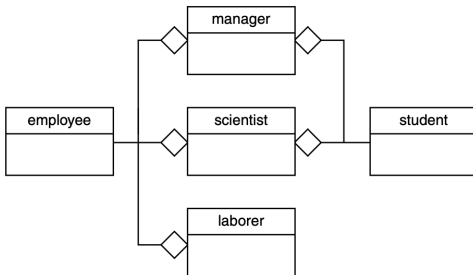


Figure 2: UML class diagram for EMPCONT.

- Composition is a stronger form of aggregation. It has all the characteristics of aggregation, plus two more:
 - ① The part may belong to only one whole.
 - ② The lifetime of the part is the same as the lifetime of the whole.
- A car is composed of doors (among other things).
- The doors can't belong to some other car, and they are born and they die along with the car.
- A room is composed of a floor, ceiling, and walls.
- While aggregation is a “has a” relationship, composition is a “consists of” relationship.
- In UML diagrams, composition is shown in the same way as aggregation, except that the diamond-shaped arrowhead is solid instead of open.

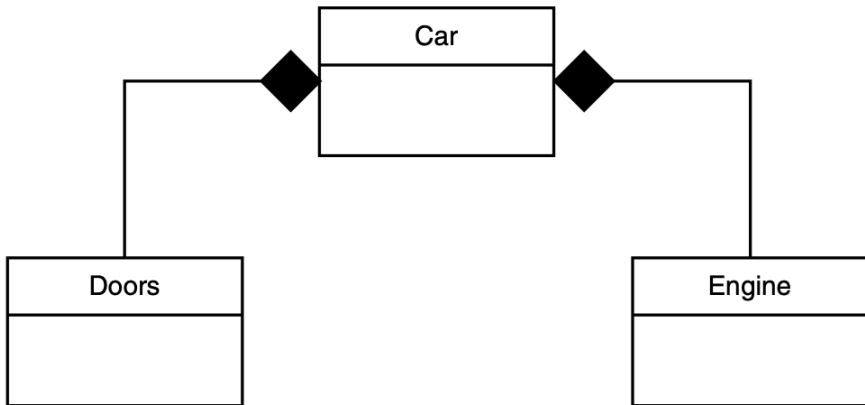


Figure 3: UML class diagram showing aggregation.