

Generalization

• **Relationship between concepts**

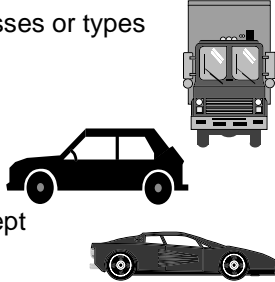
- Also between classes or types

• **Supertype**

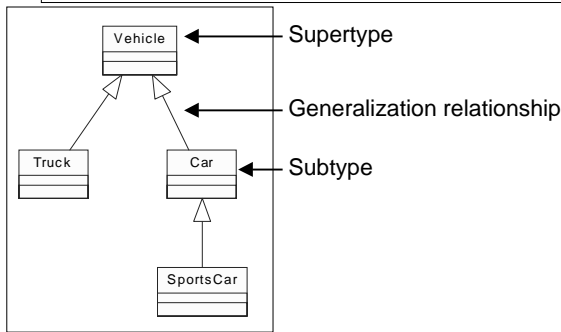
- General concept
- Base class

• **Subtype**

- Specialized concept
- Derived class



UML Notation



Definition Conformance

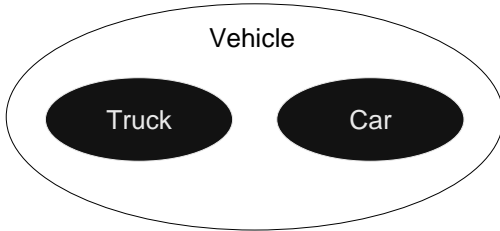
• **Supertype and subtype have**

- Attributes
- Associations

• **“100%” rule**

- Subtype must conform to 100% of
 - Supertype’s attributes
 - Supertype’s associations

Type Sets



Set Membership Conformance

- **Subtype must be a member of the set of the supertype**
- **Each subtype is a kind of the supertype**
- **“Is a” rule**
 - Every subtype “is a” supertype

A circle “is a” ellipse (true or false?)

Circle is a subtype of Ellipse (true or false?)

When to Generalize (Partition)

- **Have existing “general” type**
- **Subtype has added attributes**
 - Truck has specified cargo capacity
- **Subtype has added associations**
 - LabCourse has link to lab rooms
- **Subtype behavior differs**
 - Different operations
 - Represents distinct domain concept

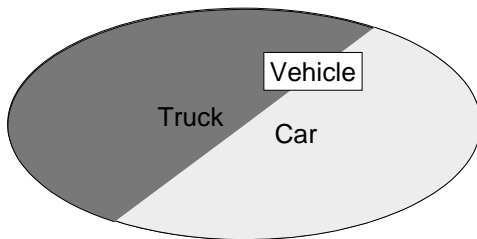
When to Generalize (Factor)

- **Have existing “specific” types**
- **Potential subtype commonality**
 - Variations on a theme
- **Subtypes conform to rules**
 - “100%”, “Is a”
- **Commonality factored out**
 - Attributes
 - Associations

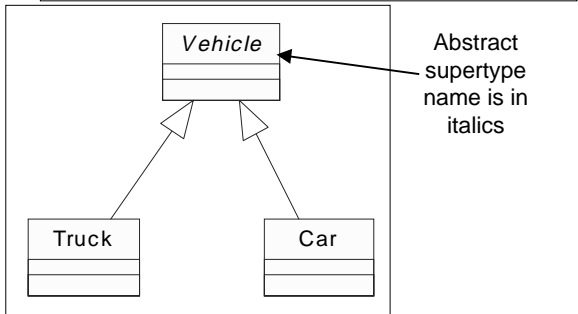
Abstract Types

- **Is there really a “Vehicle”?**
- **Or is this an abstract concept?**
 - Serves to “factor out” commonality
 - But can’t really stand on its own
- **Set theory formulation**
 - Every member of supertype must be a member of some subtype

Type Set for Abstract Supertype



UML Notation



C++ Implementation

- **Supertype is base class**
- **Subtype is derived class**
- **Automatic upcasting**
- **Virtual functions**
 - Implement variant behavior
- **Abstract base class**
 - At least one pure virtual function
 - Could be destructor (still called!)

Generalization Exercise

- **Consider project, phase 2**
 - Multiple types of file scans
- **Could generalization be used?**
- **If so, how?**
 - What is supertype (base class)?
 - What are subtypes (derived classes)?
- **Any other applications of generalization?**