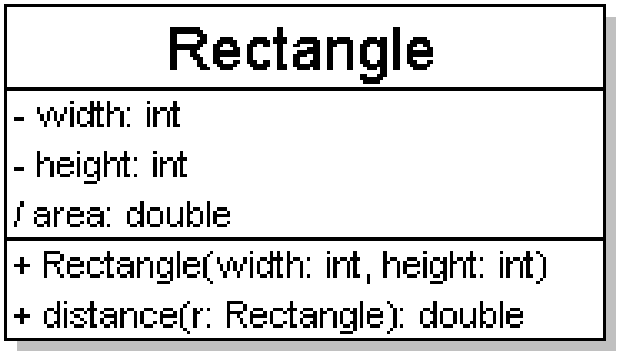
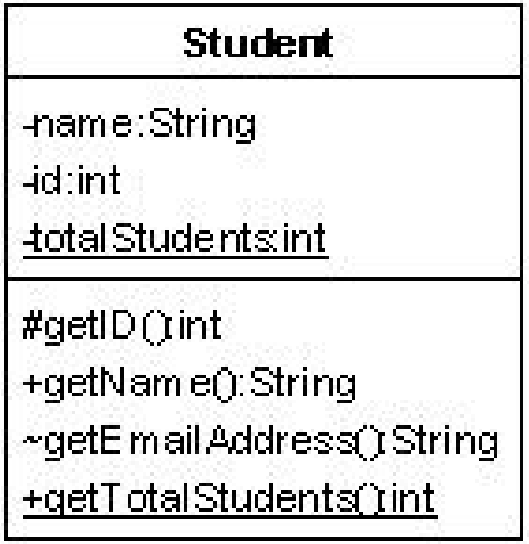
UML class diagrams

- What is a UML class diagram?
  - **UML class diagram**: a picture of the classes in an OO system, their fields and methods, and connections between the classes that interact or inherit from each other

Diagram of one class

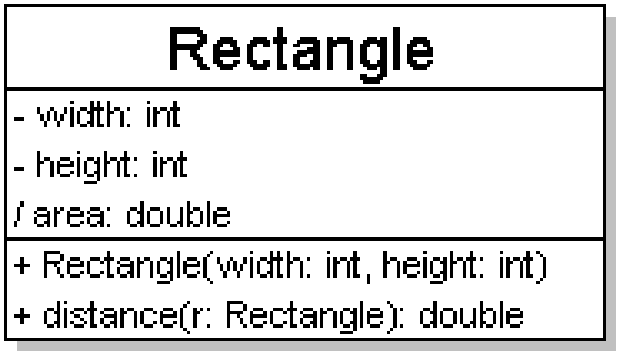
- class name in top of box
- attributes
- operations / methods

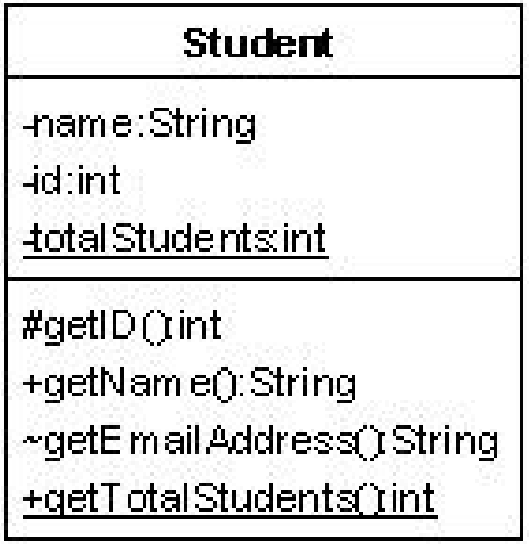




Class attributes

- attributes (fields, instance variables)
  - visibility:
    - `+` public
    - `#` protected
    - `-` private
    - `/` derived
  - underline static attributes



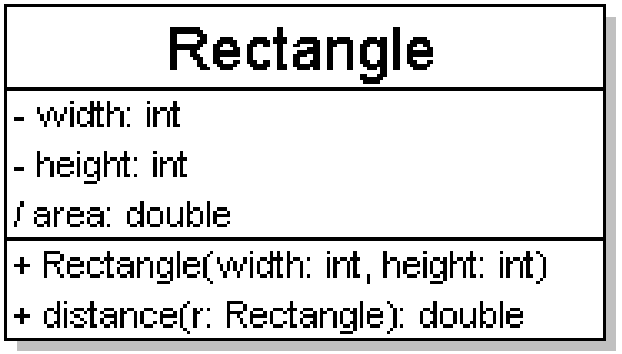


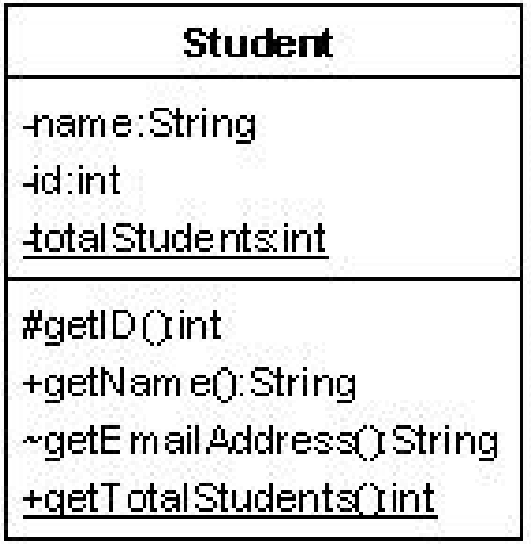
Class operations / methods

- operations / methods
  - *visibility name* (*parameters*) : *return_type*
  - visibility:

+	public
#	protected
-	private
~	package (default)

  - underline static methods
  - parameter types listed as (name: type)
  - omit *return_type* on constructors and when return type is void
  - method example:
    + distance(p1: Point, p2: Point): double





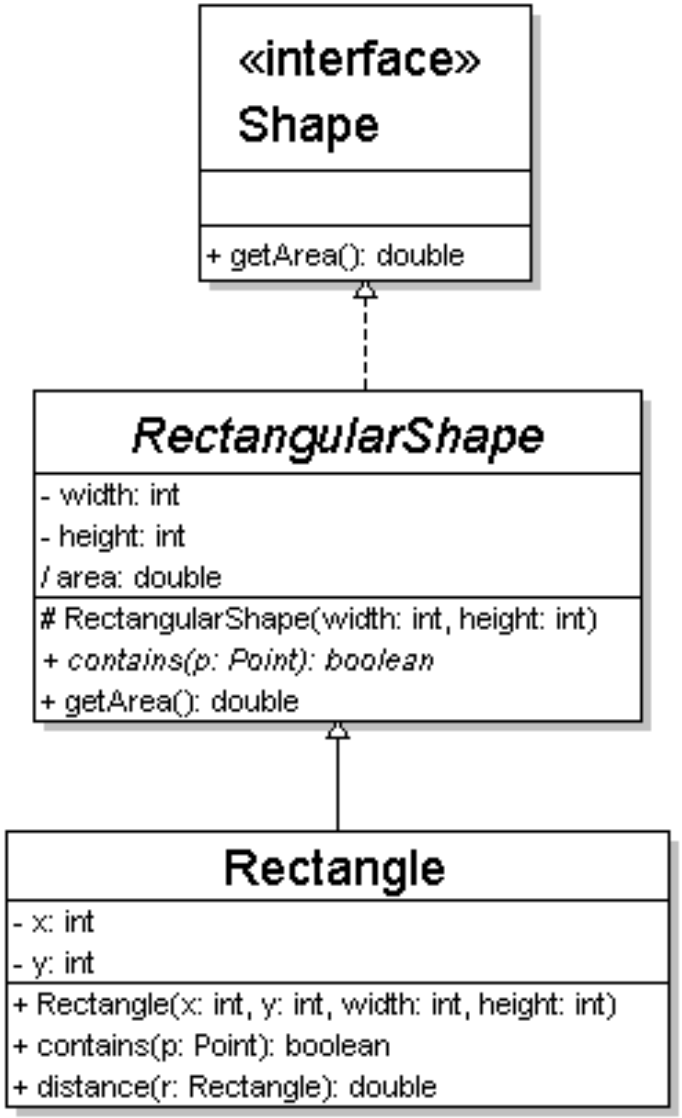
Relationships btwn. classes

- **generalization**: an inheritance relationship
  - inheritance between classes
  - interface implementation

- **association**: a usage relationship
  - dependency
  - aggregation
  - composition

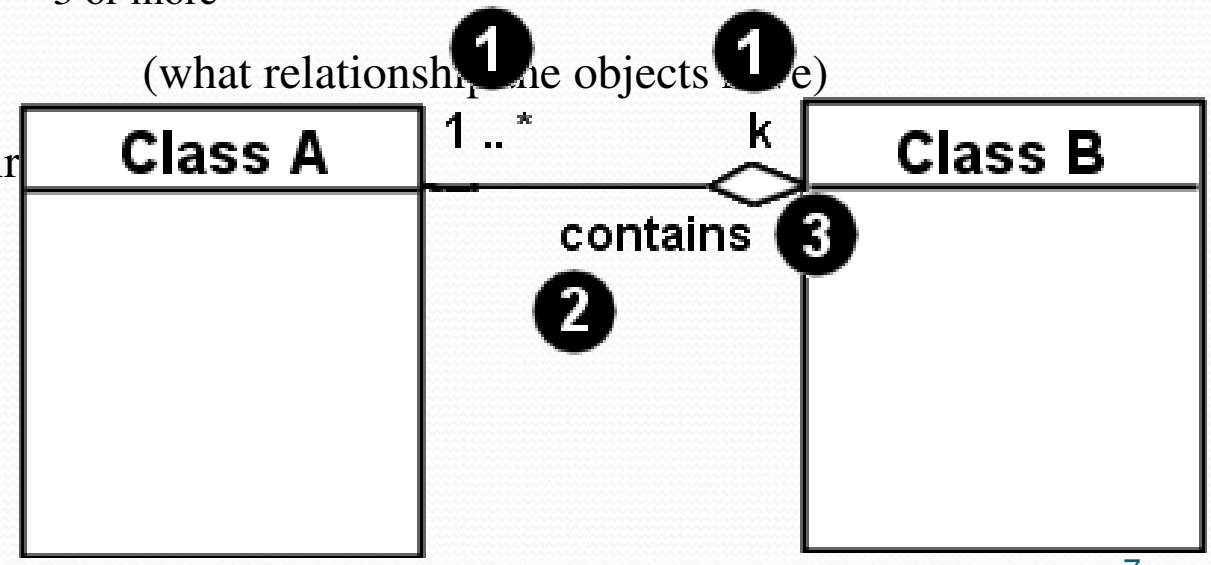
Generalization relationships

- generalization (inheritance) relationships
  - hierarchies drawn top-down with arrows pointing upward to parent
  - line/arrow styles differ, based on whether parent is a(n):
    - class:
      solid line, black arrow
    - abstract class:
      solid line, white arrow
    - interface:
      dashed line, white arrow



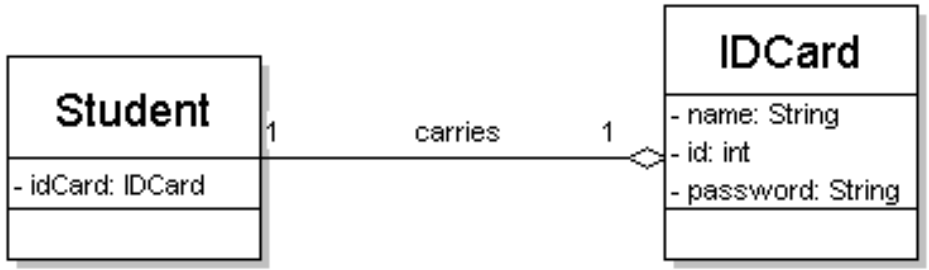
Associational relationships

- associational (usage) relationships
  1. multiplicity (how many are used)
     - * ⇒ 0, 1, or more
     - 1 ⇒ 1 exactly
     - 2..4 ⇒ between 2 and 4, inclusive
     - 3..* ⇒ 3 or more
  2. name (what relationship the objects have)
  3. navigability (dir

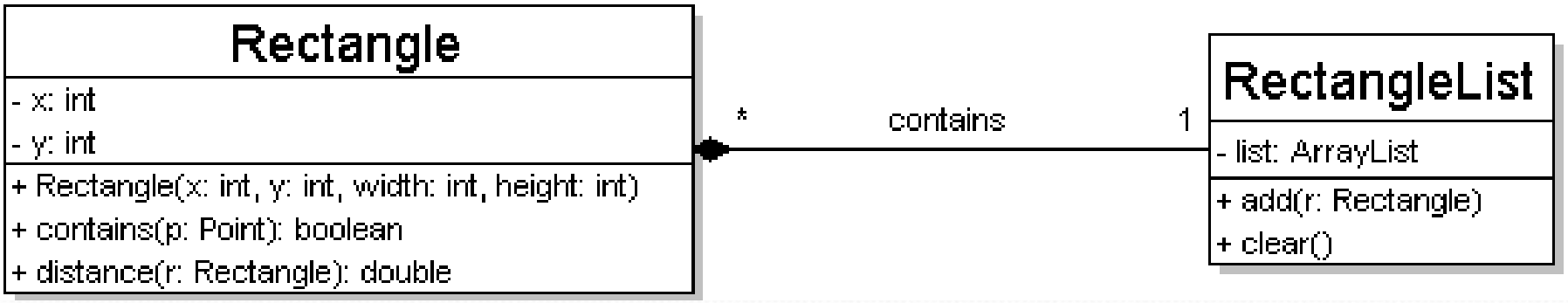


Multiplicity of associations

- one-to-one
  - each student must carry exactly one ID card

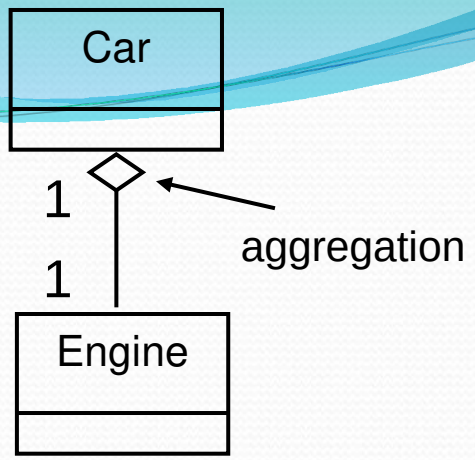


- one-to-many
  - one rectangle list can contain many rectangles

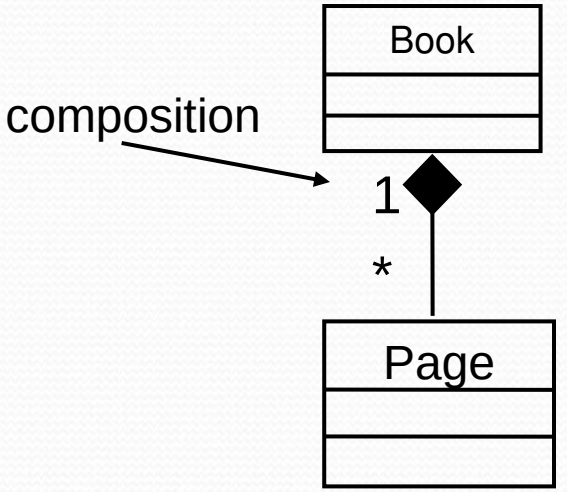


Association types

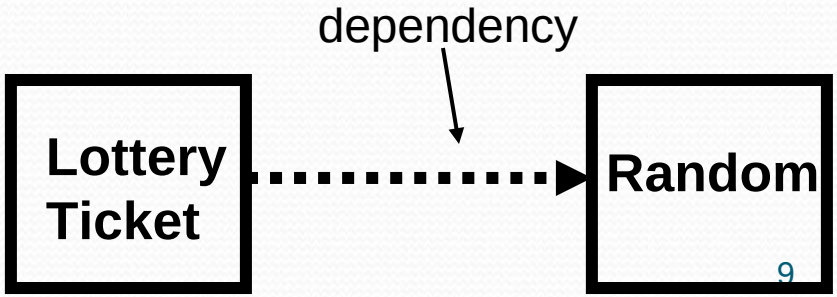
- **aggregation**: "is part of"
  - symbolized by a clear white diamond



- **composition**: "is entirely made of"
  - stronger version of aggregation
  - the parts live and die with the whole
  - symbolized by a black diamond



- **dependency**: "uses temporarily"
  - symbolized by dotted line
  - often is an implementation detail, not an intrinsic part of that object's state



Class diagram example