OO Techniques & UML Class Diagrams

SE3A04 – Tutorial

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Outline

Object-Orientation

Definition (Class)

A class is a construct that is used as a blueprint to create instances of itself. Classes usually contain a list of attributes (state variables) and a list of methods.

Definition (Object)

An object is an instance of a class. Objects of the same class share the same set of attributes, yet will typically differ in what those attributes contain.

Definition (Method)

A method is a procedure or function associated with a class which enable a class object's behaviour.

UML

Definition (UML)

The Unified Modelling Language (UML) is a means of precisely expressing requirements, analysis models and designs, in a platform independent manner.

- UML is the result of a successful unification of the many object-oriented analysis and design notations which arose during the 1980's and 1990's
- Version 1.1 was endorsed by the Object Management Group (OMG), representing many companies and organizations, as a standard for object-oriented analysis and design
- A major revision of UML, to version 2.0, was published in 2004
- As of March 2011, UML is in version 2.4 beta

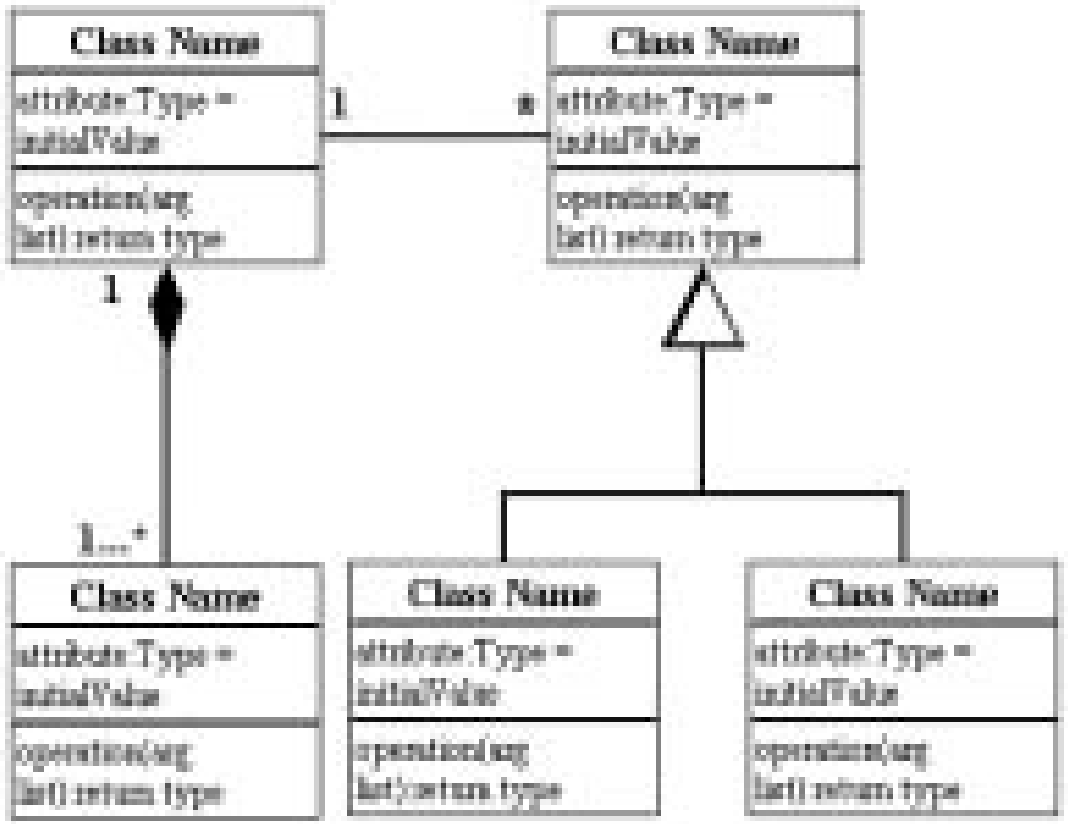
Class Diagrams

Definition (Class Diagram)

Class diagrams are the backbone of almost every object oriented method, including UML. They describe the static structure of a system.

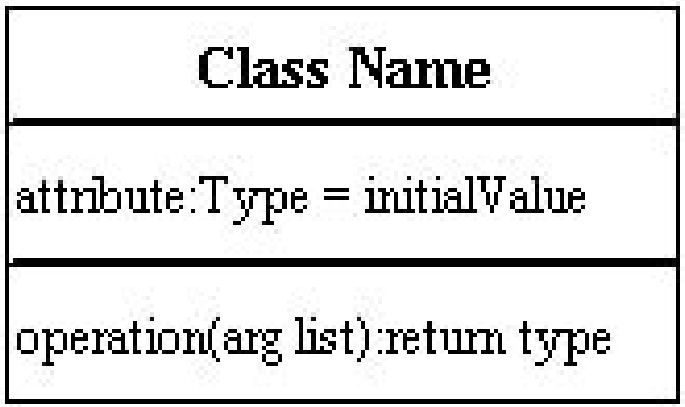
- Purpose is to depict the classes within a model
- Classes have attributes, operations and relationships with other classes
  - All can be graphically depicted using UML class diagrams

Class Diagrams



Class

- Classes represent an abstraction of entities with common characteristics
- Illustrate classes with rectangles divided into compartments
- Place the name of the class in the first partition (centred, bolded, and capitalized)
- List the attributes in the second partition
- Write operations into the third partition

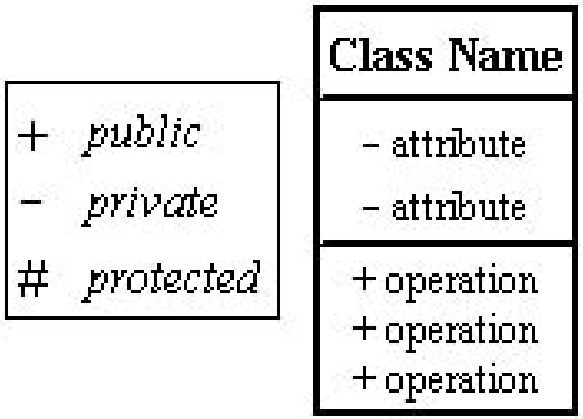


Active Class

- Active classes initiate and control the flow of activity, while passive classes store data and serve other classes
- Illustrate active classes with a thicker border

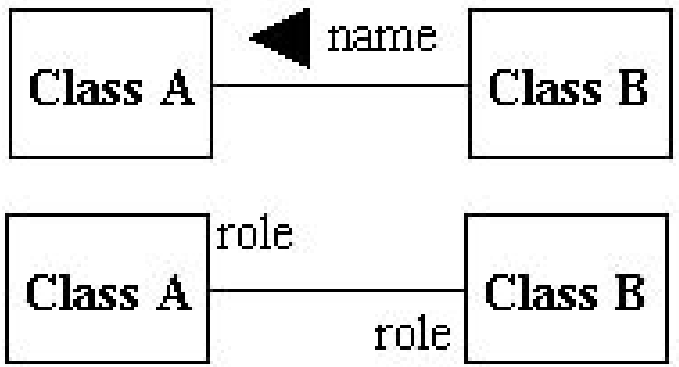
Visibility

- Use visibility markers to signify who can access the information contained within a class
- Private visibility hides information from anything outside the class partition
- Public visibility allows all other classes to view the marked information
- Protected visibility allows child classes to access information they inherited from a parent class



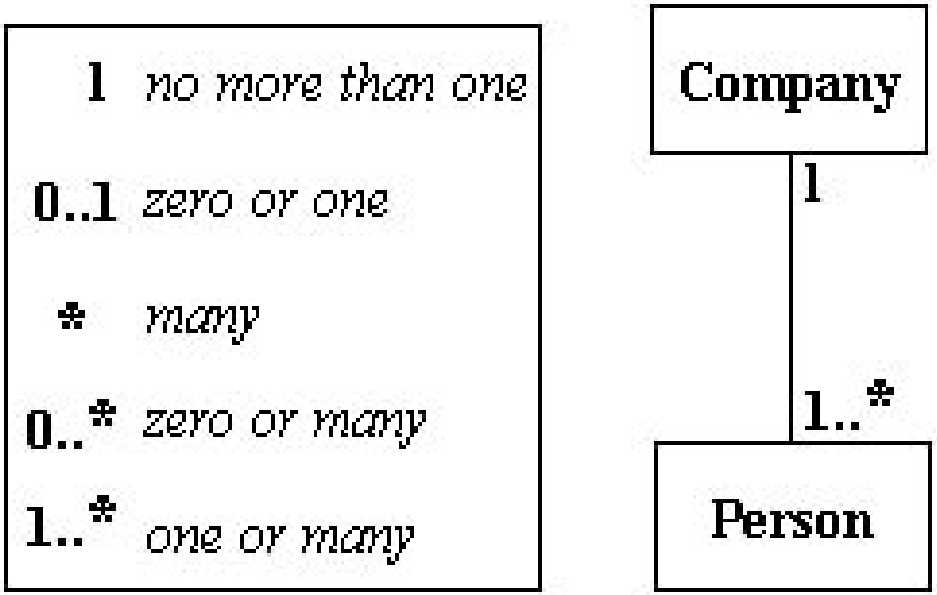
Associations

- Associations represent static relationships between classes
- Place association names above, on, or below the association line
- Use a filled arrow to indicate the direction of the relationship
- Place roles near the end of an association
- Roles represent the way the two classes see each other
- **Note**: It is uncommon to name both the association and the class roles



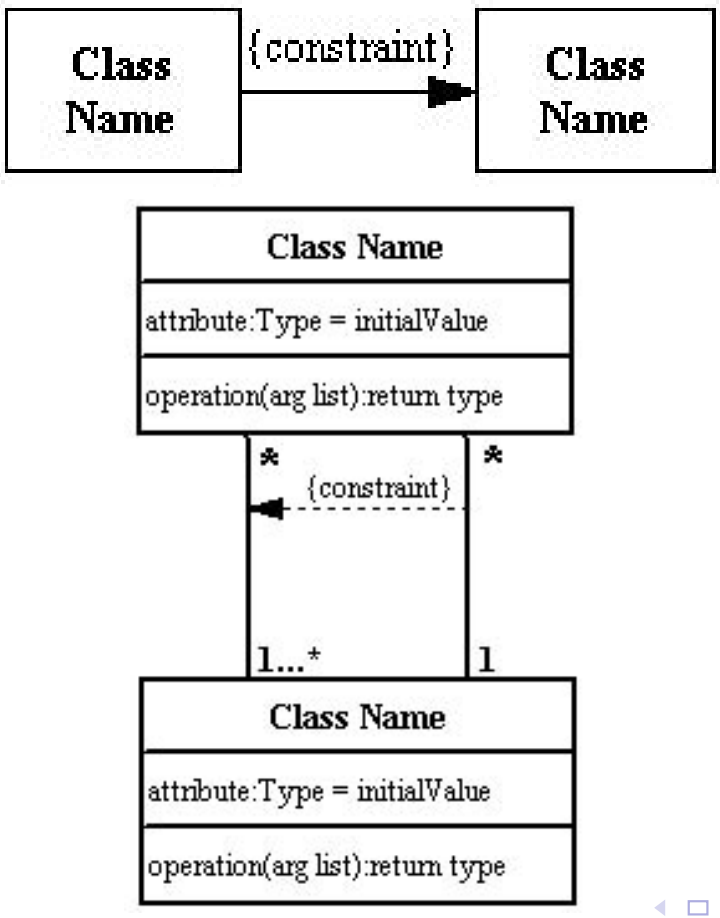
Multiplicity

- Place multiplicity notations near the ends of an association
- These symbols indicate the number of instances of one class linked to one instance of the other class
- For example, one company will have one or more employees, but each employee works for one company only



Constraints

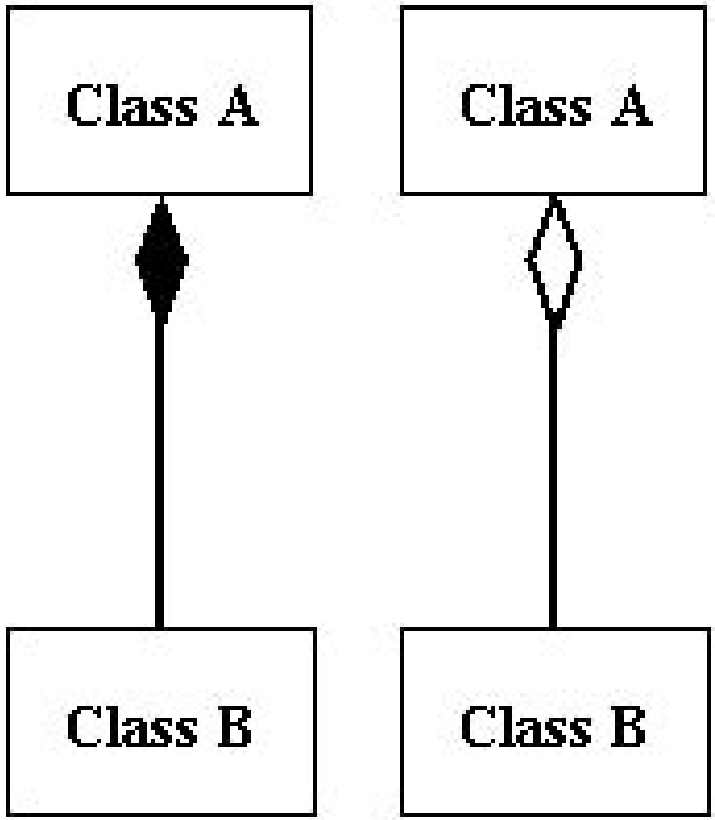
- Place constraints inside curly braces {}



Aggregation and Composition

- Aggregation is a relationship in which the "whole" class plays a more important role than the "part" class, but the two classes are not dependent on each other
- Use a hollow diamond to represent a simple aggregation relationship
- Composition is a special type of aggregation that denotes a strong ownership between Class A, the whole, and Class B, its part
- Illustrate composition with a filled diamond
- The diamond end in both a composition and aggregation relationship points toward the "whole" class or the aggregate

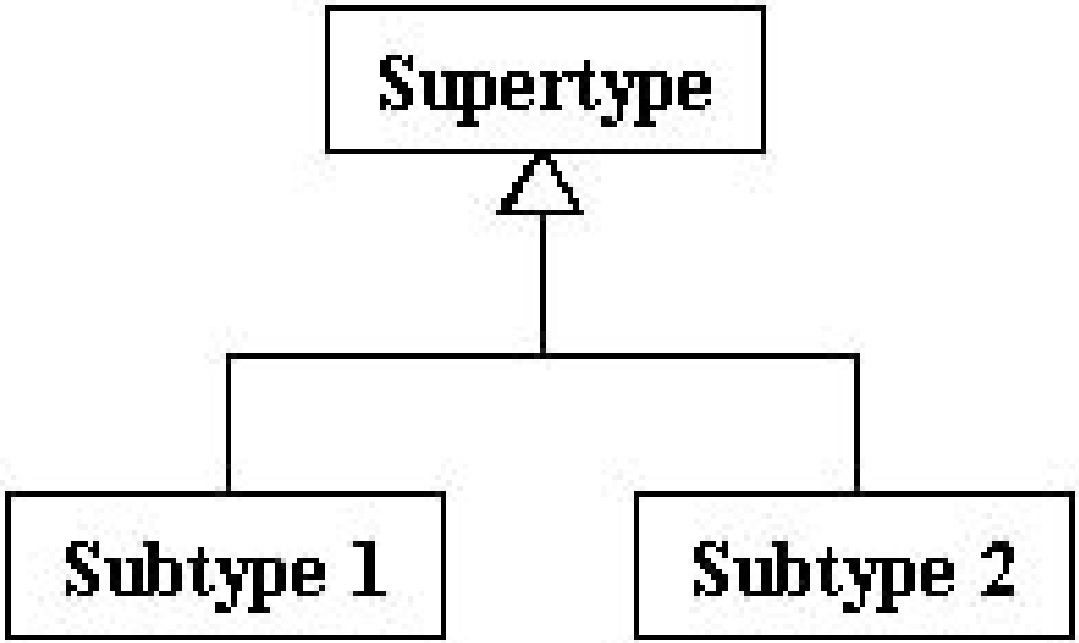
Aggregation and Composition



Generalization

- Generalization is another name for *inheritance* or an "is a" relationship
- It refers to a relationship between two classes where one class is a specialized version of another
- Use a hollow arrow head to denote a generalization relationship
- For example, a *Circle* and a *Square* are both shapes; so the class *Circle* and *Square* would have a generalization relationship with the class *Shape*

Generalization



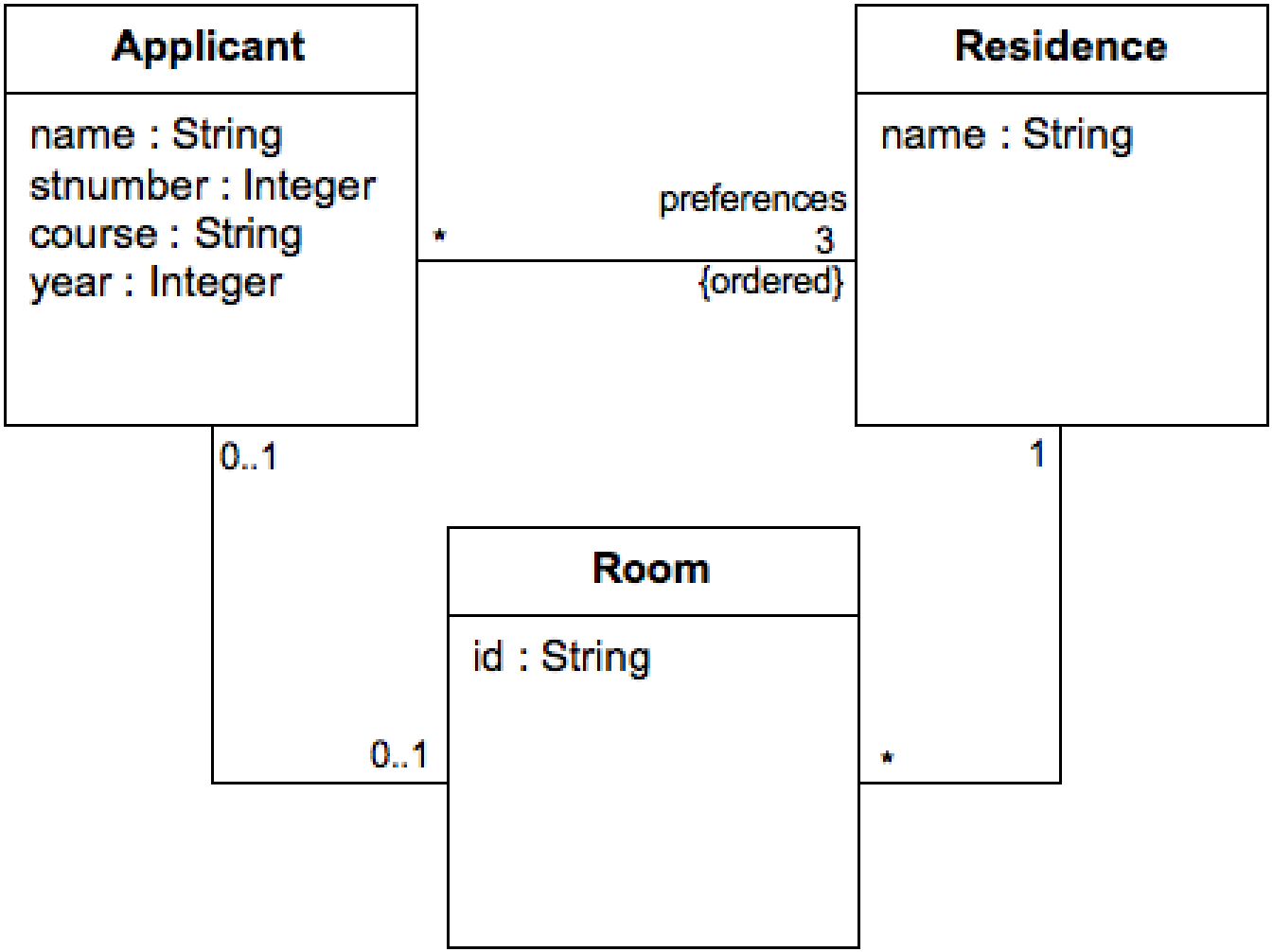
Allocation of Student Rooms

Example (Allocation of Student Rooms)

Draw a class diagram to represent the following system:

- Over the summer holiday, university students can book college hall accommodation online. They must specify their name, student number, course, year, and identify three college residences as their preferences.
- The system makes an allocation of students to rooms before the start of the term, trying, where possible, to allocate students to a room in one of their preferred halls.

Allocation of Student Rooms

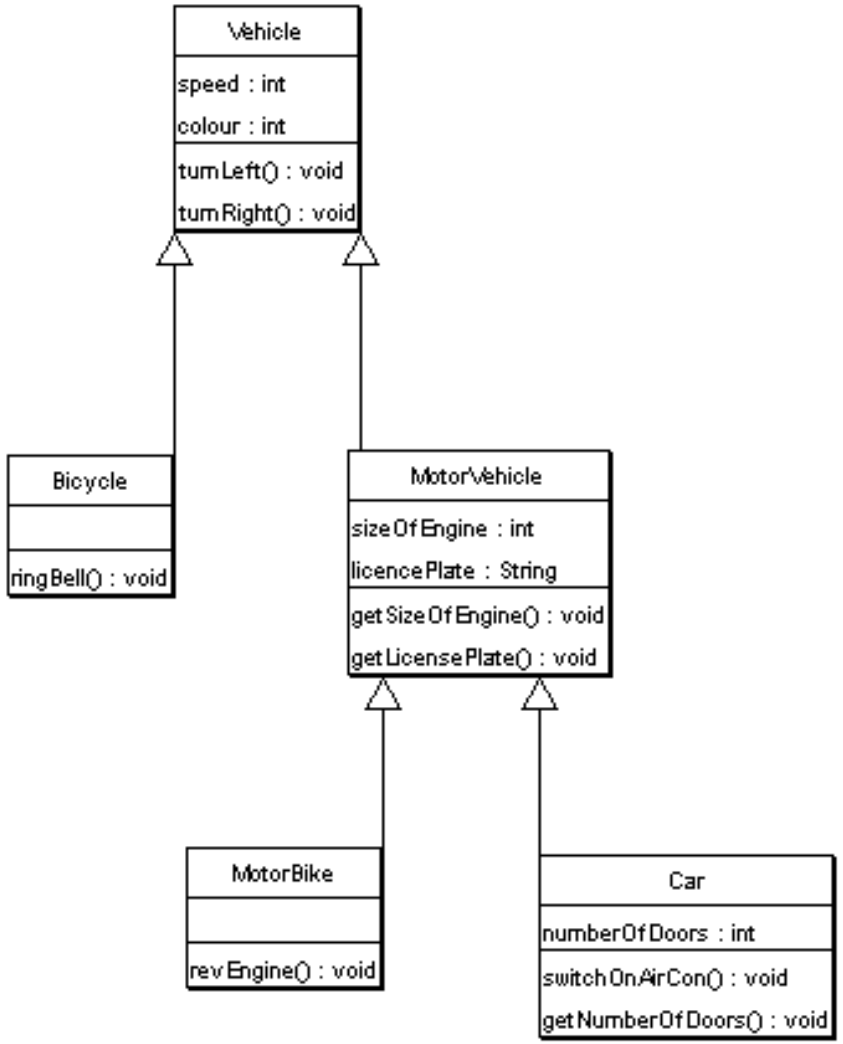


Vehicles

Example (Vehicles)

Draw a class diagram to represent an imaginary application that must model different kinds of vehicles such as bicycles, motor bikes and cars.

Vehicles

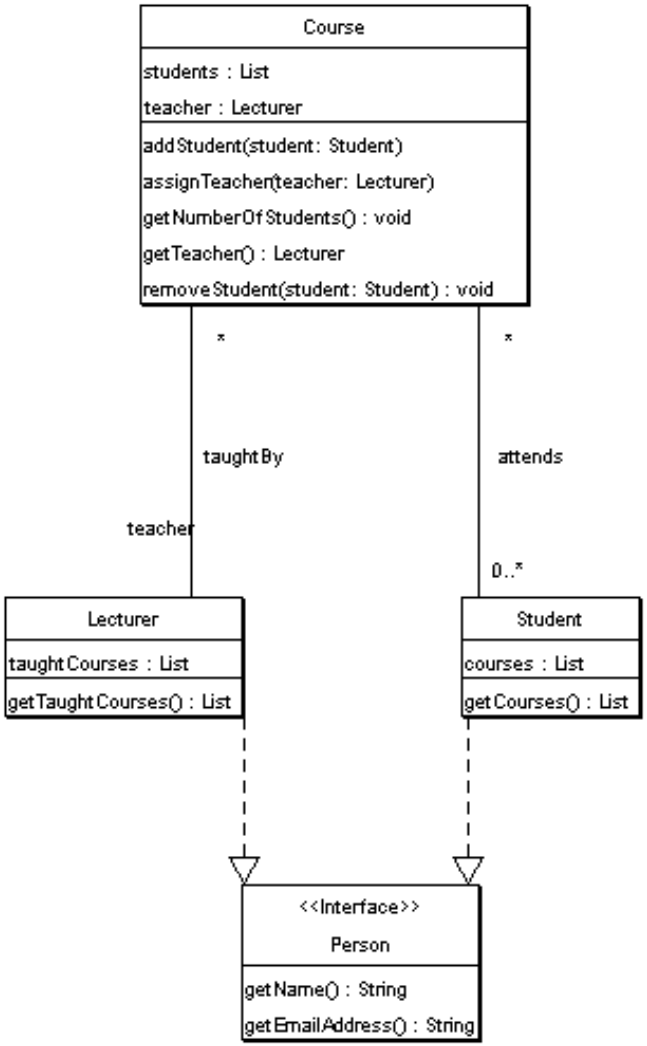

Vehicle
speed : int
colour : int
turnLeft() : void
turnRight() : void
Bicycle
ringBell() : void
MotorVehicle
sizeOfEngine : int
licencePlate : String
getSizeOfEngine() : void
getLicensePlate() : void
MotorBike
revEngine() : void
Car
numberOfDoors : int
switchOnAirCon() : void
getNumberOfDoors() : void

University Courses

Example (University Courses)

Draw a class diagram for an imaginary application that models university courses.

University Courses

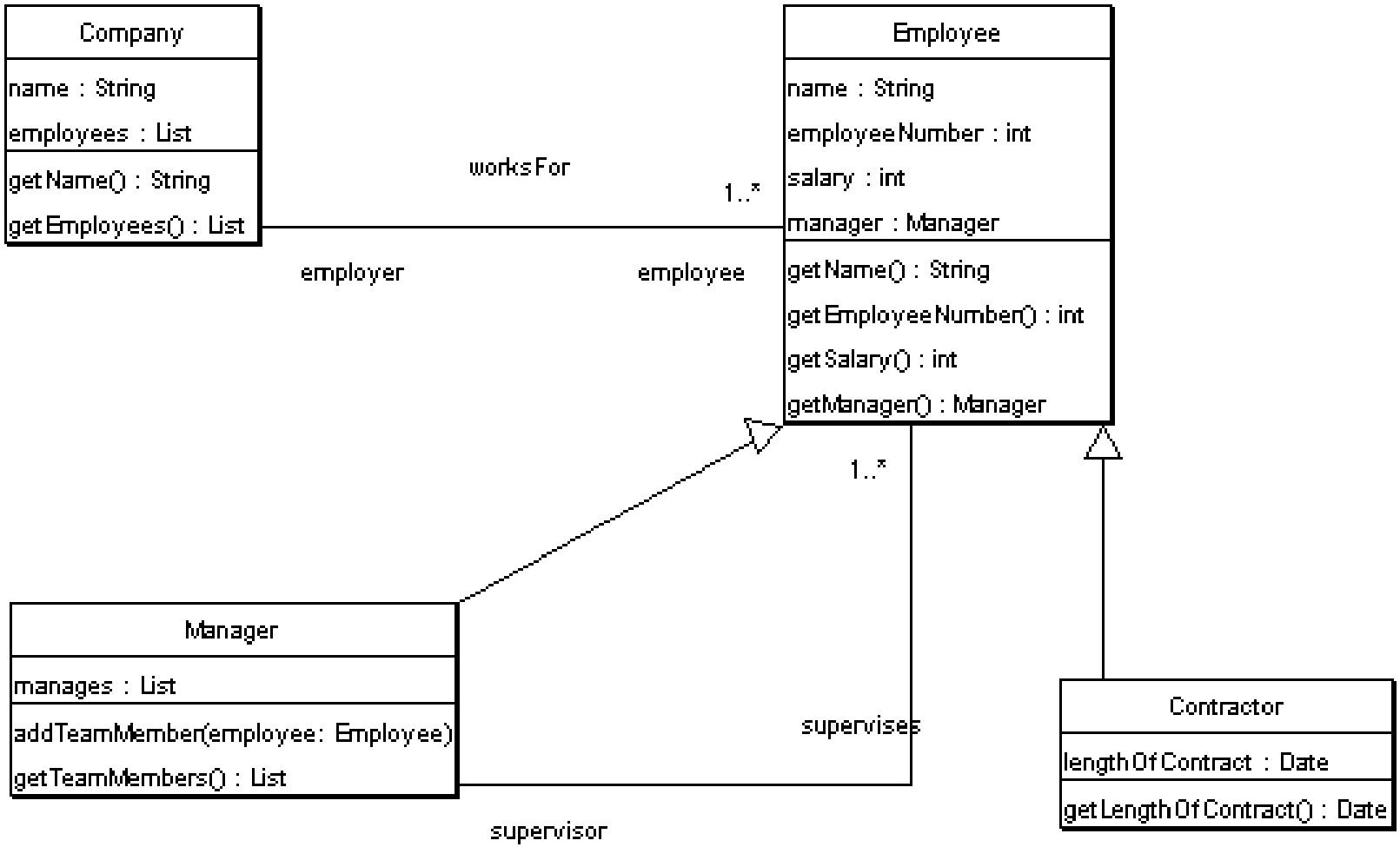


Company Payroll

Example (Company Payroll)

Draw a class diagram that models an imaginary company payroll system.

Company Payroll

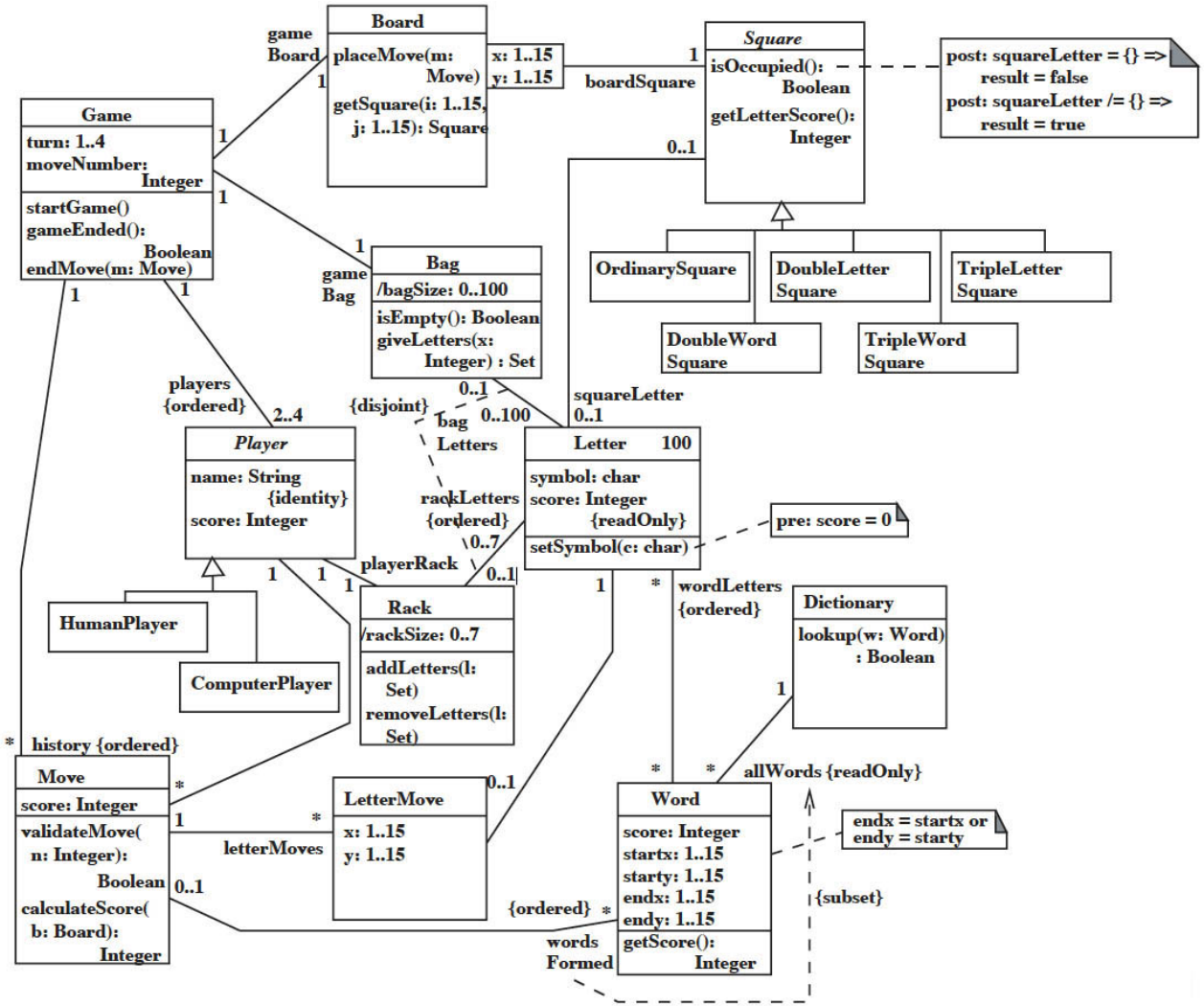


Scrabble

Example (Scrabble)

Draw a class diagram for a Scrabble system.

Scrabble


Board
placeMove(m: Move)
getSquare(i: 1..15, j: 1..15): Square
x: 1..15
y: 1..15
game Board
Square
isOccupied(): Boolean
getLetterScore(): Integer
boardSquare
post: squareLetter = {} => result = false
post: squareLetter /= {} => result = true
Game
turn: 1..4
moveNumber: Integer
startGame()
gameEnded(): Boolean
endMove(m: Move)
Bag
/bagSize: 0..100
isEmpty(): Boolean
giveLetters(x: Integer) : Set
game Bag
OrdinarySquare
DoubleLetter Square
TripleLetter Square
DoubleWord Square
TripleWord Square
players {ordered}
2..4
{disjoint}
bag
Letters
squareLetter
Player
name: String {identity}
score: Integer
Letter
100
symbol: char
score: Integer {readOnly}
setSymbol(c: char)
pre: score = 0
rackLetters {ordered}
playerRack
Rack
/rackSize: 0..7
addLetters(l: Set)
removeLetters(l: Set)
HumanPlayer
ComputerPlayer
wordLetters {ordered}
Dictionary
lookup(w: Word) : Boolean
history {ordered}
Move
score: Integer
validateMove(n: Integer): Boolean
calculateScore(b: Board): Integer
LetterMove
x: 1..15
y: 1..15
letterMoves
allWords {readOnly}
Word
score: Integer
startx: 1..15
starty: 1..15
endx: 1..15
endy: 1..15
getScore(): Integer
endx = startx or endy = starty
{subset}
{ordered}
words Formed

Questions

- Questions?