UML

- Back Ground
- Class Diagrams
- Inheritance Hierarchy
- UML
- Patterns

UML Back Ground

- UML stands for Unified Modeling Language
- UML is a graphical language used for designing and documenting OO software
- In 1996, Brady Booch, Ivar Jacobson, and James Rumbaugh released an early version of UML
- Since then, UML has been developed and revised in response to feedback from the OOP community
  - Today, the UML standard is maintained and certified by the Object Management Group (OMG)

UML Introduction

- Pseudo code is a way of representing a program in a linear and algebraic manner
  - It simplifies design by eliminating the details of programming language syntax
- Graphical representation systems for program design have also been used
  - *Flowcharts* and *structure diagrams* for example
- *Unified Modeling Language* (*UML*) is yet another graphical representation formalism
  - UML is designed to reflect and be used with the OOP philosophy

UML Class Diagrams

- Classes are central to OOP, and the *class diagram* is the easiest of the UML graphical representations to understand and use

- A class diagram is divided up into three sections
  - The top section contains the class name
  - The middle section contains the data specification for the class
  - The bottom section contains the actions or methods of the class

UML Class Diagrams

- The data specification for each piece of data in a UML diagram consists of its name, followed by a colon, followed by its type

- Each name is preceded by a character that specifies its access type:
  - A minus sign (-) indicates private access
  - A plus sign (+) indicates public access
  - A sharp (#) indicates protected access
  - A tilde (~) indicates package access

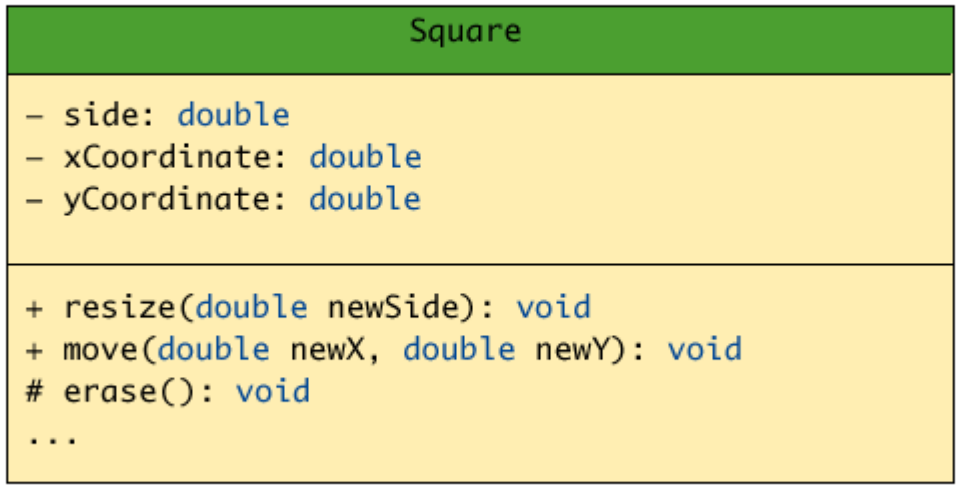
UML Class Diagrams

- Each method in a UML diagram is indicated by the name of the method, followed by its parenthesized parameter list, a colon, and its return type

- The access type of each method is indicated in the same way as for data

A UML Class Diagram

Display 12.1 **A UML Class Diagram**



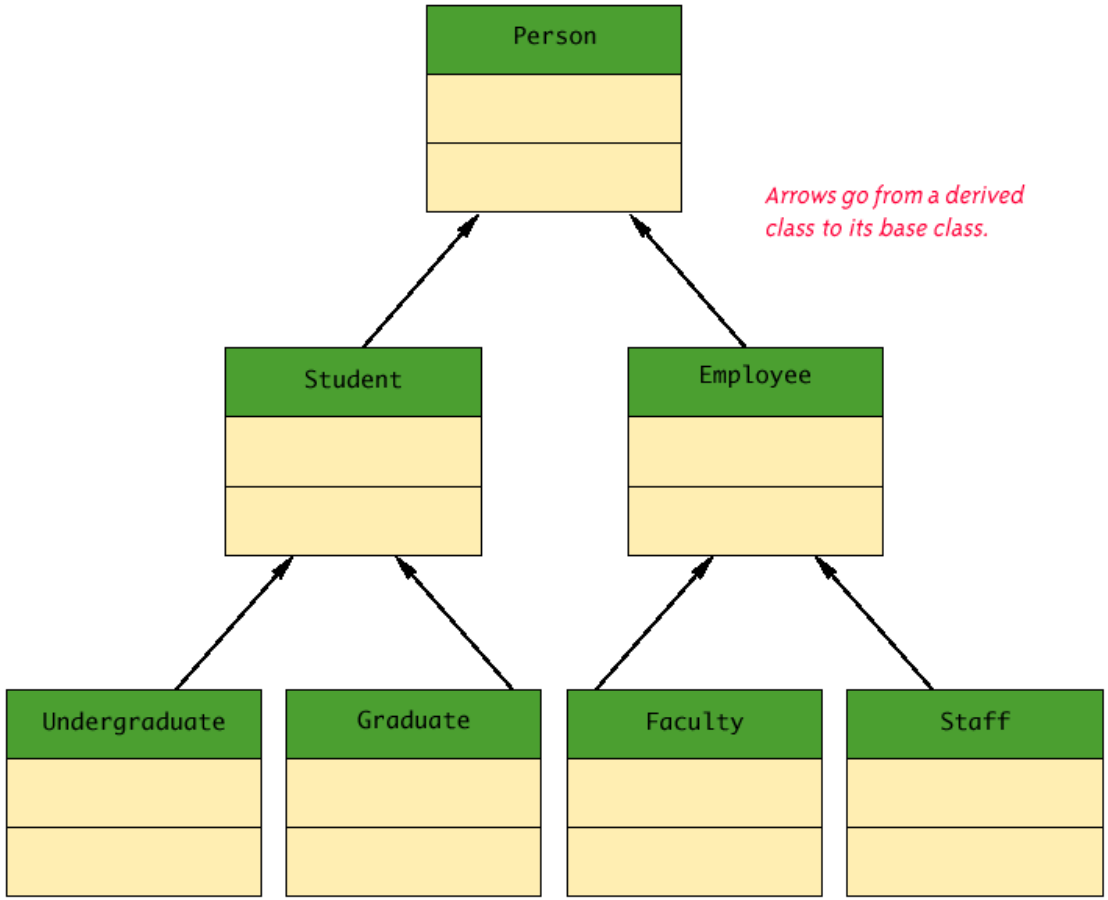
Inheritance Diagrams

- An *inheritance diagram* shows the relationship between a base class and its derived class(es)

- Each base class is drawn above its derived class(es)
  - An upward pointing arrow is drawn between them to indicate the inheritance relationship

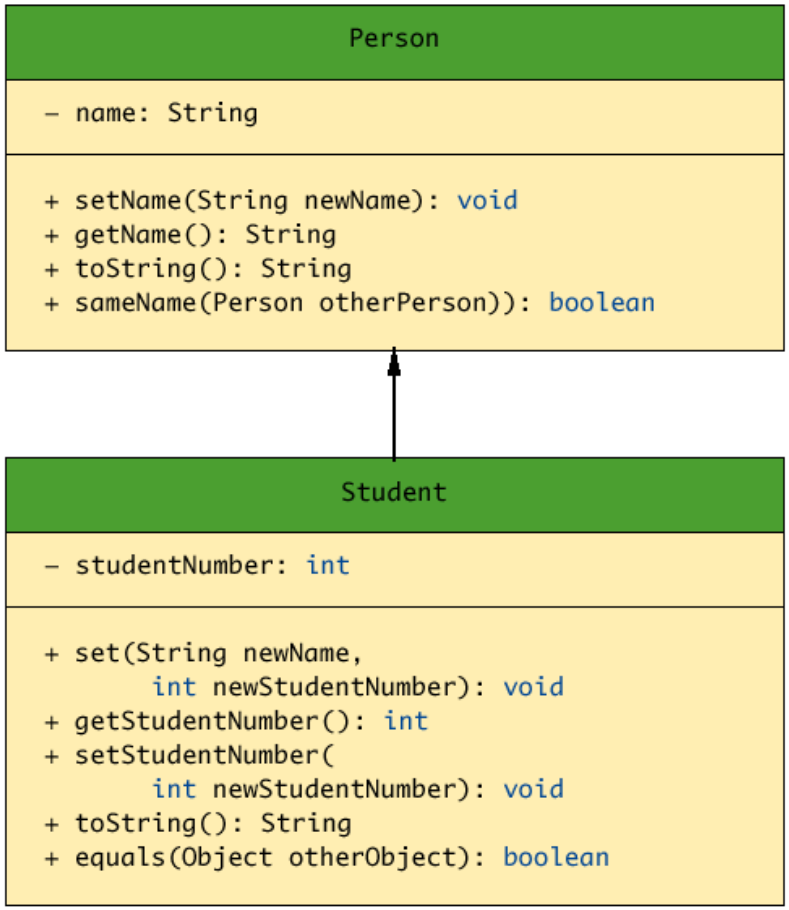
Inheritance Diagram Example

Display 12.2 **A Class Hierarchy in UML Notation**



A Detailed UML Inheritance Hierarchy

Display 12.3 **Some Details of a UML Class Hierarchy**



Patterns

- *Patterns* are design outlines that apply across a variety of software applications
  - To be useful, a pattern must apply across a variety of situations
  - To be substantive, a pattern must make some assumptions about the domain of applications to which it applies

A Sorting Pattern

- Patterns are best explained by looking at examples
- The most efficient sorting algorithms all seem to follow a divide-and-conquer strategy
- Given an array `a`, and using the `<` operator, these sorting algorithms:
  - Divide the list of elements to be sorted into two smaller lists (`split`)
  - Recursively sort the two smaller lists (`sort`)
  - Then recombine the two sorted lists (`join`) to obtain the final sorted list

A Sorting Pattern

- The method **`split`** rearranges the elements in the interval **`a[begin]`** through **`a[end]`** and divides the rearranged interval at **`splitPoint`**

- The two smaller intervals are then sorted by a recursive call to the method **`sort`**

- After the two smaller intervals are sorted, the method **`join`** combines them to obtain the final sorted version of the entire larger interval

- Note that the pattern does not say exactly how the methods **`split`** and **`join`** are defined
  - Different definitions of **`split`** and **`join`** will yield different sorting algorithms

Merge Sort

- The simplest realization of this sorting pattern is the *merge sort*
- The definition of **`split`** is very simple
  - It divides the array into two intervals without rearranging the elements
- The definition of **`join`** is more complicated
- Note: There is a trade-off between the complexity of the methods **`split`** and **`join`**
  - Either one can be made simpler at the expense of making the other more complicated

Quick Sort

- In the *quick sort* realization of the sorting pattern, the definition of **`split`** is quite sophisticated, while **`join`** is utterly simple
  - First, an arbitrary value called the *splitting value* is chosen
  - The elements in the array are rearranged:
    - All elements less than or equal to the splitting value are placed at the front of the array
    - All elements greater than the splitting value are placed at the back of the array
    - The splitting value is placed in between the two

Quick Sort

- Note that the smaller elements are not sorted, and the larger elements are not sorted
  - However, all the elements before the splitting value are smaller than any of the elements after the splitting value
- The smaller elements are then sorted by a recursive call, as are the larger elements
- Then these two sorted segments are combined
  - The `join` method actually does nothing

Exercise

```
public class Parent
{
    int anumber;
    public void PrintQuiz( ) {}
    void PrintA( ) {}
    protected  int PrintB( ) {}
}
```

```
class Child1 extends Parent
{
    public char ID;
    public int getStatus( ){}
    public void setID( ){}
}
 class Child2 extends Parent
{
    private double Value;
    private void PrintValues( ) {}
    public boolean Method1( ) {}
}
```