Introduction to UML

- What is UML?
  - Unified Modelling Language
  - A modelling language allows the specification, the visualisation and the documentation of a software development process
- 

‘‘The soul never thinks without an image’’

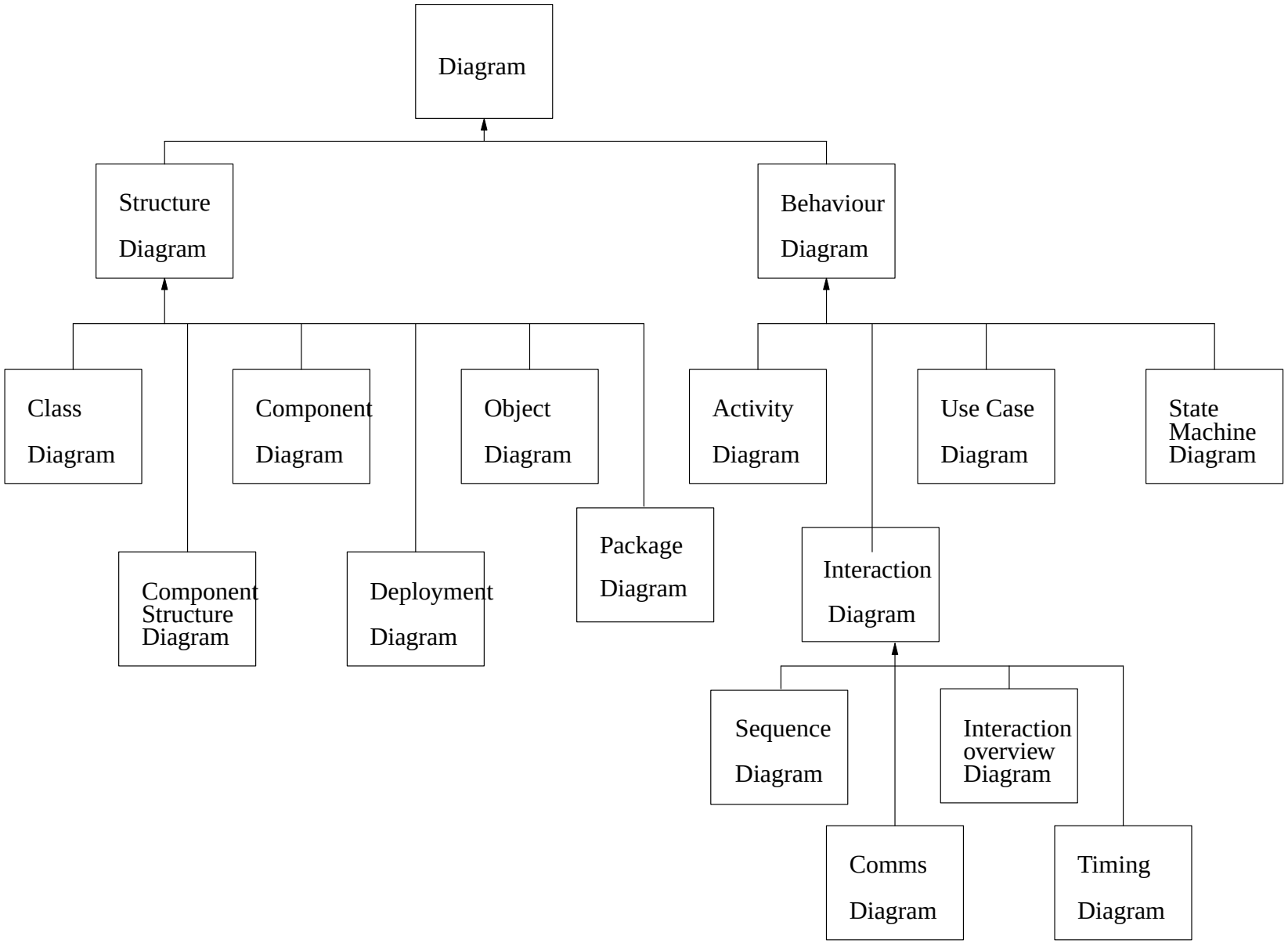
Aristotle, De Anima

Simplex Veri Sigillum

- simplicity is the hallmark of truth
- complexity continues to have a morbid attraction
- When you give for an academic audience a lecture that is crystal clear from alpha to omega, your audience feels cheated and leaves the lecture hall commenting to each other: ‘‘That was rather trivial, wasn’t it?’’
  - The sore truth is that complexity sells better

Edsger W.Dijkstra, EWD898

Overview of UML



Advantages of UML

- UML is a useful method of visualisation and documenting software systems design
- uses object oriented design concepts and it is programming language independent
- UML is a popular technique for documenting and modelling a system
- can model a systems structure and behaviour

Disadvantages of UML

- open source projects and free software projects by and large ignore UML
- UML diagrams do not run and they require time to create and maintain
  - you need to keep the diagrams synchronised with your code
- you cannot represent every condition in a diagram
- poor for distributed systems
  - says nothing about where the software resides
    - server process or client process etc

Alternatives to UML

- E-R diagrams for database ER structure
- Petri Nets (often used to design distributed systems)
- SysML for systems engineering applications
- MASCOT for real-time systems
- again these rarely feature in open source/free software projects

The class diagram

- is the main building block of object oriented modelling
- it is used both for general conceptual modelling of the systematics of the application, and for detailed modelling translating the models into programming code
- the classes in a class diagram represent both the main objects
  - the interactions between the application and the classes have to be programmed

An example class (and diagram)

Bank account
ownersname: String balance: Pounds = 0
deposit (amount: Pounds) withdrawal (amount: Pounds)

Class diagram sections

- it has three sections
- the top part: the name of the class
  - printed in Bold, centered and the first letter capitalised
- the middle part: attributes of the class
  - left aligned and the first letter is lower case
- the bottom part: the methods or operations for the class
  - left aligned and the first letter is lower case

Class diagram sections

- in the design of a system, a number of classes are identified and grouped together in a class diagram which helps to determine the static relations between those objects

- with detailed modelling, the classes of the conceptual design are often split into a number of subclasses

Class diagram sections

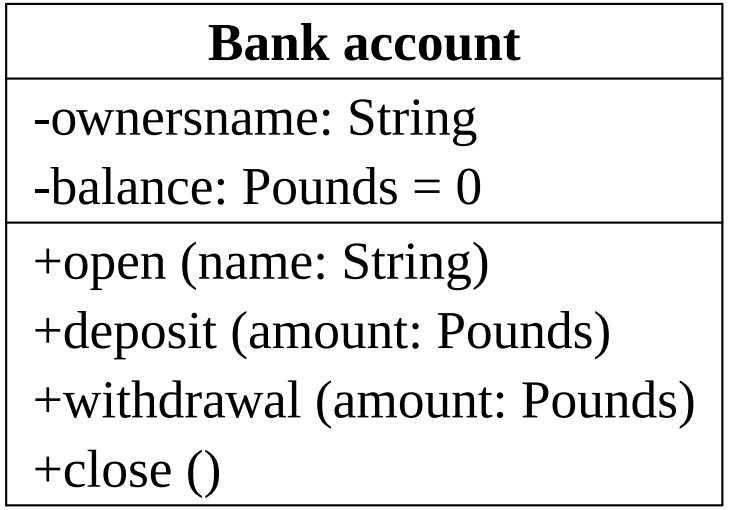
- in order to further describe the behaviour of systems, these class diagrams can be complemented by a state diagram or a UML state machine

Visibility

- the visibility of a class member is defined by the following symbols
  - which are placed before the member name

Symbol	Visibility
+	Public
−	Private
#	Protected
/	Derived (can be combined with one of the others)
_	Static
~	Package

Example


Bank account
-ownersname: String
-balance: Pounds = 0
+open (name: String)
+deposit (amount: Pounds)
+withdrawal (amount: Pounds)
+close ()

Advantages of UML

- clearly this allows us to specify classes quickly
  - a tool can also generate the appropriate language bindings
  - C++, Java, C#, Objective C
  - with some work a tool could also produce bindings for: C, Modula-2, Ada

- it also creates a common lexicon between developers

Scope

- UML specifies two types of scope for members
  - *instance* and *classifier*

- *classifier* members are commonly recognised as `static` in many programming languages
  - thus scope is the class itself
  - attribute values are the same for all instances
  - are represented by underlining the class name

- *instance* members are scoped to a specific instance
  - attribute values may vary between instances
  - methods or functions may affect the instance's attributes
  - are represented by not underlining the class name (the default)

Class level relationships

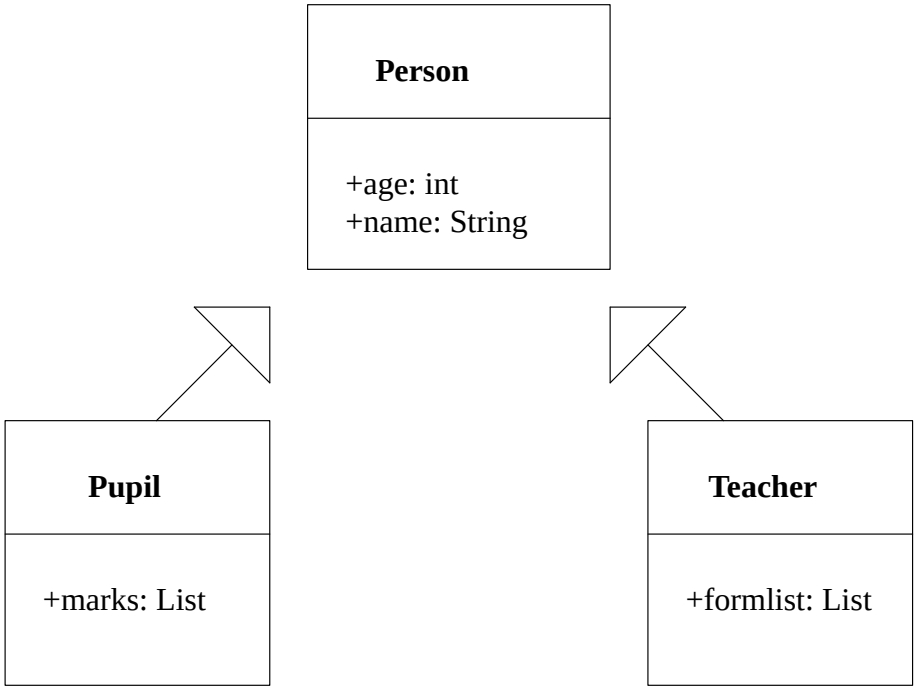
- when designing a program it is necessary to consider interaction between classes

- we start to see some of the power of UML when we consider the relationship between classes

Generalisation

- the generalisation relationship is also known as the inheritance or ‘‘is a’’ relationship

- represented by a hollow triangle shape on the superclass end of the line
  - or tree of lines that connects it to one or more subtypes



UML tool

- a UML tool would convert the previous diagram into the following code:

- **Person.cs**

```
public class Person
   {
      public int age;
      public String name;
   }
}
```

UML tool

Student.cs

```
using Person;

public class Student : Person
    {
        List marks;
    }
}
```

UML tool

Teacher.cs

```
using Person;

public class Teacher : Person
    {
        List formlist;
    }
}
```

Conclusion

- there is much more to UML than this!
- notice how you still need to write all the implementation code
- UML `class diagram`s allow an easier way to consider the design of a multi class program
- you will be using UML next year!