Unified Modeling Language (UML) crash course

SoftEng http://softeng.polito.it

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Learning objectives

- Understand the concepts of UML model and UML diagram
  - What is a UML Class Diagram?
- Understand the steps of development process
  - How to translate specs to code?

Intro

- UML is a standardized modeling and specification language by the Object Management Group (OMG)
- Graphical notation to specify, visualize, construct and document an object-oriented system
- Support throughout many development phases (analysis and requirements, high-level design, detailed design, implementation, deployment ...)
- Integrates the concepts of Booch, OMT and OOSE, and coalesces them into a single, common and widely used modeling language

Note well

- This slide set presents a very small fraction of UML capabilities
- Further readings
  - www.cetus-links.org
  - M.Fowler, K. Scott, “UML Distilled 2nd ed.”, Addison-Wesley
- ArgoUml, UML design tool
  - http://argouml.tigris.org
- Omondo UML, Eclipse plugin for UML
  - http://www.omondo.com

Models and diagrams

- It is important to distinguish between a UML model, and a (set of) UML diagram(s)
- A diagram is a graphical representation of the information in the model, but the model exists independently
- Use Case Diagram, Collaboration Diagram, Activity Diagram, Sequence Diagram, Deployment Diagram, Component Diagram, Class Diagram, StateChart Diagram

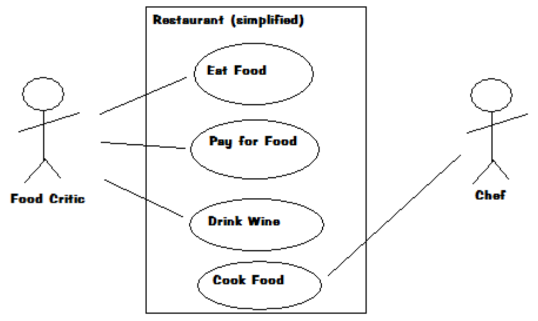
Models and diagrams

- There are three prominent models of the UML system development
- Functional Model – Showcases the functionality of the system from the User's Point of View
- Object Model – Showcases the structure and substructure of the system using objects, attributes, operations, and associations
- Dynamic Model – Showcases the internal behaviour of the system

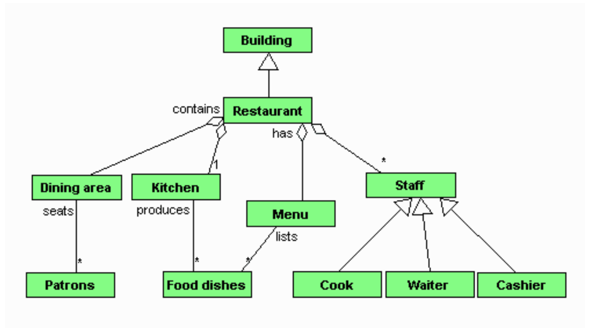
Models and diagrams

Functional Model	Use Cases Diagrams
Object Model	Class Diagrams
Dynamic Model	Sequence Diagrams, Activity Diagrams, Statechart Diagrams

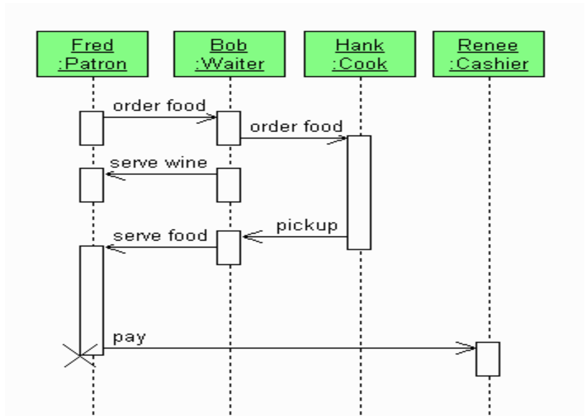
Use Case Diagram



Class Diagram

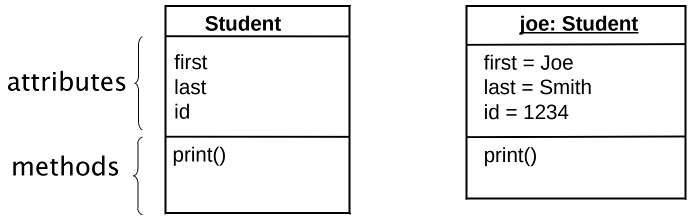


Sequence Diagram



Class diagram

Class and object



Class

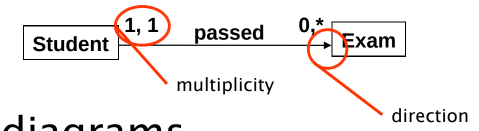
Object

Class/Object Diagrams

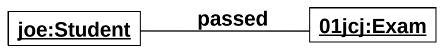
- Class diagrams
  - Shows relationships among (part of the) application classes
  - Classes and Associations
- Object diagrams
  - Shows relationships among (part of the) application objects
  - Objects and Links

Class/Object Diagrams

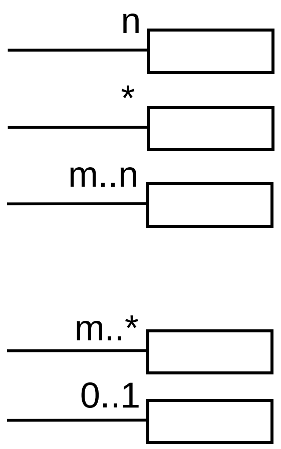
- Class diagrams



- Object diagrams



Multiplicity of assoc. ends



Exactly n

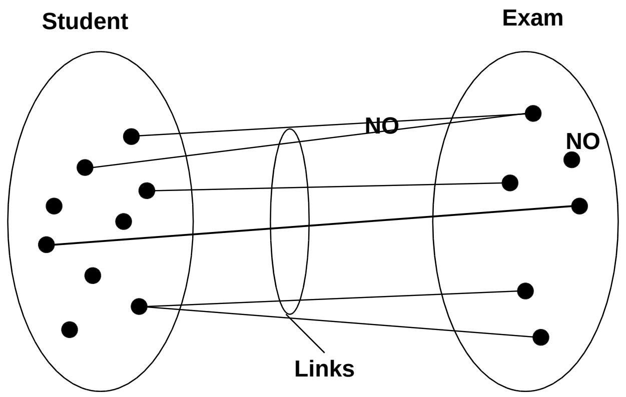
Zero or more

Between m and n (included)

m or more

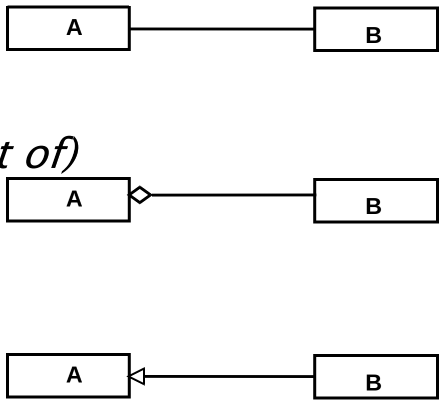
Zero or one (optional)

Example

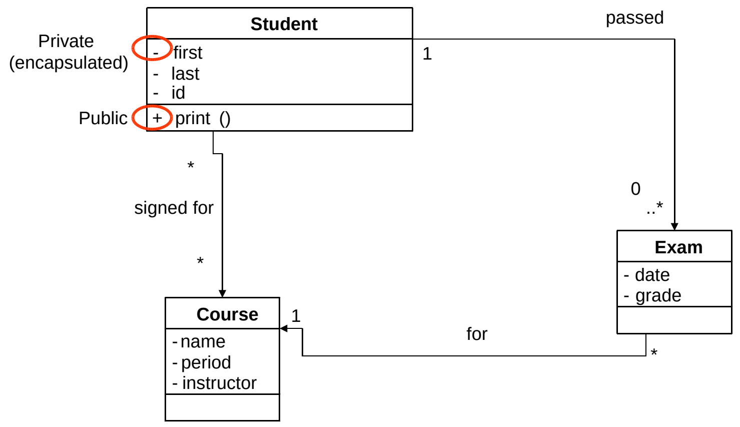


Types of association

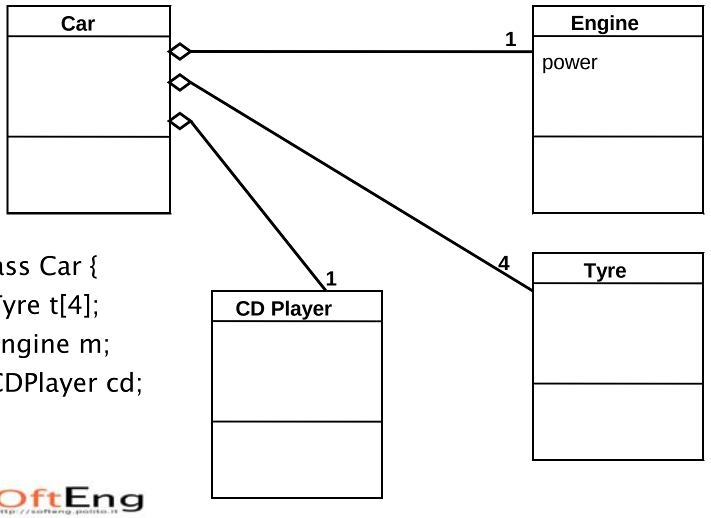
- Use
  - B uses A
- Aggregation *(part of)*
  - B is part of A
- Inheritance (*is a*)
  - B is a child of A



Use

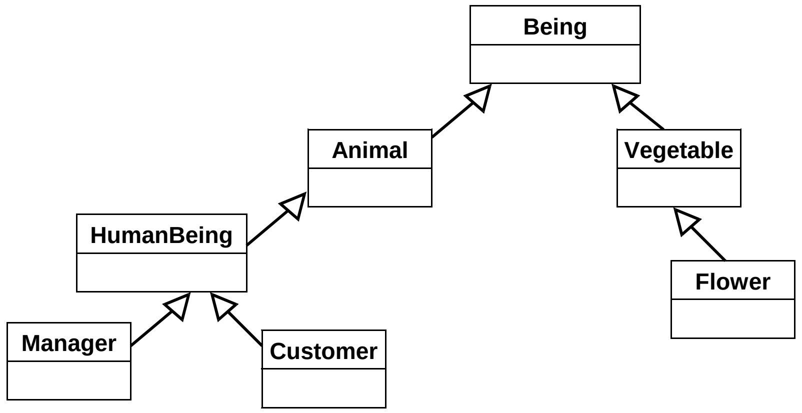


Aggregation



```
class Car {
  Tyre t[4];
  Engine m;
  CDPlayer cd;
}
```

Inheritance

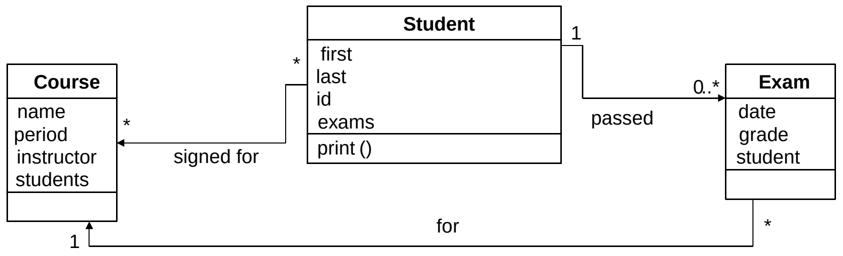


Process

Analysis

- Identify classes
  - Substantives and real objects (having attributes)
- Identify attributes
  - Substantives, physical properties
- Identify methods
  - Delegation, information hiding
- Identify associations

UML analysis



Design

- Add/modify classes for
  - User Interface / Graphical user Interface
  - DB access
  - Net distribution
  - Efficiency/Optimization

OO - Design Heuristics

- All data should be hidden within its class
- Keep related data and behavior in one place
- Model the real world whenever possible
- Eliminate classes that are outside the system
- Avoid all-powerful (omnipotent) classes
- Minimize the number of messages sent between two classes

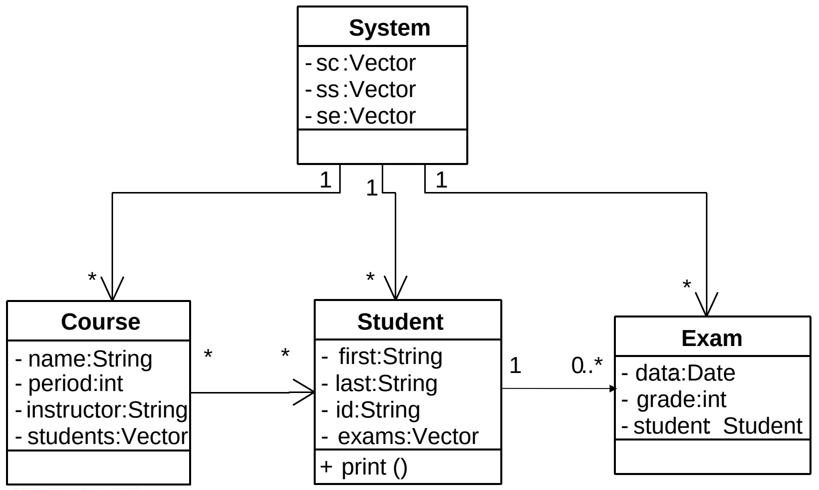
More OO Design Heuristics

- If a class contains objects of another class, then the containing class should be in charge of sending messages to the contained objects
- The containment relationship should always imply a uses relationship
- A class must know what it contains, but it should not know who contains it

Low level design

- Implement classes
- Implement attributes
  - Define the type
- Implement methods
  - Define the prototype
- Implement associations

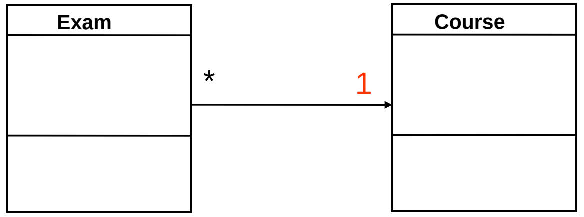
UML low-level design



How to implement associations

Association :1

- From Exam towards Course



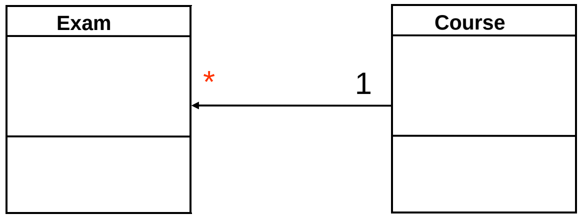
```
Class Exam {
  Course c;
  setCourse(Course c){
    this.c=c;}
}
```

```
Class Course {

}
```

Association :n

- From Course towards Exams



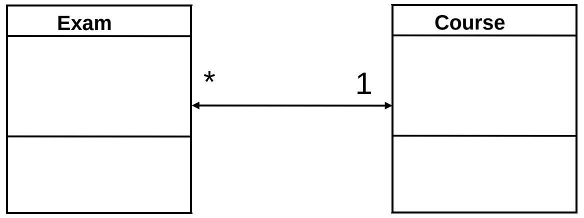
```
Class Course {

  Vector exams;

  Course(){ exams = new Vector(); }
  addExam(Exam e){ exams.add(e);}
}
```

Association 1:n

- Both directions

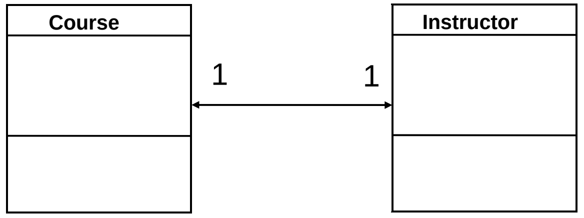


```
Class Exam {
  Course c;
  setCourse(Course c){
    this.c=c;
  }
}
```

```
Class Course {
  Vector exams;
  Course(){ exams = new Vector(); }
  addExam(Exam e){ exams.add(e);}
}
```

Association 1:1

- Both directions

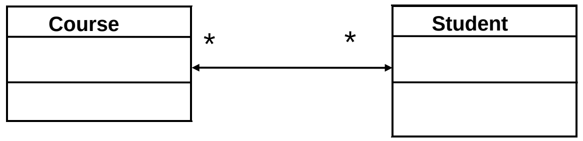


```
Class Course {
   Instructor i;
}
```

```
Class Instructor  {
  Course c;
}
```

Association n:m

- Both directions



```
Class Course {
  Vector students;
  Course(){
     students = new Vector();
  }
  addStudent(Student s){
    students.add(s);
  }
}
```

```
Class Student {
  Vector courses;
  Students(){
    courses = new Vector();
  }
  addCourse(Course c){
    courses.add(c);
  }
}
```

Wrap-up session

- UML is a graphical notation for modeling and documenting OO systems
- Class diagram
  - Classes and associations
- Three types of associations
- Developing is not “just coding”!
  - Use the process to tackle the req. spec.