



University of Dublin
Trinity College



Information Modeling

... the art of communication of the design of information..

Taking Stock

So Far....

Groups have been allocated.

Topics have been assigned to groups.

Group Assignment details have been described.

The following ideas have been introduced.

- Setting the scene for data/information/knowledge
- Modelling
- UML
- UML Use cases
- Ethics Canvas

Work has begun on the group projects.

Note about Naming when Modelling

Use terms relevant to the domain of interest

Avoid abbreviations, computer terms or acronyms

Avoid spaces in names

Use underscores (preferred) or capitalisation to show multiple words (e.g. Academic_Record or AcademicRecord)



University of Dublin
Trinity College



Recap and a little more on UML Use Cases

With the help of a use case diagram, you can communicate:

- The scope of the system
 - Functionality of the system (tasks your information model supports)
 - The people, organizations, or external systems using the system
-

Use cases: advantages

Documents behaviour of the system *from the user's point of view*.

Useful for...

... Capturing Requirements

- Provides structure to the activity
- Find what user needs from system and uses cases that have direct value for them
- Find other situations where user interacts with the system

... Planning iterations of development

- Estimation
- Negotiation
- Politics !
- High risk use case identification... do first

... Validating Systems

- Upon implementation ... “Walk the use cases” along with other diagrams.
-

Identify Actors

When looking for actors, ask the following questions:

- Who or what provides inputs to the system?
 - Who or what receives outputs from the system?
 - Are interfaces required to other systems?
 - Are there events that are automatically triggered at a predetermined time?
 - Who will maintain information in the system?
-

Example Table of Actors

Actor	Synonym	Role
Student		An individual who will attend courses, do assignments and produce results
Data Entry Staff	Administrator
Registrar Office	
Student Information System	SIS
Department delegate	Academic

Identify Use Cases

Strive to identify and document only the most critical, complex, and important use cases, often called *essential* use cases.

When looking for use cases, ask the following questions:

- What are the main tasks of the actor?
- What information does the actor need from the system?
- What information does the actor provide to the system?
- Does the system need to inform the actor of any changes or events that have occurred?
- Does the actor need to inform the system of any changes or events that have occurred?

Requirements documents

- Trawling through “the system shall... ” statements

Story based scenario analysis

- Analysing day to day existing or expected activity of an organisation
-

Example Use-Case/Actor Table

Use Case Name	Participating Actors
Validate Program of Study	Academic
Program of Study Entry	Data Entry Staff, Academic
Approve Program of Study	Registrar Office, Student, Academic
Provide Exam Results	Student, SIS
Provide Enrolment instructions	Student, SIS
Provide Previous Programs of Study	Student

Use-Case Textual Description

Document first at high level to quickly obtain an understanding of the events and magnitude of the system.

Then expand to a fully-documented use case textual description.

- Include the use case's typical course of events and its alternate courses.

Example High-Level Version of a Use-Case Textual Description

Member Services System

Author (s): _____ ①

Date: _____ ②

Version: _____ ③

Use-Case Name:	Place New Order 4	Use-Case Type Business Requirements: <input checked="" type="checkbox"/> 5
Use-Case ID:	MSS-BUC002.00 6	
Priority:	High 7	
Source:	Requirement — MSS-R1.00 8	
Primary Business Actor:	Club member 9	
Other Participating Actors:	<ul style="list-style-type: none">• Warehouse (external receiver)• Accounts Receivable (external server) 10	
Other Interested Stakeholders:	<ul style="list-style-type: none">• Marketing — Interested in sales activity in order to plan new promotions.11 • Procurement — Interested in sales activity in order to replenish inventory.• Management — Interested in order activity in order to evaluate company performance and customer (member) satisfaction.	
Description: 12	This use case describes the event of a club member submitting a new order for SoundStage products. The member's demographic information as well as his or her account standing is validated. Once the products are verified as being in stock, a packing order is sent to the warehouse for it to prepare the shipment. For any product not in stock, a back order is created. On completion, the member will be sent an order confirmation.	

Sample Expanded Version of a Use-Case Textual Description

Member Services System

Author (s): _____

Date: _____

Version: _____

Use-Case Name:	Place New Order	Use-Case Type Business Requirements: <input checked="" type="checkbox"/>
Use-Case ID:	MSS-BUC002.00	
Priority:	High	
Source:	Requirement — MSS-R1.00	
Primary Business Actor:	Club member	
Other Participating Actors:	<ul style="list-style-type: none">• Warehouse (external receiver)• Accounts Receivable (external server)	
Other Interested Stakeholders:	<ul style="list-style-type: none">• Marketing — Interested in sales activity in order to plan new promotions.• Procurement — Interested in sales activity in order to replenish inventory.• Management — Interested in order activity in order to evaluate company performance and customer (member) satisfaction.	
Description:	This use case describes the event of a club member submitting a new order for SoundStage products. The member's demographic information as well as his or her account standing is validated. Once the products are verified as being in stock, a packing order is sent to the warehouse for it to prepare the shipment. For any product not in stock, a back order is created. On completion, the member will be sent an order confirmation.	
Precondition: ❶	The party (individual or company) submitting the order must be a member.	
Trigger: ❷	This use case is initiated when a new order is submitted.	

continued

Sample Expanded Version of a Use-Case Textual Description (cont)

Typical Course of Events:	Actor Action	System Response
3	Step 1: The club member provides his or her demographic information as well as order and payment information.	Step 2: The system responds by verifying that all required information has been provided. Step 3: The system verifies the club member's demographic information against what has been previously recorded. Step 4: For each product ordered, the system validates the product identity. Step 5: For each product ordered, the system verifies the product availability. Step 6: For each available product, the system determines the price to be charged to the club member. Step 7: Once all ordered products are processed, the system determines the total cost of the order. Step 8: The system checks the status of the club member's account. Step 9: The system validates the club member's payment if provided. Step 10: The system records the order information and then releases the order to the appropriate distribution center (warehouse) to be filled. Step 10: Once the order is processed, the system generates an order confirmation and sends it to the club member.

continued

Sample Expanded Version of a Use-Case Textual Description (cont)

Alternate Courses:	<p>4</p> <p>Alt-Step 2: The club member has not provided all the information necessary to process the order. The club member is notified of the discrepancy and prompted to resubmit.</p> <p>Alt-Step 3: If the club member information provided is different from what was previously recorded, verify what was recorded is current, then update the club member information accordingly.</p> <p>Alt-Step 4: If the product information the club member provided does not match any of SoundStage's products, notify the club member of the discrepancy and request clarification.</p> <p>Alt-Step 5: If the quantity ordered of the product is not available, a back order is created.</p> <p>Alt-Step 8: If the status of the club member's account is not in good standing, record the order information and place it in hold status. Notify the club member of the account status and the reason the order is being held. Terminate use case.</p> <p>Alt-Step 9: If the payment the club member provided (credit card) cannot be validated, notify the club member and request an alternative means of payment. If the club member cannot provide an alternate means, cancel the order and terminate the use case.</p>
Conclusion:	<p>5 This use case concludes when the club member receives a confirmation of the order.</p>
Postcondition:	<p>6 The order has been recorded and if the ordered products were available, they were released. For any product not available a back order has been created.</p>
Business Rules:	<p>7</p> <ul style="list-style-type: none"> • The club member responding to a promotion or a member using credits may affect the price of each ordered item. • Cash or checks will not be accepted with the orders. If provided, they will be returned to the club member. • The club member is billed for products only when they are shipped.
Implementation Constraints and Specifications:	<p>8</p> <ul style="list-style-type: none"> • GUI to be provided for Member Services associate, and web screen to be provided for club member.
Assumptions:	<p>9 Procurement will be notified of back orders by a daily report (separate use case).</p>
Open Issues:	<p>10</p> <ol style="list-style-type: none"> 1. Need to determine how distribution centers are assigned.



4 Problem Statements-

1. We will look at some solutions to these on Thursday.
2. Students can attempt these
Their attempts will be collected in class on Thursday and general feedback given.
Please include Student Name and Student ID on any attempts.

CS2041: Use Case Exercise: From the problem statement below Identify Actors, Use Cases and draw use case diagram. Write a textual description for “Process Sale” use case, (a) for a normal scenario and (b) for an error scenario

PROBLEM STATEMENT

The standard procedure of using a cash register is as follows:

- A customer arrives at the checkout to pay for various items
- The cashier records the bar code number of each item, as well as the quantity if it is greater than one.
- The cash register displays the price of each item and its description.
- When all the purchases are recorded, the cashier indicates the end of the sale.
- The cash register displays the total cost of the purchases.
- The customer selects his or her payment method:
 - Cash: the cashier takes the money from the customer and puts it in the cash register, the cash register indicates how much change the customer is to be given;
 - Cheque: the cashier verifies that the customer is financially solvent by sending a request to an authorisation centre via the cash register;
 - Credit card: a banking terminal forms part of the cash register. It sends a request for authorisation to an authorisation centre, according to the card type.
- The cash register records the sale and prints a receipt.
- The cashier gives the receipt to the customer.

Once the items have been entered, the customer can present money-off vouchers for certain items to the cashier. When the payment transaction is finished, the cash register sends the information on the number of items sold to the stock management system.

Every morning, the shop manager initialises the cash registers for the day.

CS2041: Use Case Exercise

From the statement below

1. Identify Actors, Use Cases and draw use case diagram
2. Write a textual description for the “withdraw money using a visa card” use case [where the visa customer is not a customer of the bank], (a) for a normal scenario and (b) for an error scenario

This case study concerns a simplified system of the automatic teller machine (ATM). The ATM offers the following services:

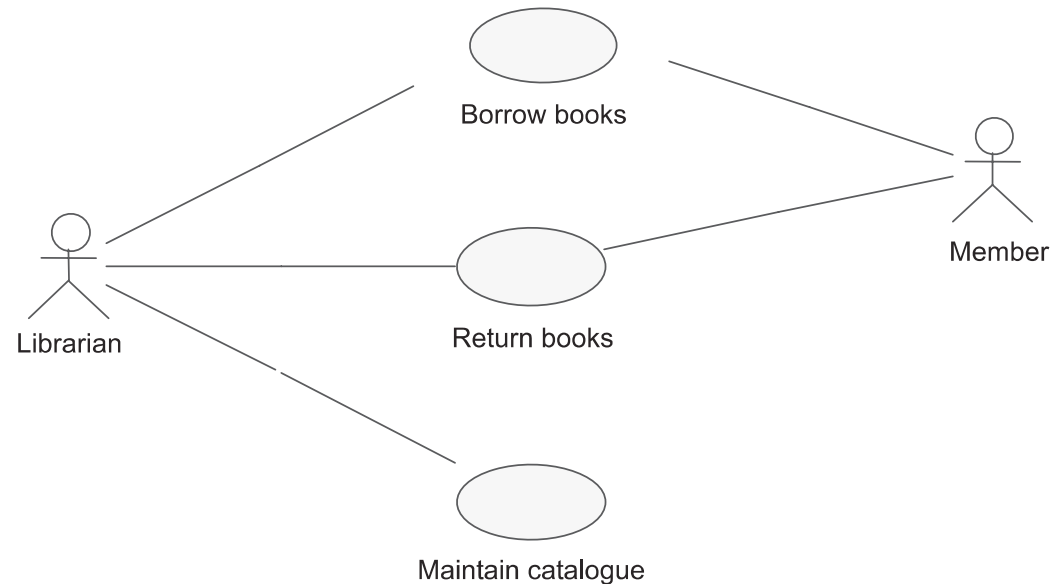
1. Distribution of money to every holder of a smartcard via a card reader and a cash dispenser.
2. Consultation of account balance, cash and cheque deposit facilities for bank customers who hold a smartcard from their bank.

Do not forget either that:

3. All transactions are made secure.
 4. It is sometimes necessary to refill the dispenser, etc.
-

CS2041: Class Diagram Exercise

From the use case diagram below, draw a UML Class diagram including associations, cardinalities, any derived attributes etc.
for a Library System including classes: Library, Loan, Catalogue, Member, Book, Librarian



CS2041: Class Diagram Exercise

draw a UML Class diagram including associations, cardinalities, any derived attributes etc.
for a Theatre Ticket Booking System

Customers may have many reservations

Each reservation is made by one customer through a box office

Reservations are of two kinds – subscription series and individual

Each reservation is associated with a ticket or tickets

Each ticket is either associated with a subscription series reservation or an individual reservation but not both

A subscription series comprises at least 3 but not more than 6 tickets

Each ticket or subscription must be paid for

Customers can pay by credit card or cash

Tickets are issued from a kiosk

Every performance has many tickets available each with a unique seat number.

A performance can be identified by a show, date and time.

A performance schedule is a list of performances for a particular show.

A cast and a reserve cast is associated with each show

A cast is composed of a group of actors



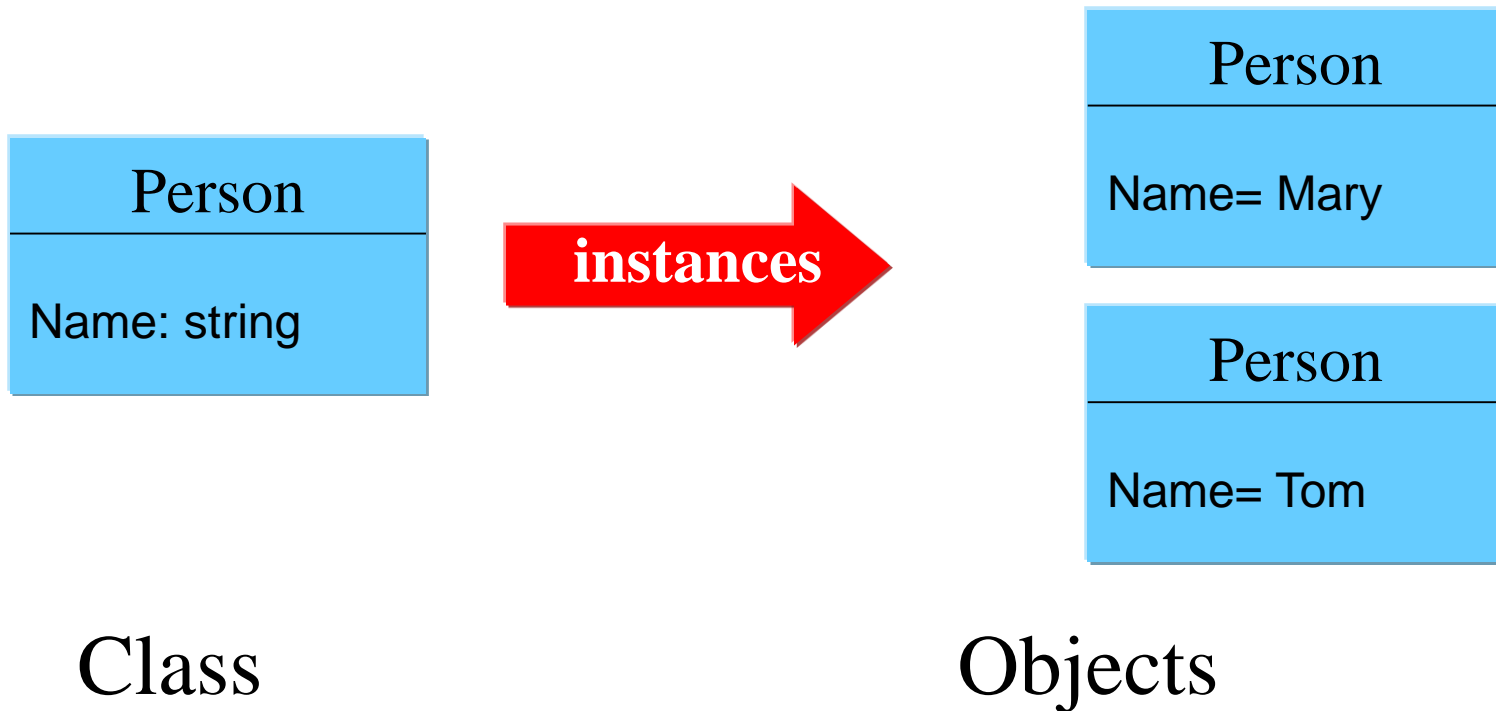
University of Dublin
Trinity College



UML Class Diagrams

Objects and Classes

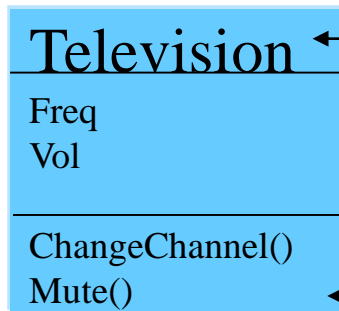
We categorise **objects** into **Classes**. We say that objects are *instances* of classes.



UML Class Diagrams: Purpose

- Used throughout the development process
 - Describe, in a visual form, the static structure of system at a certain level of abstraction
 - Features of classes: attributes, operations, associations
 - Behavioral and data management responsibilities of classes
 - Class Diagrams **Do not** show the functional requirements of a system (Use use case models for this)
 - Class Diagrams **Do not** show how classes interact at run time (Use interaction diagrams for this)
-

Classes



- The Class Name
 - The Attributes
 - The Methods
-

Class Diagram: Class Symbol



In addition to specific methods each **class** will probably have implied behaviors which are represented as operations e.g. 1) Create new instances 2) Update data or attributes 3) Delete instances 4) Display information

Objects can be persistent or transitory and have state.

Attributes

Attribute: a named property of a class that describes a range of values that instances of the property may hold

Attribute type: Either UML predefined types, model types, or programming language types

Each attribute has one *value* for each **object**

- At a given moment, an object of a class will have specific values for every one of its class attributes- This is its state.



Attributes

Syntax of an attribute in the UML:

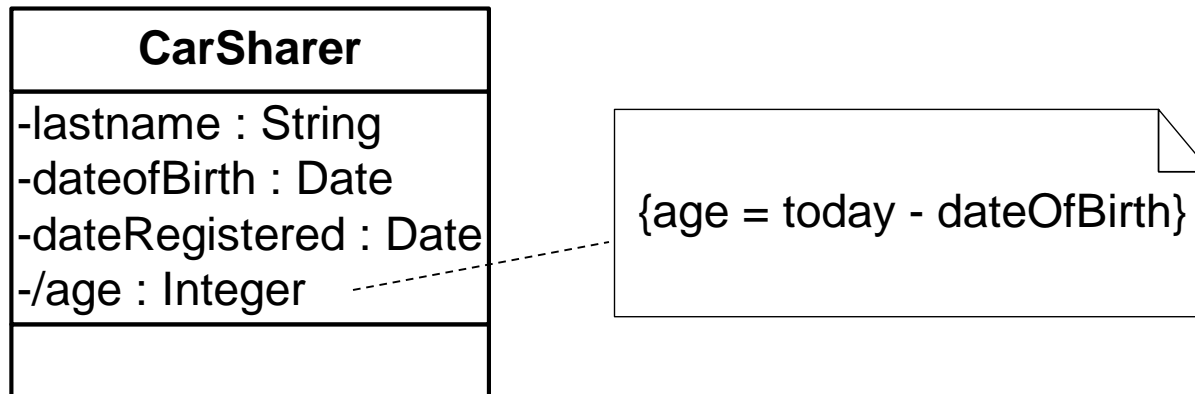
```
[visibility] name [multiplicity] [:type]  
[= initial-value] [{property-string}]
```

Visibility indicators +Public -Private

Examples

<code>origin</code>	// name only
<code>+ origin</code>	// visibility and name
<code>origin : Point</code>	// name and type
<code>name [0..1] : String</code>	// name, multiplicity, and type
<code>origin : Point = (0,0)</code>	// name, type, and initial value
<code>id : Integer {readOnly}</code>	// name, type, and property

Derived attribute



- Derived attributes are used to specify attributes whose value is the result of a computation, based on other attribute values: attribute name is preceded by a “/”.
-

Operations

Operation: the implementation of a service that you can request on any object of the class

- An abstraction of something you can do to an information entity and that is shared by all instances of that entity

A class may have any number of operations or no operation at all

Are listed in an additional box underneath the attribute box using a specific syntax

```
name (arg1 : type, arg2 : type ...) : return type
```

Operations

Bank Account
Account_number Account_name
Check_balance() Debit_account(amount:int) Credit_account(amount:int)

((Visibility
indicators
+ public
- private))

Academic
+ staff_id : String + academic_name : String + teaching_hours : Integer
+ check_workload()

Over to You....

How to start Information Modelling:

In Pairs - Identify Nouns => Potential classes and attributes

The LearnAlot University offers a number of degrees to under graduate and post graduate students who may be fulltime or parttime.. The educational structure of the university consists of schools. Schools contain several departments. While a single school administers each degree, the degree may include courses from other schools. In fact the university prides itself on the freedom of choice given to students in selecting courses towards their degrees.

Each university degree has a number of compulsory courses and a number of elective courses. Each course is at a given level and has a credit point value.

.... A student's proposed program of study is entered in the online enrolment system. The system checks the program's consistency, checks if courses are open and reports any problems.....

How to start Information Modelling:

Nouns => Potential classes and attributes

The LearnAlot University offers a number of degrees to under graduate and post graduate students who may be fulltime or parttime.. The educational structure of the university consists of schools. Schools contain several departments. While a single school administers each degree, the degree may include courses from other schools. In fact the university prides itself on the freedom of choice given to students in selecting courses towards their degrees.

Each university degree has a number of compulsory courses and a number of elective courses. Each course is at a given level and has a credit point value.

.... A student's proposed program of study is entered in the online enrolment system. The system checks the program's consistency, checks if courses are open and reports any problems.....

Relevant?
Potential Attributes?
Fuzzy?
Irrelevant?

Refinement

Relevant Classes

- Manifestly of interest within problem domain of system, potential record

Potential Attributes

- Representing aspects of an identified record => fields

Irrelevant Classes

- Outside the interest of problem domain of system

Fuzzy Classes

- Cannot confidently classify as irrelevant or relevant **yet**

Operations

- Representing actions related to a record

Roles

- Representing an actor of the system
-

LearnAlot Class Discovery

Irrelevant

structure
needs
system

Relevant

degree
school
department
course
course offering
timetable
enrolment
instructions
exam results
academic

Fuzzy

- study program
- elective course
- compulsory course

Attributes

- level
- credit point

Operations

- approval
- open

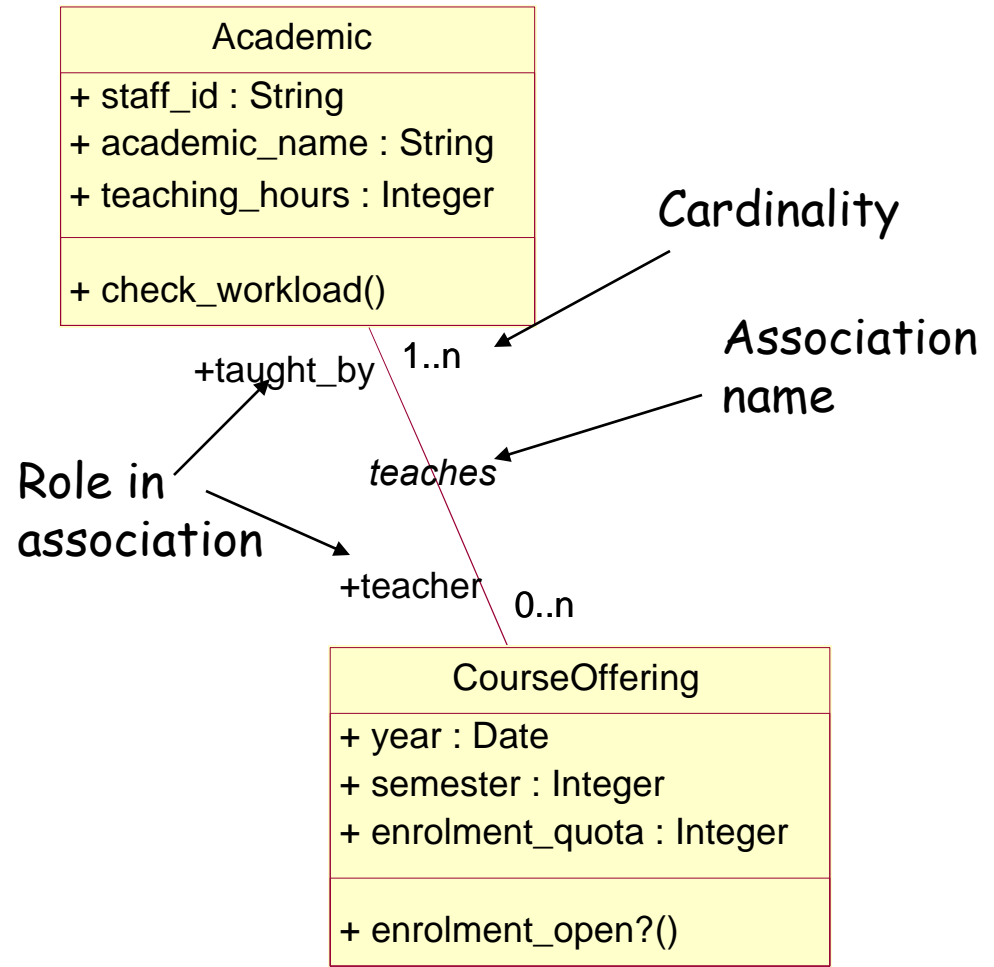
Roles

- registrar
- student
 - Parttime/ Fulltime
 - Under/Post grad
- delegate

Note... should be obvious at this stage... you need more than requirements statement

Describing relationships: Associations and roles

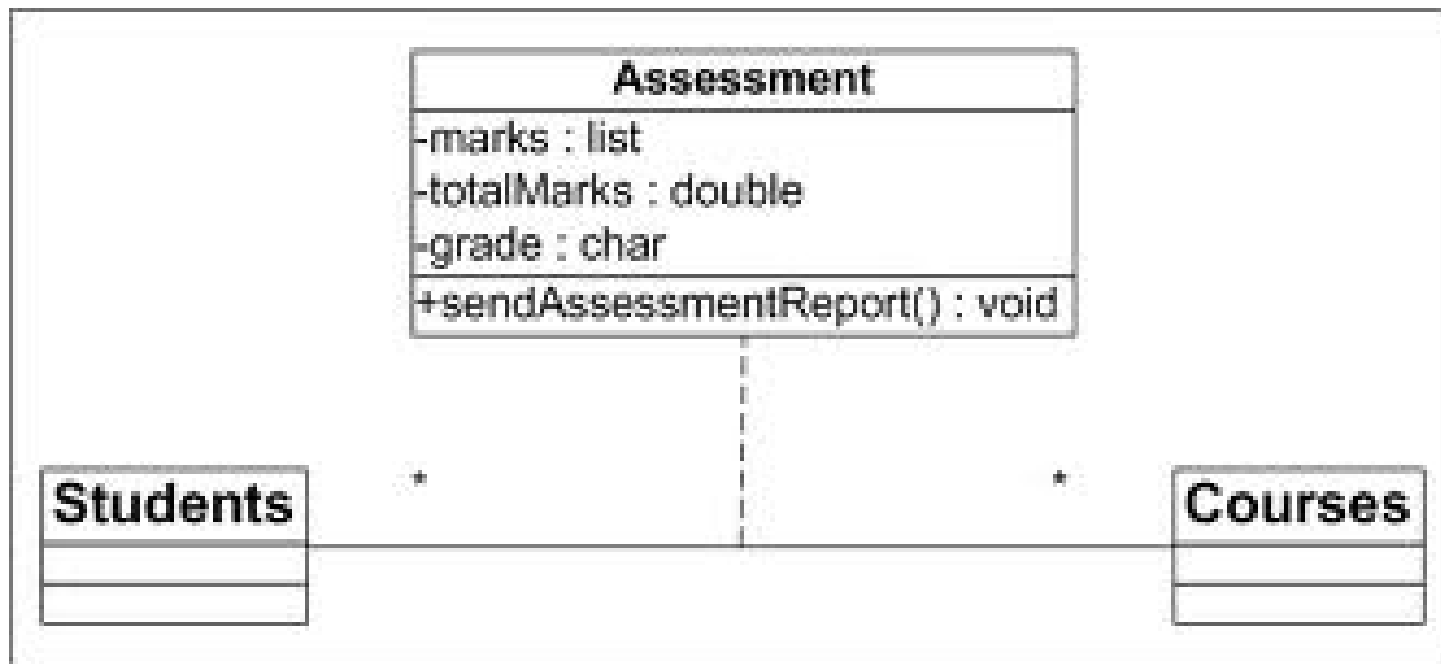
Express the
relationships between
the problem domain
classes using
associations



CourseOffering is taught_by one or more academics
Academic is teacher_of zero or more course offerings

Association Class

Used to model information in an association

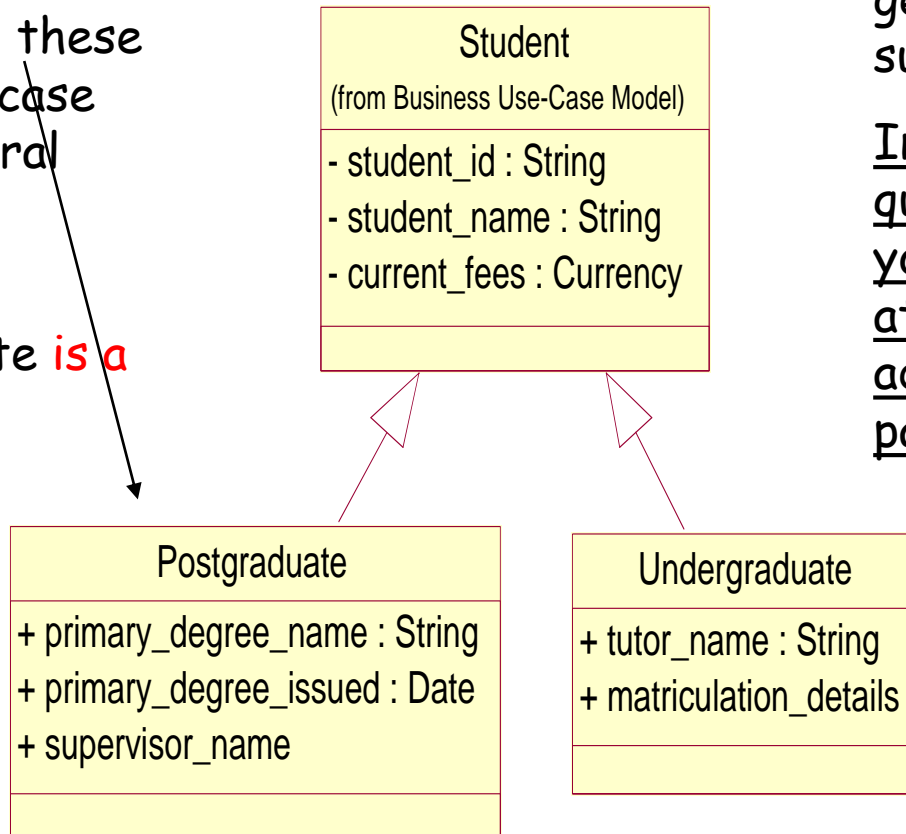


Dotted line from the relevant association indicates the association class

Class association - generalisation

e.g. Each of these
is a special case
of the general
class

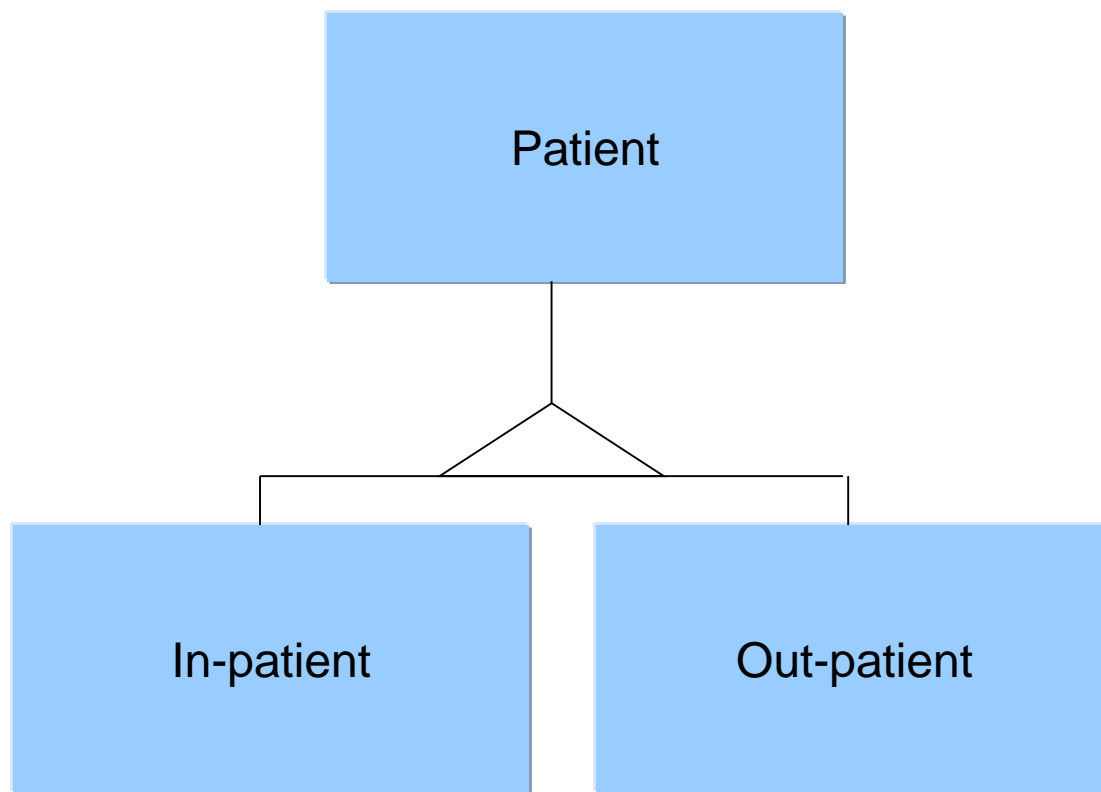
"**Every**
Postgraduate **is a**
Student"



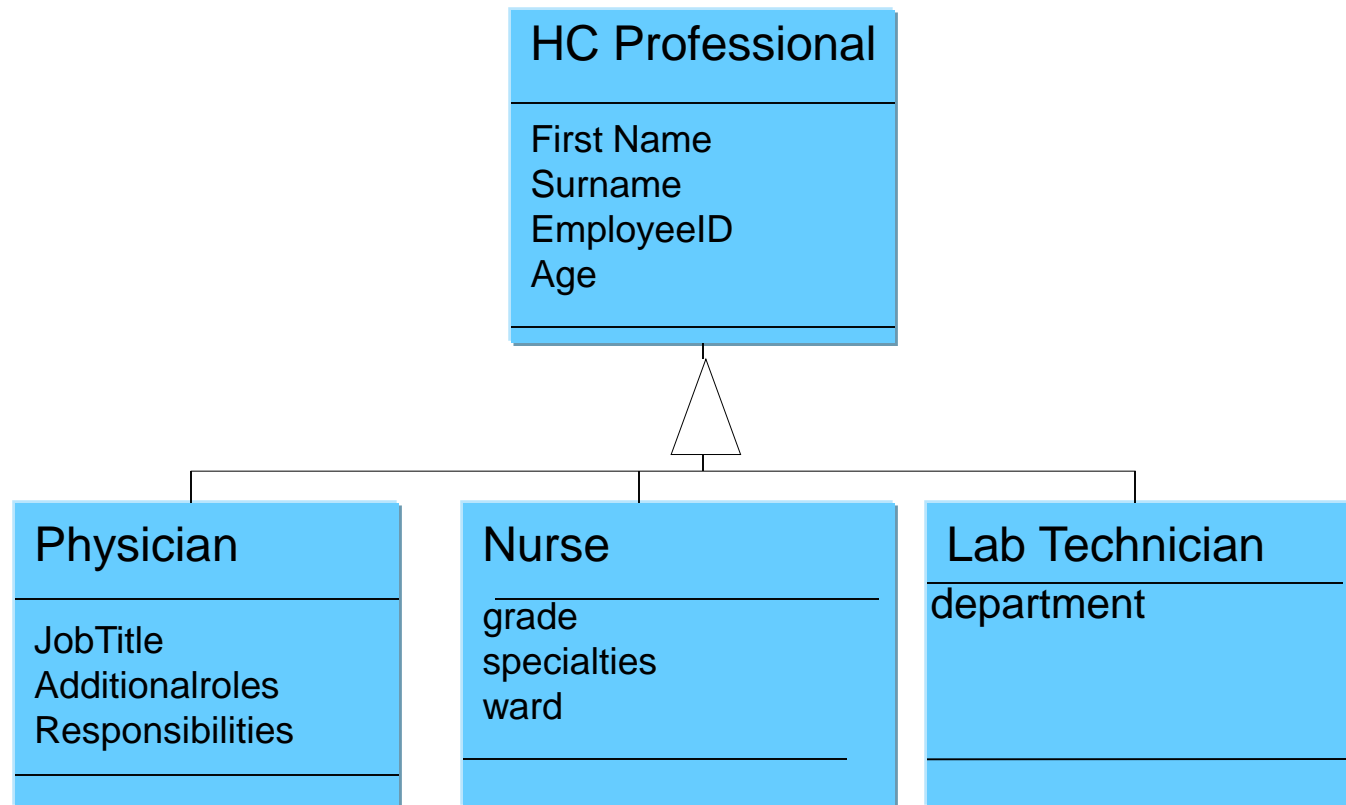
Define sub-classes of the
general abstraction -like Java
sub-classing

In Information Modelling; key
question you should ask
yourself is what new
attributes does a subclass
add that differentiates from
parent class?

Class association – generalisation, Another Example



Class association – generalisation, Another Example

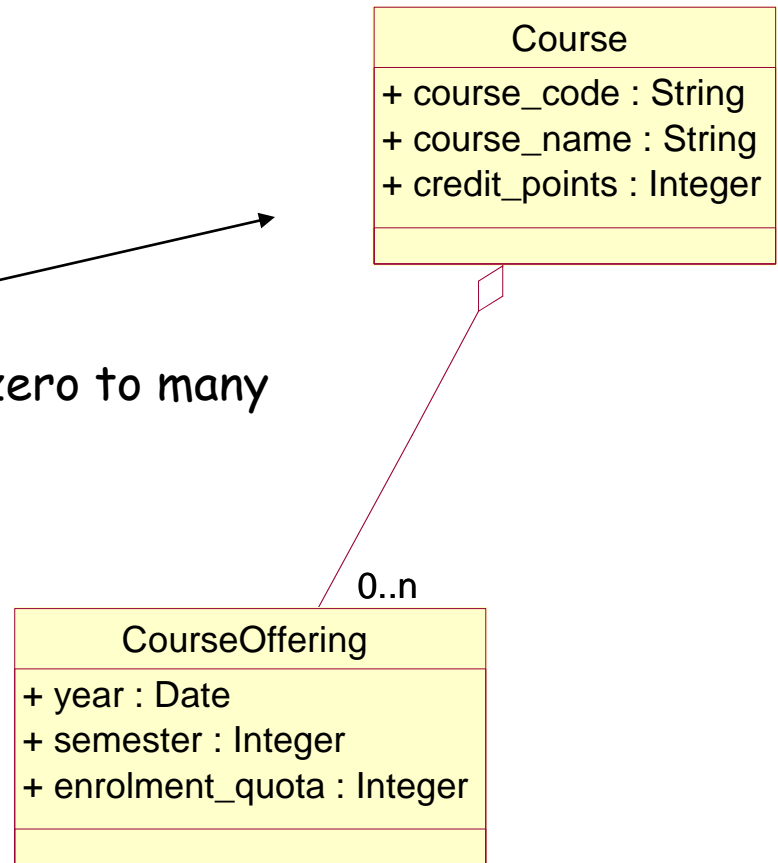


Class association - aggregation

A stronger form of association where there's some notion of objects of one class being “made-up of” those of another

This contains zero to many of these

Known as “Aggregation by Reference”

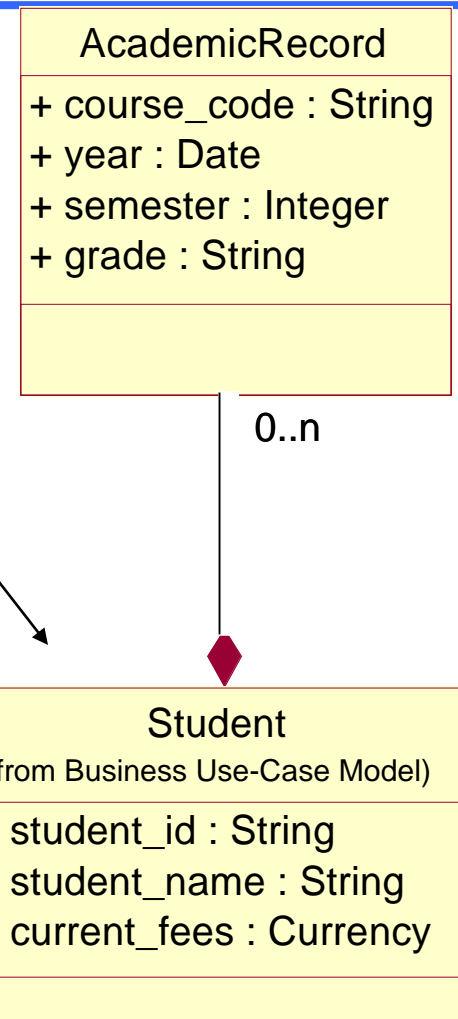


Class association - composition

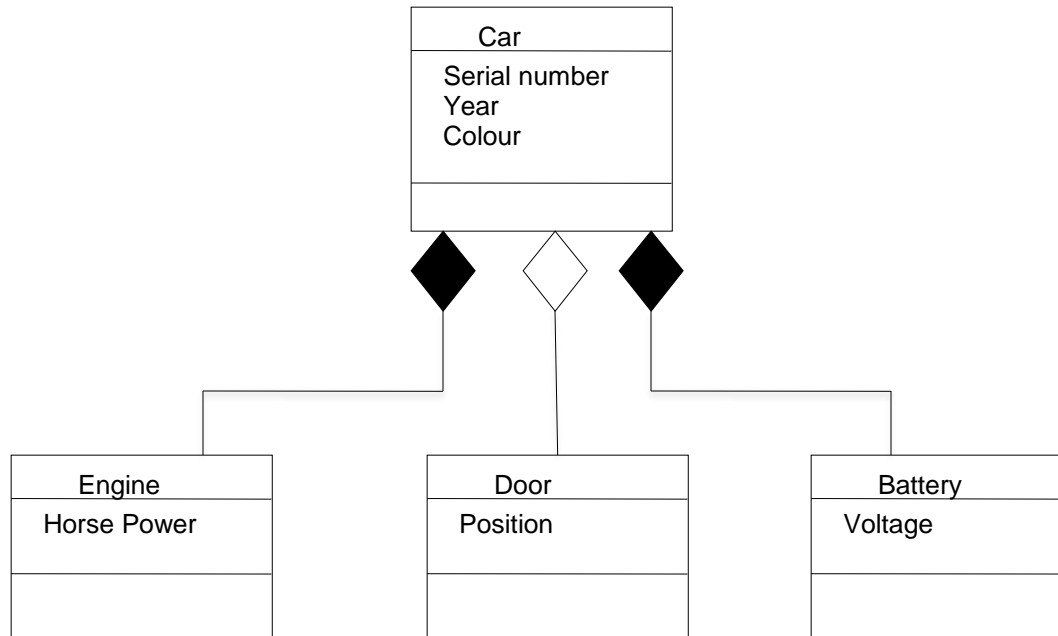
Aggregation except that the subset classes can only exist if the composed class exists

This cannot exist if this destroyed

Known as
“Aggregation by Value”

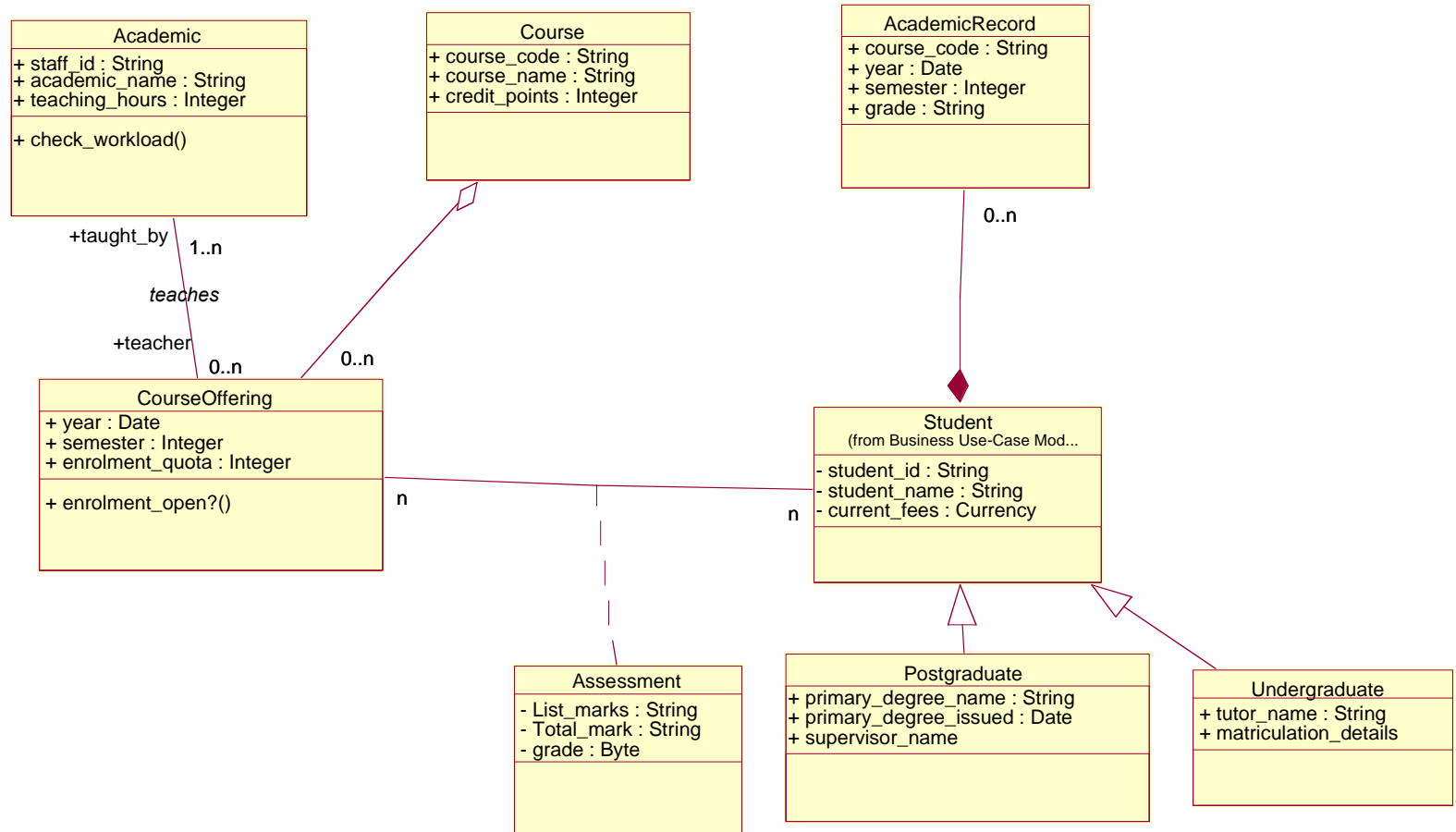


Composition and Aggregation



Putting it all together...

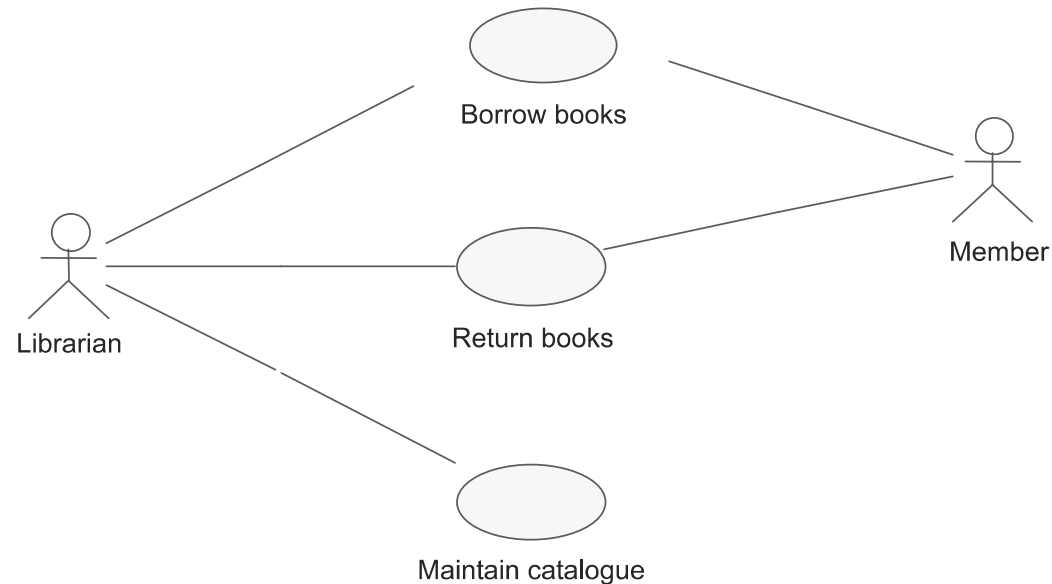
the Information Model starts to emerge



**YOUR TURN TO PUT INTO
ACTION**

CS2041: Class Diagram Exercise

From the use case diagram below, draw a UML Class diagram including associations, cardinalities, any derived attributes etc.
for a Library System including classes: Library, Loan, Catalogue, Member, Book, Librarian



A Possible Solution

