Object-Oriented Analysis - An Example

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Outline

- An example on OOA with UML

Objectives of OOA

- Analyze the requirements
- Give the system models
- Refine the models

UML diagrams

- UML diagrams
  - Use case diagrams
    - Actors
    - Use cases
    - Scenario
  - Class diagrams
    - Classes
    - Objects
    - Relationships

UML diagrams

- Sequence diagrams
  - Event between objects
  - Timing events
  - Describe the scenario in diagrams with the communications between objects
- State transition diagrams
  - States of a class
  - Events, actions, conditions
  - Transitions between states

UML diagrams

– Activity diagrams

- Activities
- Describe the time constraints of the different activities

Example

- *ispace.uic.edu.hk*
- A simplified iSpace system (delivered by lecturer)
- In short: SiS

Use Case Diagrams

- Identifying actors
  - Who interact with the system?
  - Four questions can help identifying (识别) actors
    - Which user groups are supported by the system to perform their work?
    - Which user groups execute the system's main functions
    - Which user groups perform secondary （第二） functions, such as maintenance（维护） and administration(管理)?
    - With what external （外围）hardware or software system will the system interacts?

SiS - Use Case Diagrams - Actors
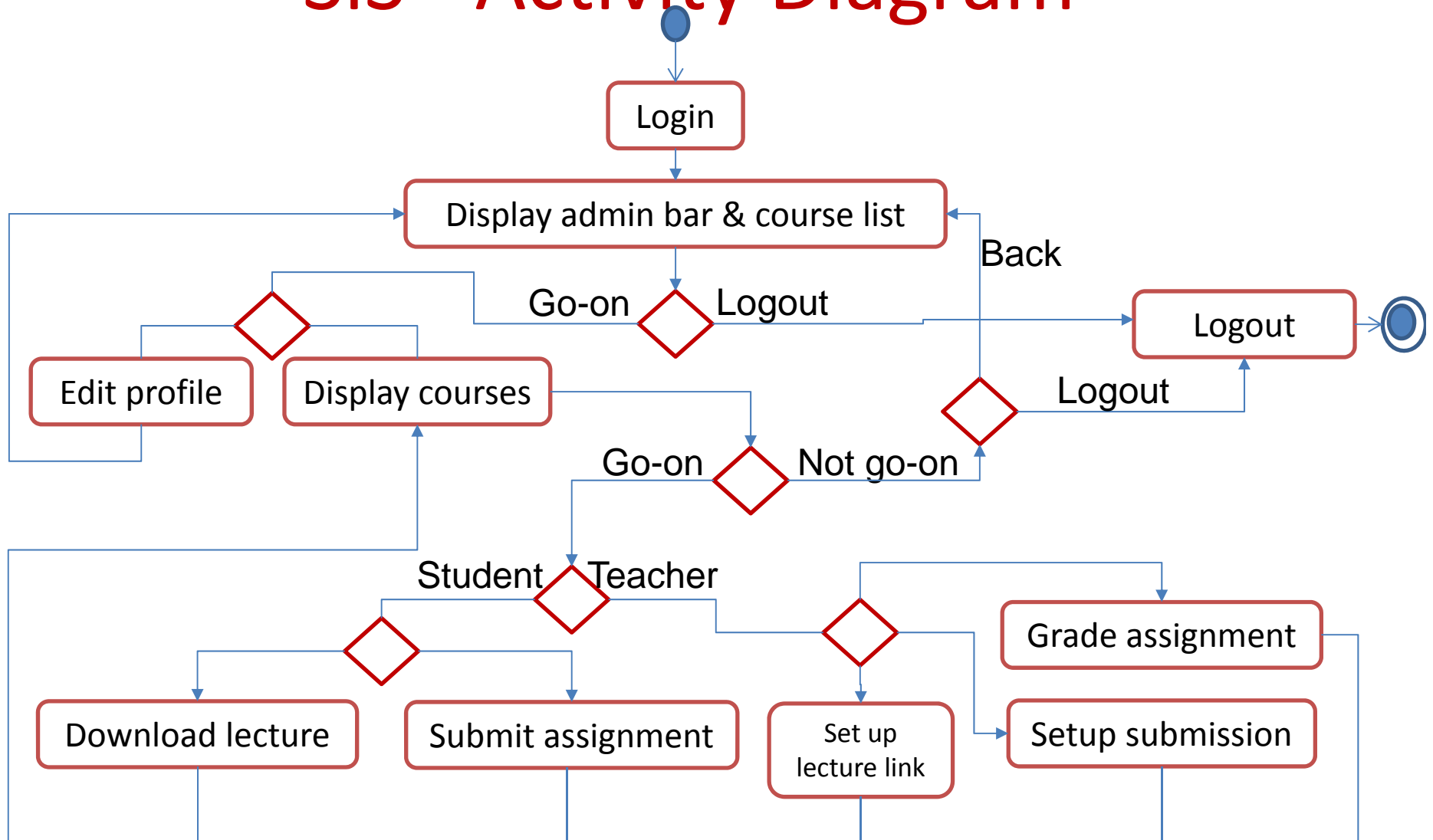
User

Teacher

Student
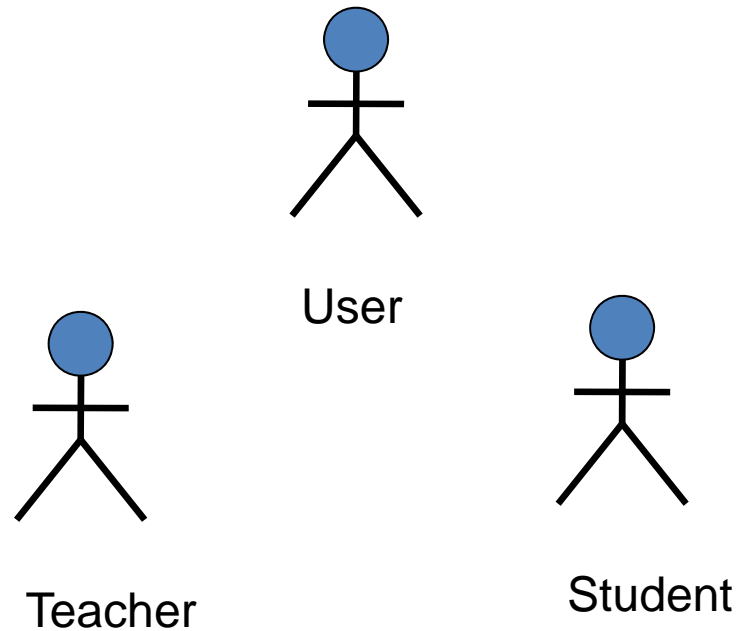
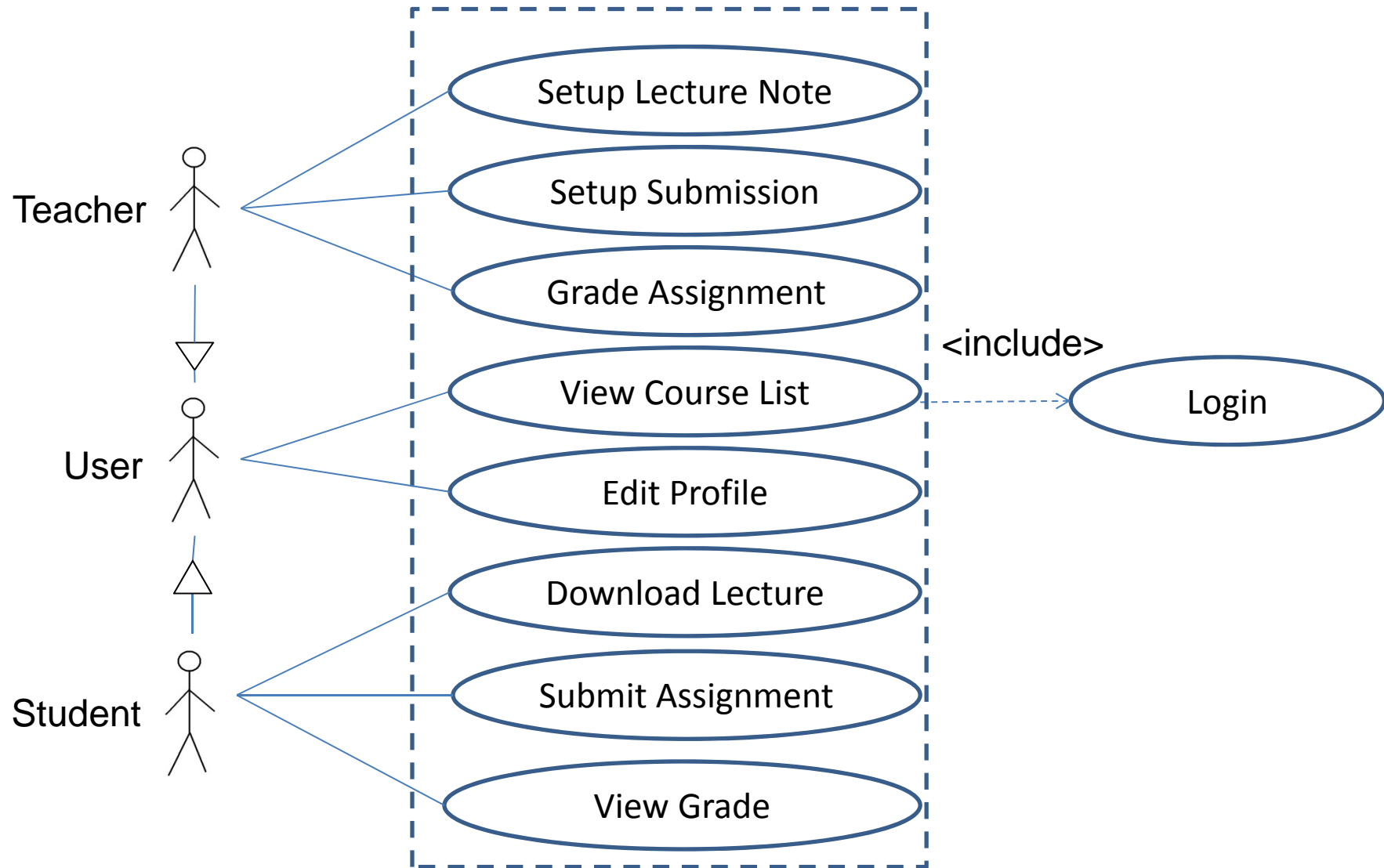What is the relationship between them?

Use Case Diagrams

- Identifying use cases
  - What does a user do when he or she uses the system?
  - How does a user use the system?
- Activity diagram and state transition diagram can help.

SiS - Activity Diagram

Software Engineering

SiS - Use Cases

Class Diagram

- What shall we need to draw a complete class diagram
  - Object
  - Attribute (including types)
  - Operations
  - Associations

Class Diagram

- What shall we need to draw a complete class diagram
  - Object ----------------------- Nouns in requirements
  - Attribute (including types) ----------- Nouns in requirements
  - Operations -------------- Sequence diagrams and state diagrams
  - Associations ----------------------- Sequence diagrams

Objects

- Three types of objects
  - Entity objects
    - Represent the persistent information tracked by the system
  - Boundary objects
    - Represents the interactions between the actors and the system
  - Control objects
    - In charge of realizing use cases

Objects

- Entity objects
  - Participating （参与）objects
  - The objects in the application domain
  - They are not about the interface of the system

Entity Objects

- Entity objects are participating objects
  - Identify all the noun phrases （名词短语）
  - Find the entity objects, attributes, values
  - The following entities are not participating entities:
    - entity that initiates （启动）a user interface
    - entity whose information is not used in the system
    - an interface for control that is responsible for the coordination （协调）between the interface and the functions.

SiS - Entity Objects

- Objects, attributes, and values
  - Not all the nouns are objects
  - Some nouns are attributes
  - Some nouns are values.

SiS - Entity Objects

 iSpace , course management system, college, teacher, student ,user, user name, password, administration bar, course, course name, system, browse page, that course, teacher name.

"Edit profile" button., button, page, profile, email, country, language, portrait. Information, drop-down list.

course browse page, work, lecture note link, assignment submission link, assignment, setting, link, display title, description. attached file, deadline, submission link, submission list page, page, "cancel", "grading" button, grading page, download link submission, rubric table, homework, rubric, evaluation item, grade levels, cell, table, marking, "continue", or "cancel" button, "continue", warning , score, grading.

grade, submission time

What are the entity objects ???

SiS - Entity Objects

Entity Objects	Attributes	Values
User (teacher, student)	User name Password Role	TEACHER (as a teacher) STUDENT (as a student)

SiS - Entity Objects

Entity Objects	Attributes	Values
Profile	Name Email Country Language Portrait	Country list Language list

SiS - Entity Objects

Entity Objects	Attributes	Values
Course	Name, instructor name	
Assignment (Assignment submission link)	Display title, description, deadline	
Lecture note (lecture note link)	Display title, description, file name	
Submission (Student's submission)	Score, submission time, file name	

SiS - Attributes

- Attributes are properties （性质）of individual （单个）objects
- Check the possessive （所有格的）phrases
- An attribute can have
  - A name that describe them within an object
  - A brief （简短）description
  - A type that describe the legal （合法）values
- Only the attributes relevant （相关）to the system are considered
- Properties that are represented by objects are not attributes
  - *Rubric* is not an attribute of *Assignment* but an object.
  - *Portrait* is an attribute of *Profile*

SiS - Attributes and Types

Profile
Name: String
Email: String
Country: String (or enumeration)
Language: String (or enumeration)
Portrait: String

SiS - Attributes and Types

Assignment
DisplayTitle: String
Description: String
Deadline: DATE-TIME

LectureNote
DisplayTitle: String
Description: String
File: FILE

SiS - Objects

The following nouns are **NOT** participating (entity) objects, attributes, values:

| iSpace system | link | button |
| warning | table | page |

SiS - Boundary Objects

- Boundary （边界）objects represent the system interface with the actors. They are used to accept input from users and to display information to users
  - Dialogue box
  - Message
  - … …

SiS - Boundary Objects

What objects are the boundary objects:

iSpace system	link	button
warning	table	page

SiS - Boundary Objects

Initialize UI or Use Case	Interface for input	Notice and message
• Button (grade, continue, cancel…	• Page(grading page, browse page ….) • Table (rubric table in grading page)	• Warning

SiS - Control Objects

- Control objects are responsible for coordinating boundary and entity objects
  - Identify one control object for each actor in each use case
  - A single control object is usually created at the beginning of the use case and accumulate （累积） all the information needed to complete the use case
  - The control object is usually destroyed with the completion of the use case
  - Sometime, if the system is small, only one control object is created for the whole system.

SFBS – Control Objects

What objects are the control objects:

iSpace system

SFBS – Control Objects

- EditProfileControl

- GradeAssignmentControl

- SetupLectureNoteControl

- ……

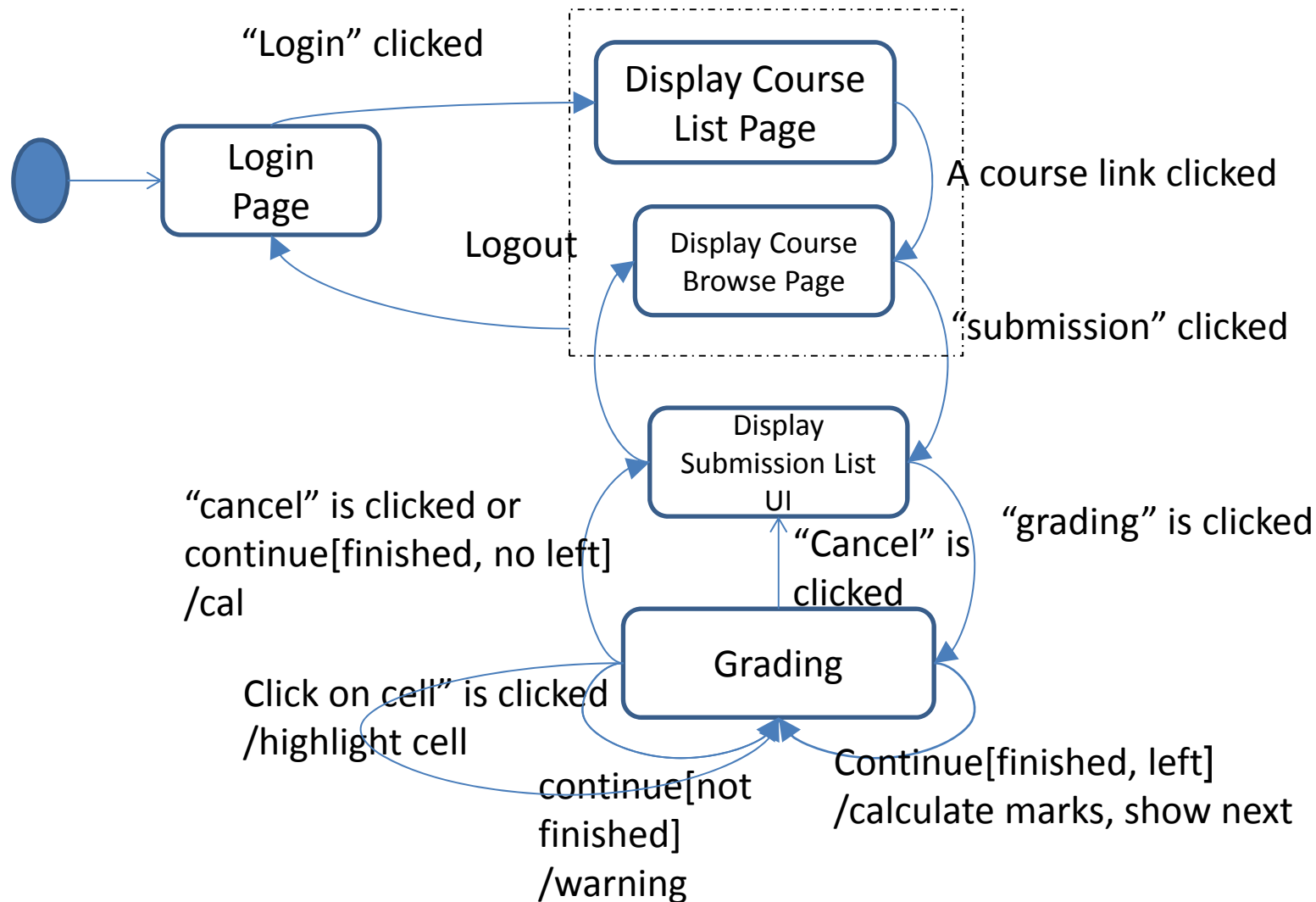*Each use case has
a control object*

or

iSpaceSystemControl

The system has only one control object

SiS – State Transition Diagram

- A state transition diagram can help figure out the events and actions in a use case

- These events and actions can be reflected in the sequence diagram
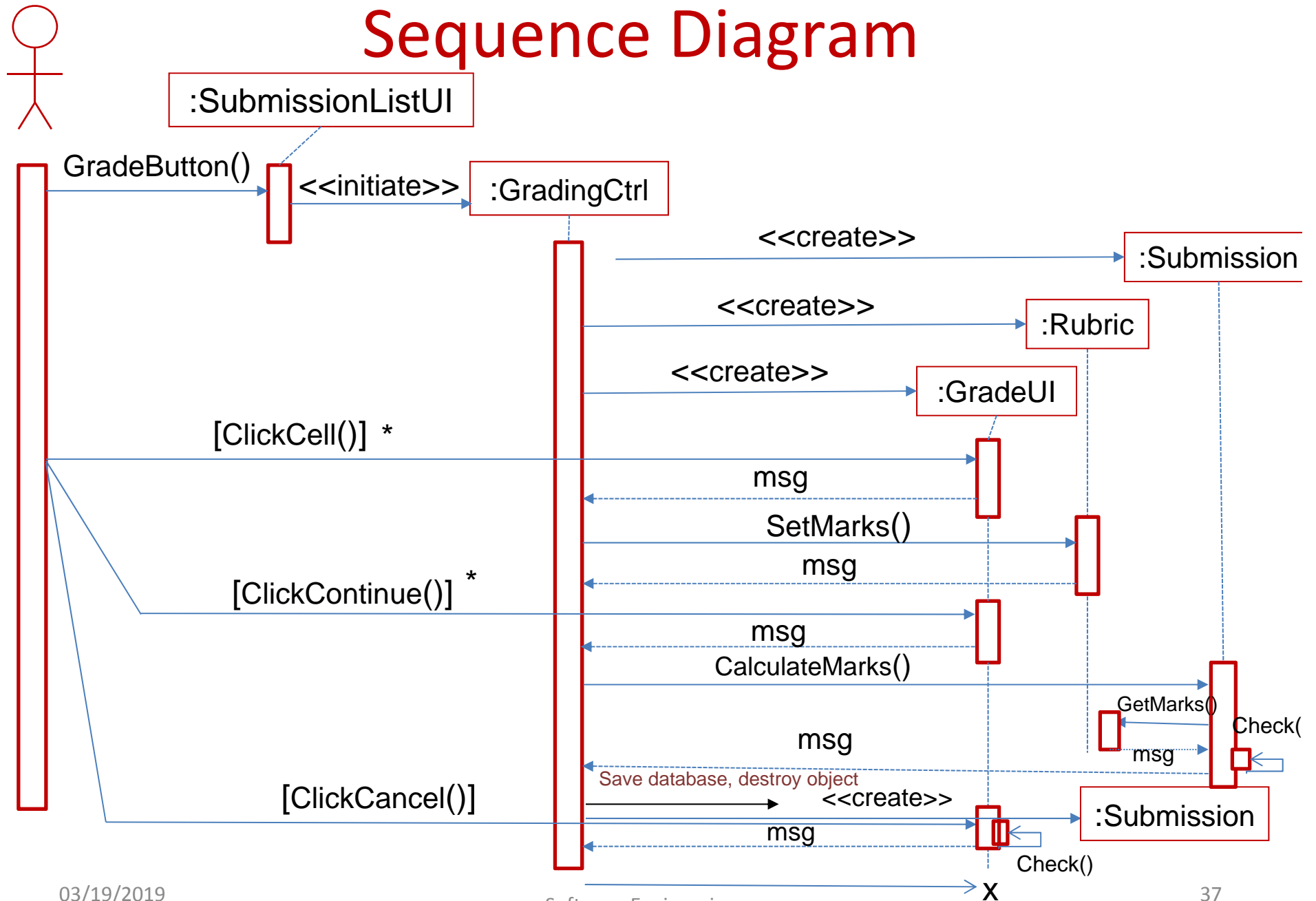
SiS – State Transition Diagram

"Login" clicked

Login Page

Display Course List Page

A course link clicked

Logout

Display Course Browse Page

"submission" clicked

Display Submission List UI

"cancel" is clicked or continue[finished, no left] /cal

"Cancel" is clicked

"grading" is clicked

Grading

Click on cell" is clicked /highlight cell

continue[not finished] /warning

Continue[finished, left] /calculate marks, show next

SiS - Sequence Diagrams

- For each use case, see how the objects work together to finish the behavior of a use case
    - The first column is the actor who initiates （启动） the use case
    - The second column is a boundary object used by the actor to initiate the use case
    - The third column is a control object that manage the rest of the use case

SiS - Sequence Diagrams

- Boundary objects are created by control objects (in the same use case)

- Entity objects are accessed by control and boundary objects

- Entity objects never access boundary or control objects.

Sequence Diagram

:SubmissionListUI

GradeButton()
<<initiate>>
:GradingCtrl

<<create>>
:Submission

<<create>>
:Rubric

<<create>>
:GradeUI

[ClickCell()] *

msg

SetMarks()
msg

[ClickContinue()] *

msg

CalculateMarks()

GetMarks()
Check(

msg

msg

Save database, destroy object
<<create>>
[ClickCancel()]

:Submission

msg

Check()

X

SiS - Behavior

- Operations for each class can be derived from the sequence diagrams
- Distribute behavior for individual objects
- Find the behaviors that affect the states
- Use a state transition diagram and the sequence diagram to help
- get() and set()

SiS - State Diagrams

- State transition diagram can be used to describe the state transition for single object

- It is not necessary to build state-chart diagram for every class

- Only the objects with an extended lifespan （寿命）and state dependent （依靠）behaviors are worth considering.

SiS - State Transition Diagram
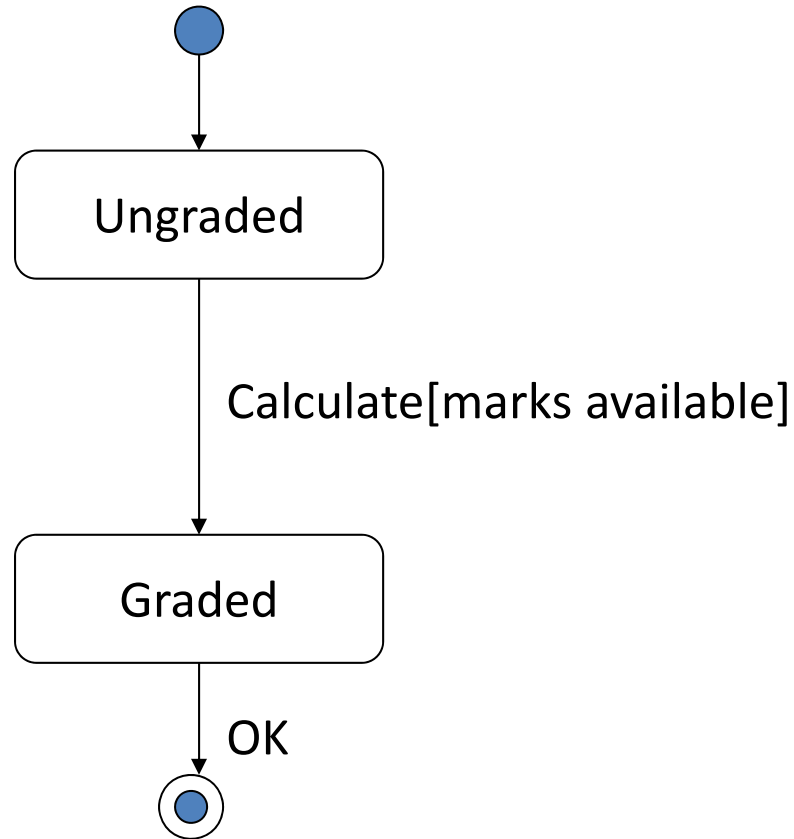

A state transition diagram for Submission

SiS - Behaviors

Submission
score: Real submissionTime:DATE_TIME file: FILE status: {NOT_GRADED, GRADED}
calculateMarks() checkStatus() checkLateSubmission()

SiS - Association

- Focus on the association between entity objects
- Check the verb phrases
  - Has, consists of, contain, include, produce, create
- Use qualifier （修饰语）as often to identify key (关键) attributes
- Eliminate （去除） any association that can be derived （推导）from other associations （关联）

SiS - Association
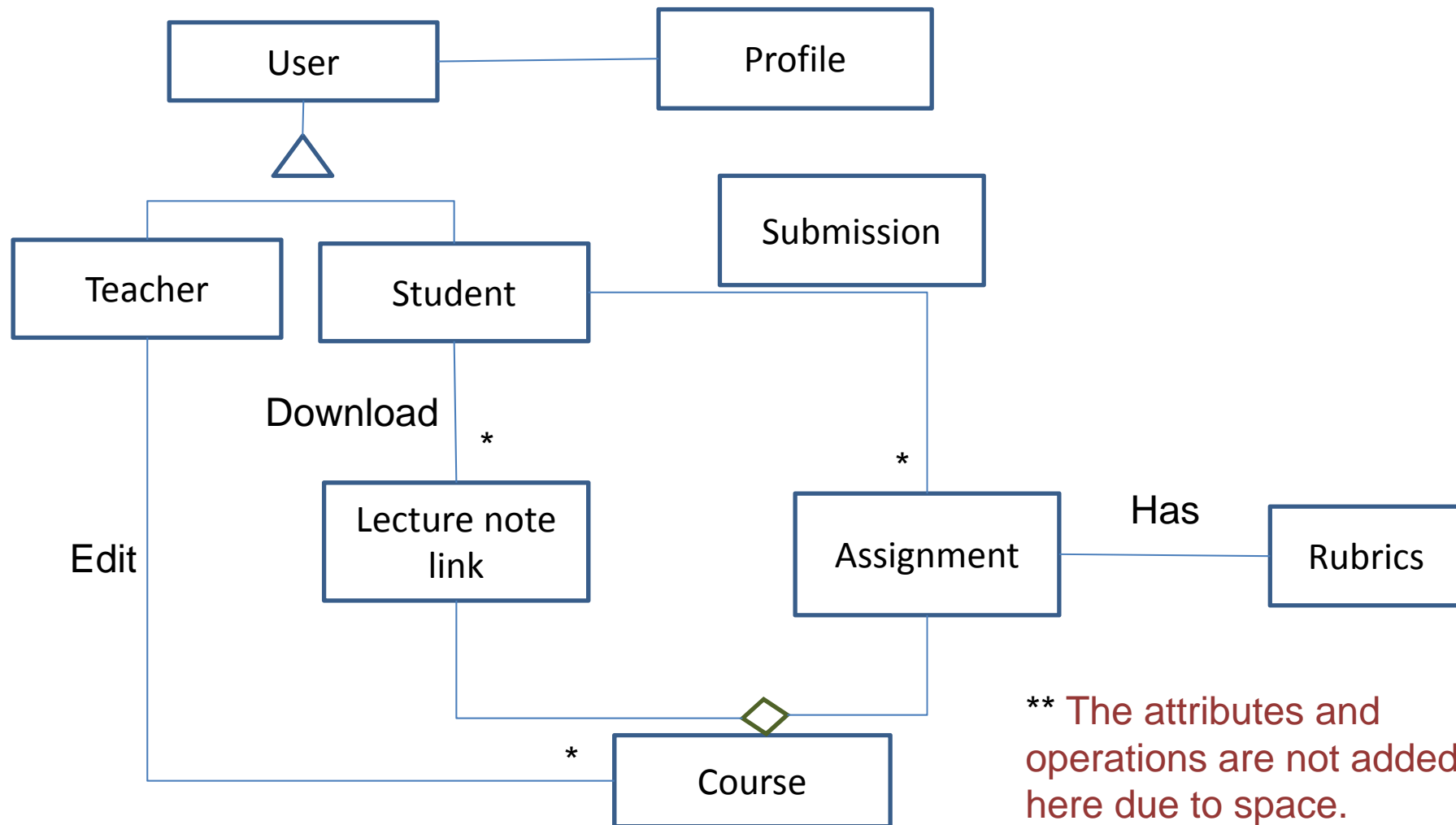
Summary

- We can follow a certain procedure to analyze the requirements and draw the requirements in UML models

- There are three types of objects

- Objects, attributes and attribute types are obtained from the analysis of nouns in the requirements

- Sequence diagrams can help us understand the behaviors of an object and the relationships between the objects.