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Lecture 09

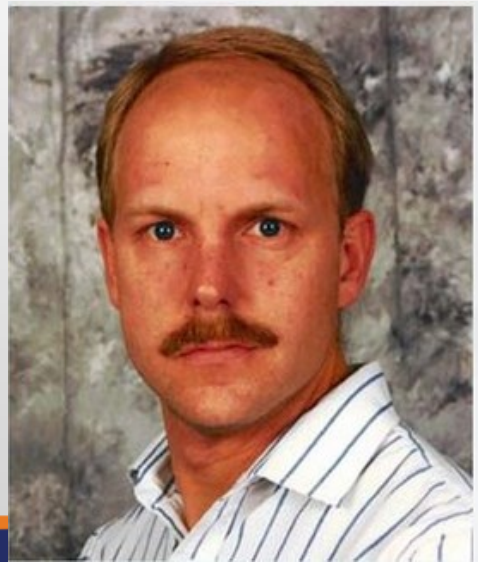
Object Oriented Analysis Using CRC Cards

Agenda

- Object Oriented Analysis
  - Class Responsibility and Collaboration (CRC) Cards.

What is CRC Cards Method?

- Class Responsibility and Collaboration (CRC) cards:
  - Developed by Kent Beck and Ward Cunningham (1989).
- Used to explore class relationships between classes in a particular use- case scenario.



A CRC Card

A CRC is a 4 × 6 inch card divided into three sections.

- The name of the class on the top of the card.
- The responsibilities of the class on the left of the card.
- The class collaborations on the right of the card.
  - (the list of other classes with which the class collaborates to realize its responsibilities)

Class name:	
Responsibilities:	**Collaborations:**

Identifying the Classes' Responsibilities

Responsibilities relate to actions. You can generally identify responsibilities by selecting the verbs from the summary of the requirements.

The list of responsibilities on the CRC card is not the list of methods in the class.

- A responsibility may be realized by several methods.
- e.g. An Item class in a Supermarket may have the responsibility of "Store Details of Item"
  - We may need the following methods to realize the responsibility
  - addItems(), updateItems(), deleteItems()

What is a Collaboration?

- To identify the collaborations, we need to study the responsibilities and determine what other classes the object interacts with.
- A class may not be able to act upon its responsibility on its own.
- It may require some interaction with other classes.(need help)
  - these helper classes are the collaborators.

e.g. An ItemReport class that has responsibility of "producing a list of Items which needs to be reordered" would need to collaborate with the Item class

Activity 1:

Scenario step :

"You (the student) should e-mail your CV to my (Lecturer's) boss "

Write few CRC cards for this

Steps

1. Take these as the *classes* for (the first) cards.

   Student, CV, Boss, Lecturer

2. The only verb you need to make this scenario happen is **"send an e-mail with CV"**

3. Add that as a *responsibility* to the “Student" card. However, Student can not do this activity alone. (because the card doesn’t have enough information).

   So, Student needs two *collaborators/helpers* :

Have to attach **The CV** > student should have a CV
Find **boss’s e-mail address**. > student should ask Lecturer

Activity 1: Basic CRC Cards

Student	
Responsibility	**Collaborators**
e-mail CV to a given e- mail address.	CV
find e-mail address.	lecturer

CV	
Responsibility	**Collaborators**

Boss	
Responsibility	**Collaborators**

Lecturer	
Responsibility	**Collaborators**
Know boss's e-mail address.	

Activity 2

- In a DVD rental store there are two types of users, a registered member can borrow up to 3 DVDs at a time. These members have already paid a deposit and only need to pay 50/= per DVD.
- Unregistered members can also borrow DVDs at the rate of 75/= per DVD. They are required to provide their id card for this purpose.
- Members can keep the DVD for three days and when they are returned appropriate fines may be calculated.

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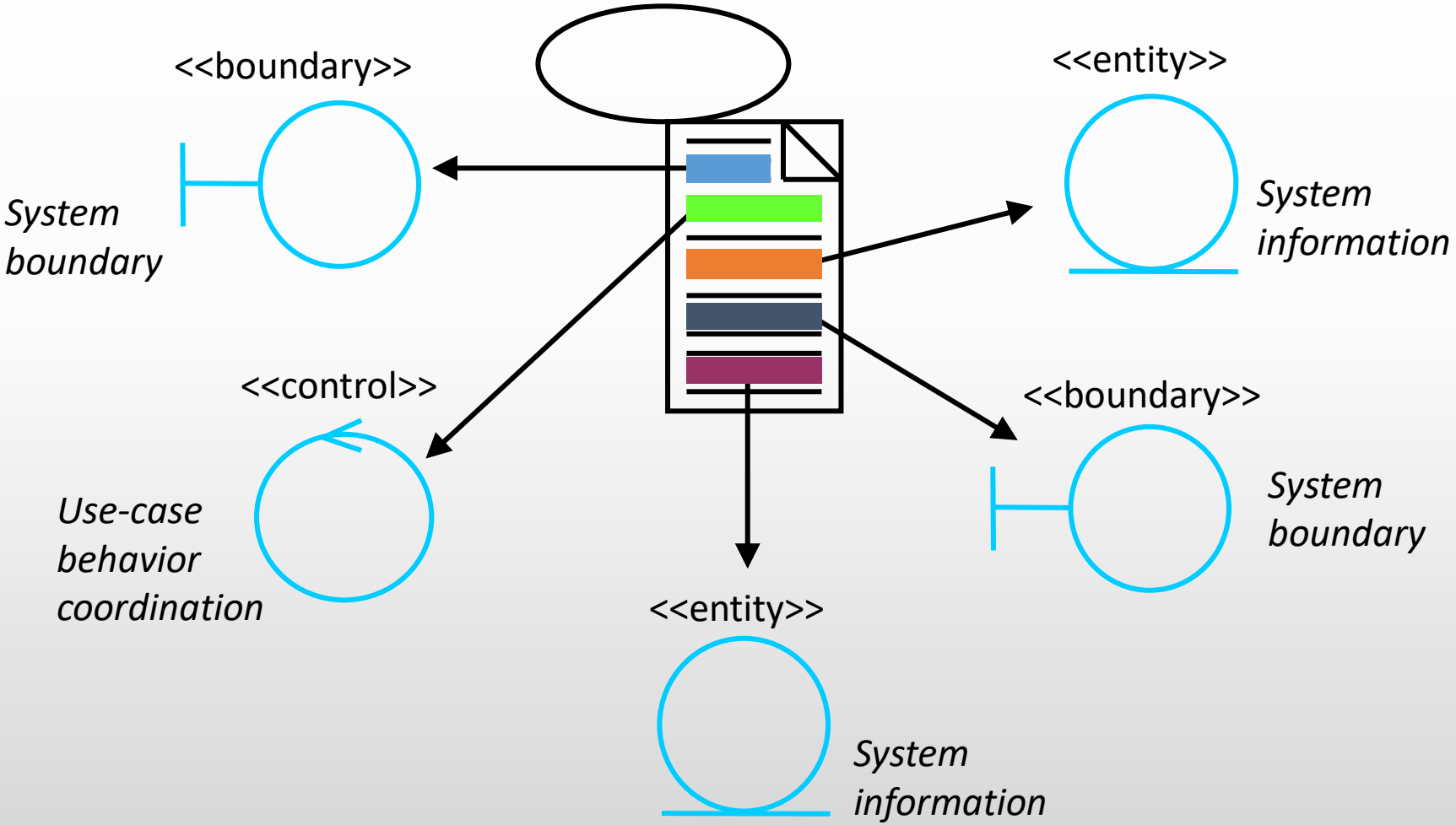
Activity 2 - Solution

DVD Class	
Responsibilities	Collaborations
Store Details of DVDs	

Registered Member Class	
Responsibilities	Collaborations
Pay Deposit	
Borrow DVD	DVD
Return DVD	DVD
Pay Fine	

Unregistered Member Class	
Responsibilities	Collaborations
Borrow DVD	DVD
Return DVD	DVD
Pay Fine	

What Is an Analysis Class?



Types of Analysis Classes

- Entity Classes – Classes that we have considered upto now.
- Boundary Classes – Interaction classes, Forms, Reports. We can one Boundary Class per Actor.
- Control classes – In a complex use case, the use case itself can be a class. Typically we can have one control class per complex use case.

Actors as Entity Classes

- Actors are users of the system in a use case diagram.
- Actors if they only have login credentials in the system will typically not be classes. e.g. user accounts, administrator.
- However if the Actor needs to do provide his/her data and that is directly relevant to the application domain then such actors would be classes.
- e.g. A Customer in an Online Store, has to register and provide details of shipping address, billing address, contact details would be a class.

Activity 3 – Online Order System

- A customer in an online store needs to first register providing details such as name, address.
- The online store administrator can add new items to the store, restock (increase quantity), generate a list of items that need to be restocked.
- A Customer can place an Order from an online store. An Order consists of multiple items.
- The customer can see the status of the Orders placed, and get a list of previous orders made.
- The customer specifies a payment method (credit card, debit card, paypal) for each order.
- Once the customer confirms the order and the payment is validated the order is placed and items are updated.

Activity 3

- Customer - Class
- Payment - Class
- Order – Class
- Item – Class

Activity 3

Step 2 –

Identify Responsibilities For each Class

Responsibilities

For Item Class

- Add New Items Items
- Restock
- ..

Activity 3

Step 3 –

Identify Collaborations for each Class

Collaborations

For Order Class

- We need to elaborate with the Payment class

Solution

Customer Class	
Responsibilities	Collaborations
Register Details	

Item Class	
Responsibilities	Collaborations
Add Items Restock List of Restock Items Update Items	

Order Class	
Responsibilities	Collaborations
Place Order Status of Order List of previous Order Confirm Order	 Payment

Payment Class	
Responsibilities	Collaborations
Store Payment Details Validate	

Handling list of Objects – Some Informal Guidelines

- A list of Previous Orders typically needs to be handled a collection class, not the Order class.
- Similarly the list of items to be reordered ideally should not be in the Item Class.
- An Entity class is typically responsible for handling one object at a time.

Activity 3

Step –

Refine CRC Cards

Solution

Customer Class	
Responsibilities	Collaborations
Register Details	

Item Class	
Responsibilities	Collaborations
Add Items Restock Update Items	

Order Class	
Responsibilities	Collaborations
Place Order Status of Order Confirm Order	 Payment

Payment Class	
Responsibilities	Collaborations
Store Payment Details Validate	

Report Class	
Responsibilities	Collaborations
List of Restock Items List of Previous Order	Item Order, Customer

References

- Grady Booch, et al (2007), Object Oriented Analysis and Design with Applications 3rd Edition – Chapters 5.

- Matt Weisfeld, The Object-Oriented Thought Process 3rd Edition