SOFTWARE ENGINEERING INSTITUTE
华东师范大学软件学院

Object-oriented Analysis &Design
面向对象分析与设计

Lecture_03 Domain model

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学习要点：

- Domain models（领域模型）
  - Identify conceptual classes.
  - Model appropriate attributes and associations.

回顾-类图(Class diagram)

What is a Domain Model

- A conceptual model, a representation of concepts in a problem domain.

domain concept

Plane

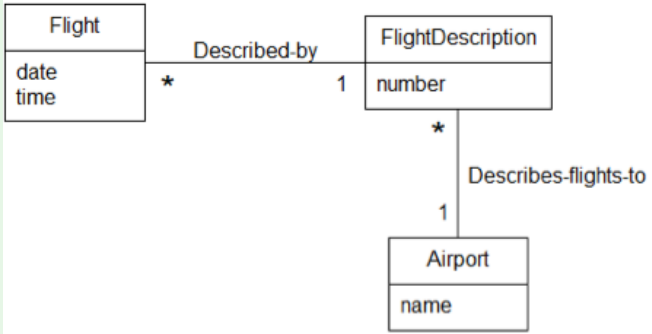
Airport

Flight: MU5211

Flight Description

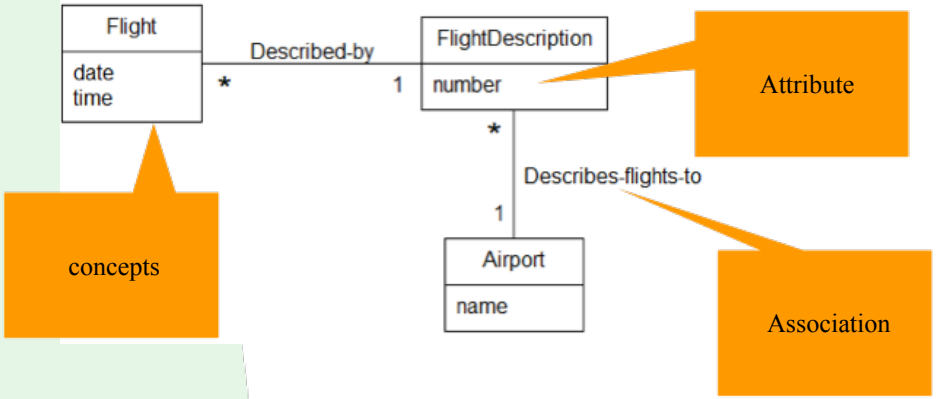
How to visually represent 'Conceptual class'?

- In UML it is basically a "class diagram without operations".
- It may show:
  - Concepts
  - Associations of concepts
  - Attributes of concepts



How to construct a domain model?

3 Things /steps



A process for constructing

- Find the concepts
- Draw them in a conceptual model
- Add associations
- Add attributes

How to identify concepts

- Reuse or modify existing models.
  - This is the first, best, and usually easiest approach, and where I will start if I can.
- Finding Concepts with the Concept Category List.
- Finding Concepts with Noun Phrase Identification.

Text book, section 9.5

- A central distinction between object oriented and structures analysis:
  - division by concepts (objects) rather than division by functions.

The Concept Category List

Table 1. Conceptual Class Category List.

Conceptual Class Category	Examples
business transactions Guideline: These are critical (they involve money), so start with transactions.	Sale, Payment Reservation
transaction line items Guideline: Transactions often come with related line items, so consider these next.	SalesLineItem
product or service related to a transaction or transaction line item Guideline: Transactions are for something (a product or service). Consider these next.	Item Flight, Seat, Meal
where is the transaction recorded? Guideline: Important.	Register(收银台), Ledger(分类帐) FlightManifest
roles of people or organizations related to the transaction; actors in the use case Guideline: We usually need to know about the parties involved in a transaction.	Cashier, Customer, Store, MonopolyPlayer Passenger, Airline
place of transaction; place of service	Store, Airport, Plane, Seat

To continue

noteworthy events, often with a time or place we need to remember	Sale, Payment MonopolyGame, Flight
physical objects Guideline: This is especially relevant when creating device-control software, or simulations.	Item, Register Board, Piece, Dice, Airplane
descriptions of things	ProductDescription FlightDescription
catalogs Guideline: Descriptions are often in a catalog.	ProductCatalog FlightCatalog
containers of things (physical or information)	Store, Bin Board Airplane
things in a container	Item Square (in a Board) Passenger
other collaborating systems	CreditAuthorizationSystem AirTrafficControl
records of finance, work, contracts, legal matters	Receipt, Ledger MaintenanceLog
financial instruments	Cash, Check, LineOfCredit TicketCredit
schedules, manuals, documents that are regularly referred to in order to perform work	DailyPriceChangeList RepairSchedule

Finding Concepts with Noun Phrase Identification

- Identify the **noun** and **noun phrases** in textual descriptions of a problem domain and consider them as candidate concepts or attributes.
- Care must be applied with this method.
  - A mechanical noun-to-concept mapping **is not possible** !

Description

The system controls a recycling machine

the value of the returned items and the total return sum that will be paid to the customer.

?

Concepts

system
recycling machine

the value
returned items
total return sum customer

Case Study: Nouns in The Recycling machine - The "return item" Use case.

- The system controls a recycling machine for returnable bottles, cans and crates(板条箱). The machine can be used by several customers at the same time and each customer can return all three types of item on the same occasion. The system has to check, for each item, what type has been returned.

- The system will register how many items each customer returns and when the customer asks for a receipt, the system will print out what was deposited , the value of the returned items and the total return sum that will be paid to the customer.
- An operator also … (not in "return item" Use Case)

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- An operator also … (not in "return item" Use Case)

Case Study: Nouns found in the description

- recycling machine
- bottles, cans, and crates
- machine
- customer
- types of item, item, type, returned items
- system
- receipt
- return sum

- recycling machine
- bottles
- machin
- custom
- types o
- system
- receipt
- return s

This concept is the "overall system". As we consider only one single use case, it is better to name this concept in the context of this use case, e.g.

Deposit item receiver

- deposit item receiver
- bottles, cans, and crates
- machine
- customer
- types of
- system
- receipt
- return su

In a conceptual model it is usually better to use singular and multiplicities instead of plural.

As bottle, can and crate have much in common (they are processed as items), they could be generalised to an "item".

We should remember this for later (inheritance).

- deposit item receiver
- bottle, can, crate
- machine
- customer
- types of item, item, ty
- system
- receipt
- return sum

"Machine" and "System" mean here the same, namely the "Recycling machine", i.e. the

Deposit item receiver

- deposit item receiver
- bottle, can, crate
- customer
- types of item, item, type, returned items
- receipt
- return sum

- The customer has already been identified as an actor.
- They are outside of the system.

- deposit item receiver
- bottle, can, crate
- customer
- ~~types of item, item, type, returned items~~
- receipt
- return sum

- The items that are inserted in the machine.
- Good candidate as superclass for bottle, can, crate.
- Let's call it
  - Deposit item, (instead of 'item')

Case Study:
Discussion of “receipt”.

- deposit item receiver
- bottle, can, crate
-
- customer
- deposit item
-
- receipt
- return sum

- The concept that “remembers” all items inserted in the machine.

Case Study:
Discussion of "return sum".

- deposit item receiver
- bottle, can, crate
-
- customer panel
- deposit item
-
- receipt
- return sum

- The sum that it is returned to the customer is actually computed by adding up all values of the items stored in the receipt basis.
- The sum itself is only a primitive data value, and may therefore not be considered as a concept.

Case Study:
Discussion of other concepts.

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- deposit item receiver
- bottle, can, crate
- customer panel
- deposit item
- receipt

- These are the concepts identified by nouns. Did we forget something?

- deposit item receiver
- bottle, can, crate
- customer
- deposit item
- receipt

- These are the concepts identified by nouns. Did we forget something?
- Check the "Concept Category List" !

other collaborating systems

The system will print out what was deposited.

- The system "interfaces" with the physical object "printer", so we add an interface concept
  - Receipt printer

Case Study:
Summary of concepts identified in the analysis

- deposit item receiver
- bottle, can, crate
- customer
- deposit item
- receipt
- receipt printer

- So far we have identified:
  - Concepts
  - A generalisation relationship.
- Next step: Finding associations.

How to make a conceptual model.

- Find the concepts
- Draw them in a conceptual model
- Add associations
- Add attributes

Drawing of Concepts

Customer

Deposit item receiver

Deposit item

Receipt printer

Receipt

Can

Bottle

Crate

How to make a conceptual model.

- Find the concepts
- Draw them in a conceptual model
- Add associations
- Add attributes

Adding Associations

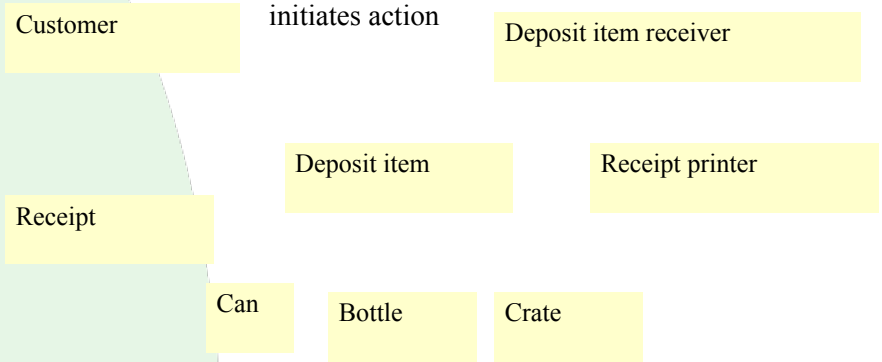
- If one concept needs to know of another concept for some duration, they should be linked by an association.
  - Add “Adornment” to association
- Also use the following list in order to identify associations.

Common Association List(Ch 9.14)

- A is a part of B
- A is contained in B
- A is a description for B
- A is a line item of B
- A is known or reported in B
- A is a member of B
- A is a organisational subunit of B
- A uses or manages B
- A communicates with B
- A is related to a transaction B
- A is a transaction related to another transaction B
- A is next to B
- A is owned by B

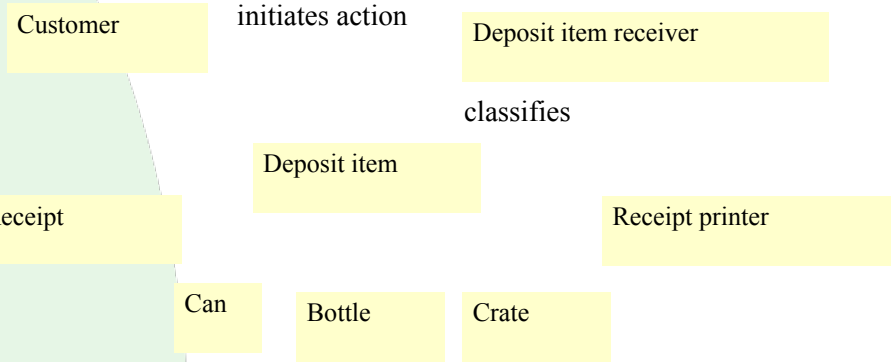
Adding associations

- The Customer communicates to the receiver when an item is inserted.
- Also when the receipt is requested.



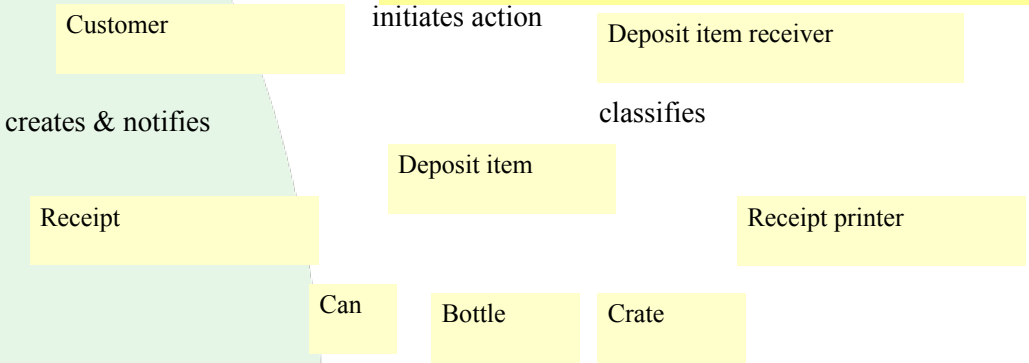
Adding associations

- The Deposit item receiver manages Deposit items:
- The items are classified.



Adding associations

- The Deposit item receiver communicates to Receipt basis:
- Items received and classified are stored.
- It also creates the receipt when it is needed for the first time.



Adding associations

- The Receipt basis captures Deposit items.

Customer

initiates action

Deposit item receiver

creates & notifies

classifies

captures

Deposit item

Receipt

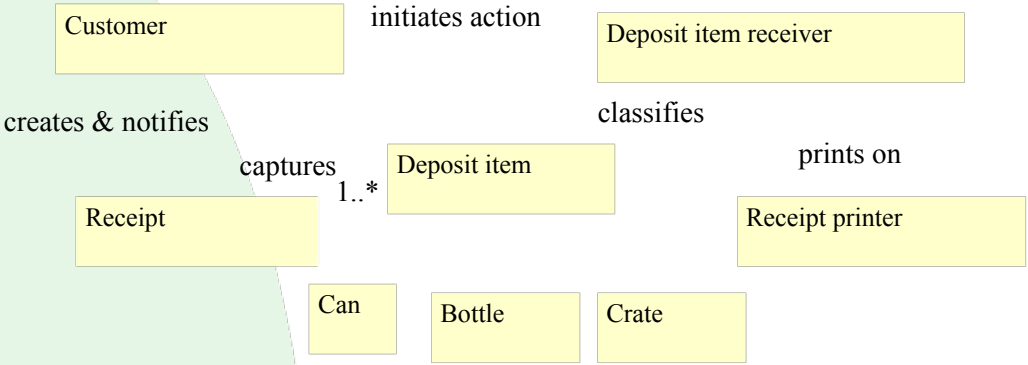
Receipt printer

Can

Bottle

Crate

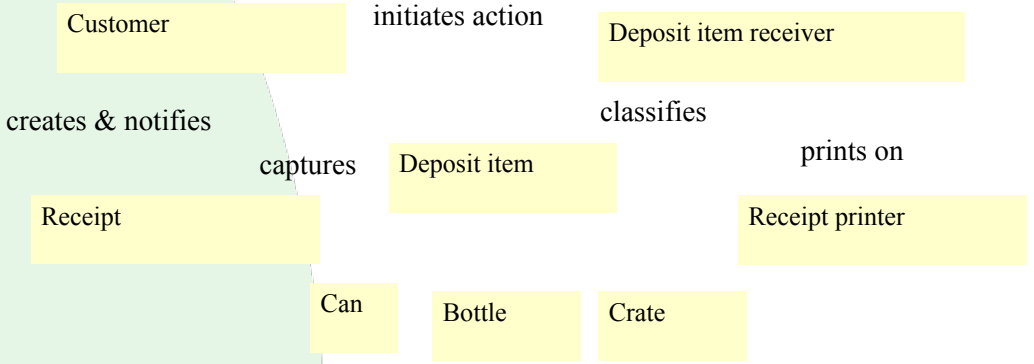
Adding associations



为什么Deposit item receiver、 Receipt、Receipt printer之间的关系是这样画的?

Adding associations

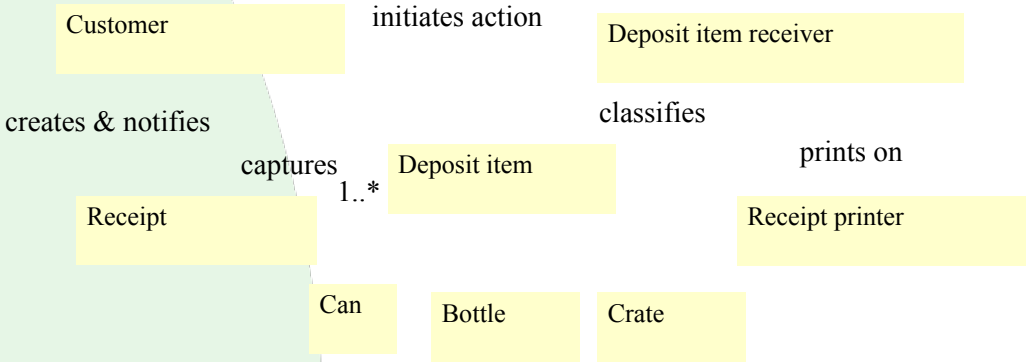
- On request by the Customer, the Deposit item receiver initiates printing of a receipt on the printer.



为什么Deposit item receiver、 Receipt、Receipt printer之间的关系是这样画的?

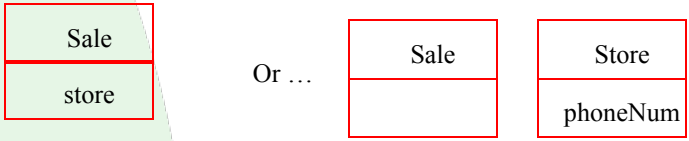
Adding associations

- Adding multiplicities
- Only one association here is a 1 to many relationship
- All others are 1 to 1.



Adding Attributes

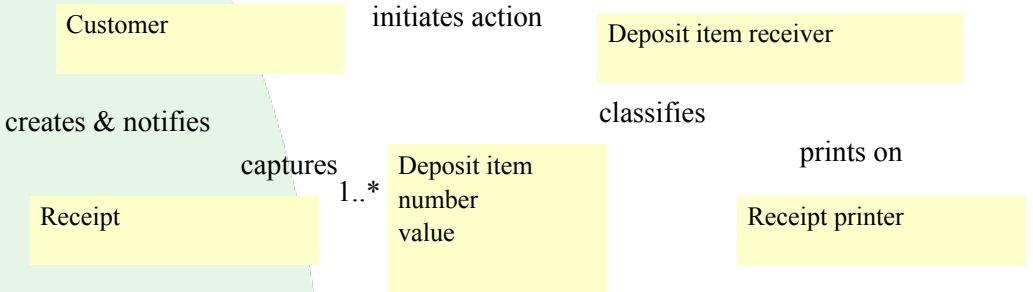
- An attribute is a logical data value of an object.
- Attributes in a conceptual model are simple data values as
  - Boolean, Date, Number, String (Text), Time, Address, Colour, Price, Phone Numbers, Product Codes, etc.
- Sometimes it is difficult to distinguish between attributes and concepts (CH 9.12)



Guideline
If we do not think of some conceptual class X as a Number or text in the real world, X is probably a Conceptual class, not an attribute.

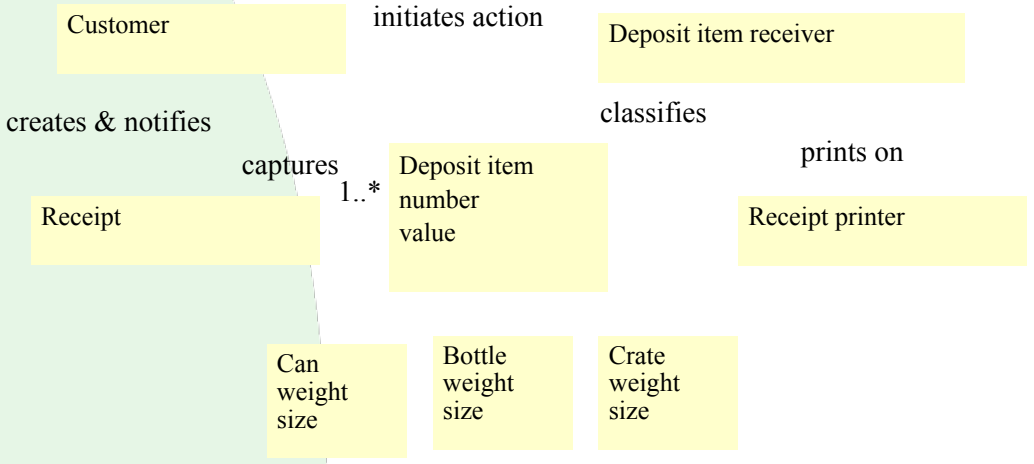
Adding attributes

- The Deposit item has a value.
- Also it will be assigned a number that shows later on the receipt.



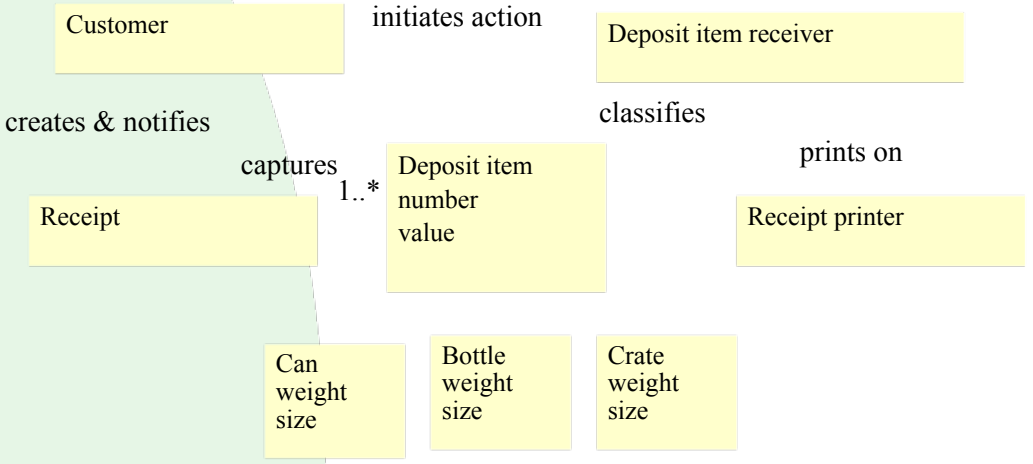
Adding attributes

- In order to be classified by the Deposit item receiver each item has also a weight and a size.
- However this is the same for each type of item, but different *between* the types.



Summary

- NOT in a conceptual model:
  - arrows
  - dotted lines
  - methods, operations, functions

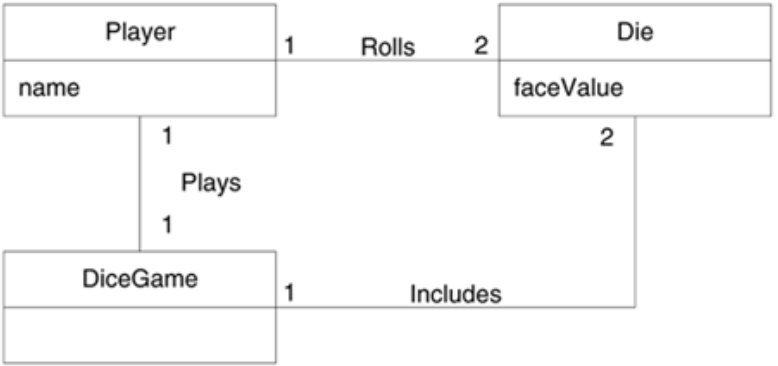


练习1: 名词短语识别-掷色子游戏(Dice game)

- 描述：我想要玩掷色子游戏，这个游戏需要两个色子。每次只要掷一下，看两个色子的值加起来是否为7，为7我就赢了，不为7我就输了。

领域模型示例

Figure 1.3. Partial domain model of the dice game.



案例：POS

Basic Flow of POS

1. Customer arrives at POS checkout with goods and/or services to purchase.
2. Cashier starts a new sale.
3. Cashier enters item identifier.
4. System records sale line item and presents item description, price, and running total. Price calculated from a set of price rules.

Cashier repeats Customer the total, and asks for payment.

5. System presents total with taxes calculated.
6. Cashier tells Customer the total, and asks for payment.
7. Customer pays and System handles payment.
8. System logs completed sale and sends sale and payment information to the external Accounting systems and inventory system.
9. System presents receipt.
10. Customer leaves with receipt and goods (if any).

From the Concept Category List

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product or service related to a transaction or transaction line item Guideline: Transactions are for something (a product or service). Consider these next.	Item Flight, Seat, Meal
where is the transaction recorded? Guideline: Important.	Register(收银台), Ledger(分类帐) FlightManifest
roles of people or organizations related to the transaction; actors in the use case Guideline: We usually need to know about the parties involved in a transaction.	Cashier, Customer, Store, MonopolyPlayer Passenger, Airline
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To continue

noteworthy events, often with a time or place we need to remember	Sale, Payment MonopolyGame, Flight
physical objects Guideline: This is especially relevant when creating device-control software, or simulations.	Item, Register Board, Piece, Die, Airplane
descriptions of things	ProductDescription FlightDescription
catalogs Guideline: Descriptions are often in a catalog.	ProductCatalog FlightCatalog
containers of things (physical or information)	Store, Bin Board Airplane
things in a container	Item Square (in a Board) Passenger
other collaborating systems	CreditAuthorizationSystem AirTrafficControl
records of finance, work, contracts, legal matters	Receipt, Ledger MaintenanceLog
financial instruments	Cash, Check, LineOfCredit TicketCredit
schedules, manuals, documents that are regularly referred to in order to perform work	DailyPriceChangeList RepairSchedule

POS Example: Create Domain Model

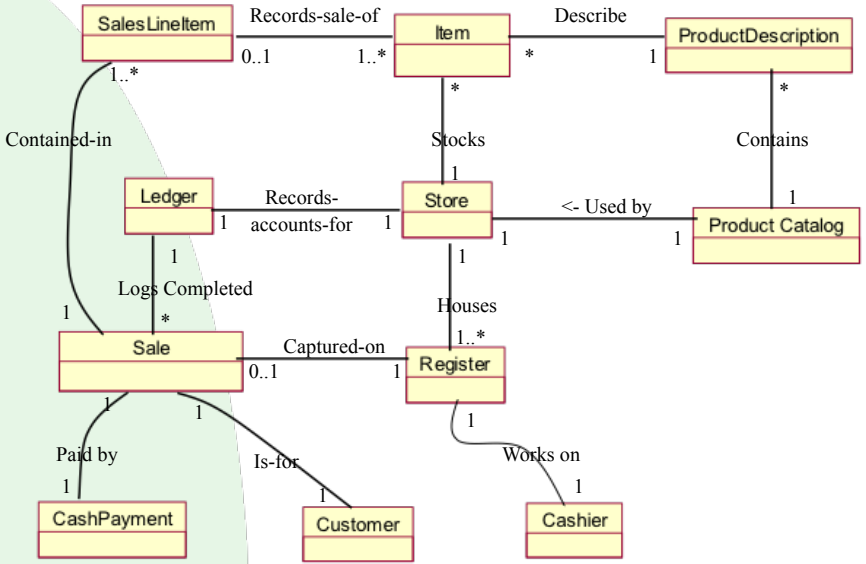
Step1: Conceptual classes in POS

Sale , Cashier , CashPayment, Customer
SalesLineItem , Store, Item, ProductDescription,
Register, ProductCatalog, Ledger

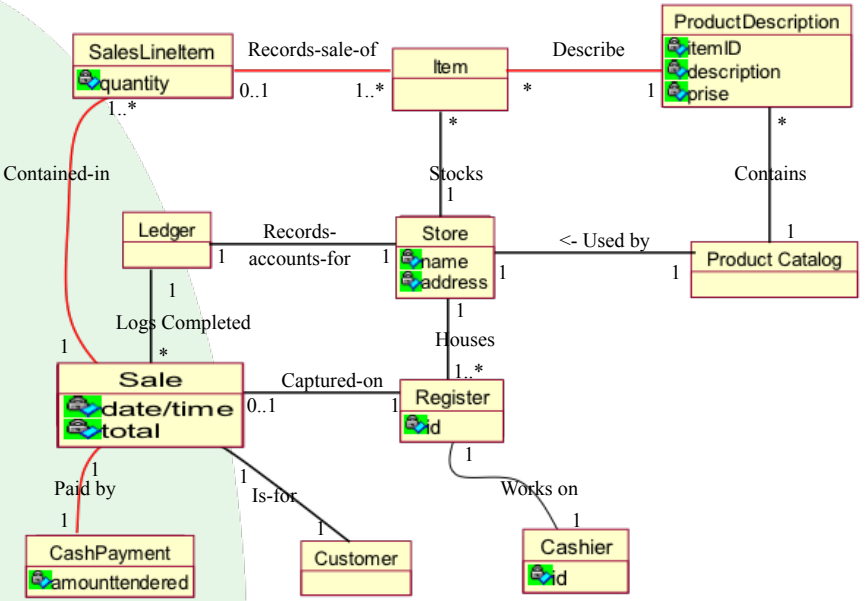
Step2: Association

Step3: Attribute

Association in POS



Attribute POS



总结

- 是否可以总结一类适用的系统？？
- Business Information System

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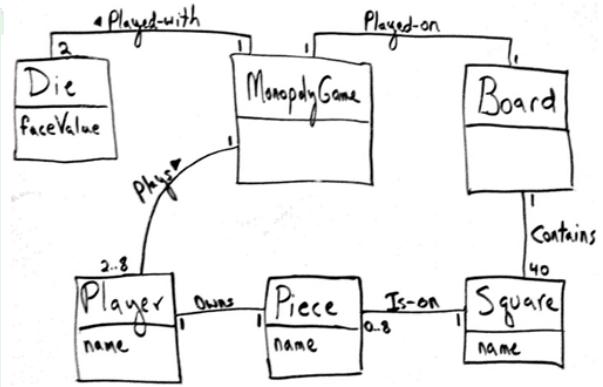
Monopoly Game

Monopoly Game

Monopoly Game



Dice: faceValue, after rolling the dice, needed to calculate the distance of a move.

Square: name , to print the desired trace output.

Summary - Object Oriented Analysis-Classes

- The main task is to identify the objects.
- Also: Relationships between objects.

作业：

- 手抄一份POS以及Monopoly Game的domain model，请写出你认为这样画有什么好处？ 在绘制领域模型时，POS与Monopoly Game属于一类系统么？有什么区别？如果写不出来区别，就分别列举下你认为与他们类似的系统有哪些?

- 作业提交日期： 9.29日 课堂交

- End

Thank you!