How to Make a Domain Model

Tutorial

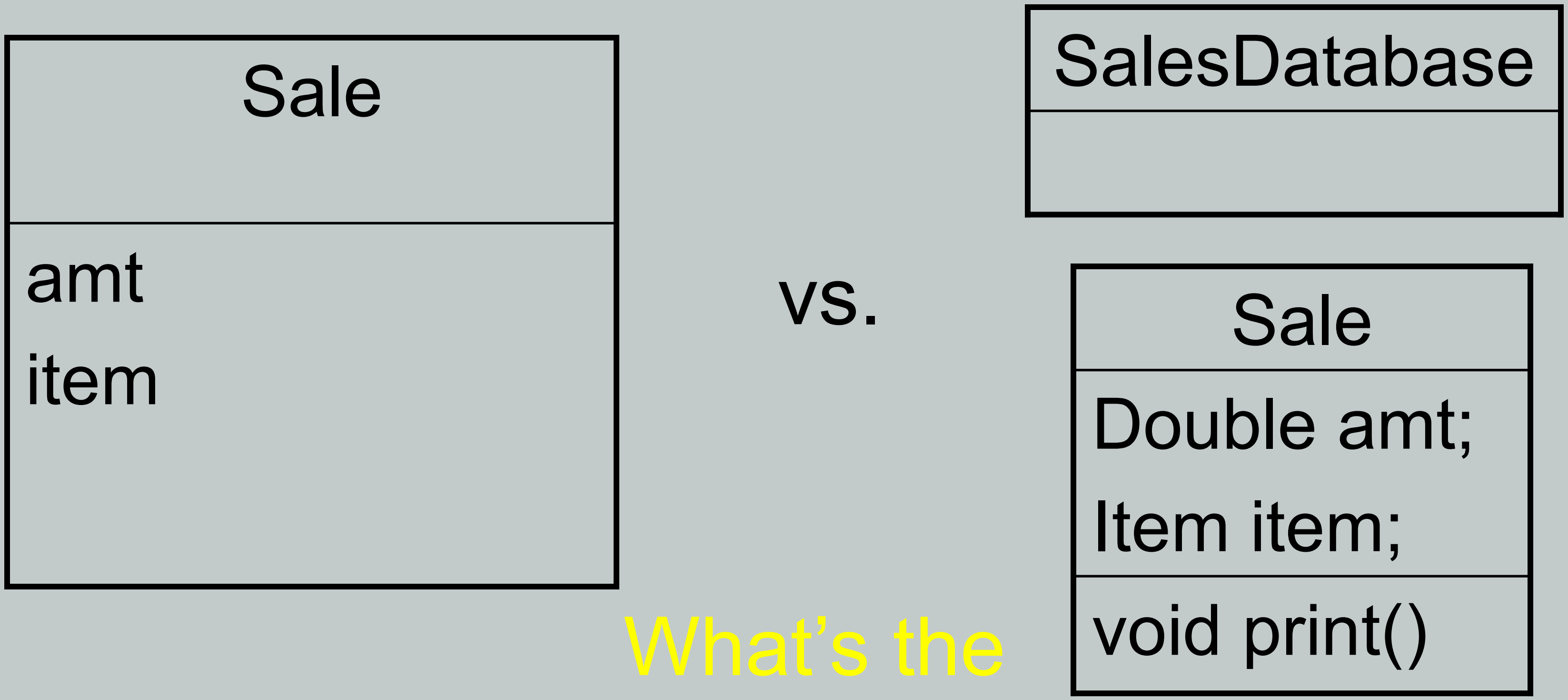
What is a Domain Model?

- Illustrates meaningful conceptual classes in problem domain
- Represents real-world concepts, not software components
- Software-oriented class diagrams will be developed later, during design

A Domain Model is Conceptual, not a Software Artifact

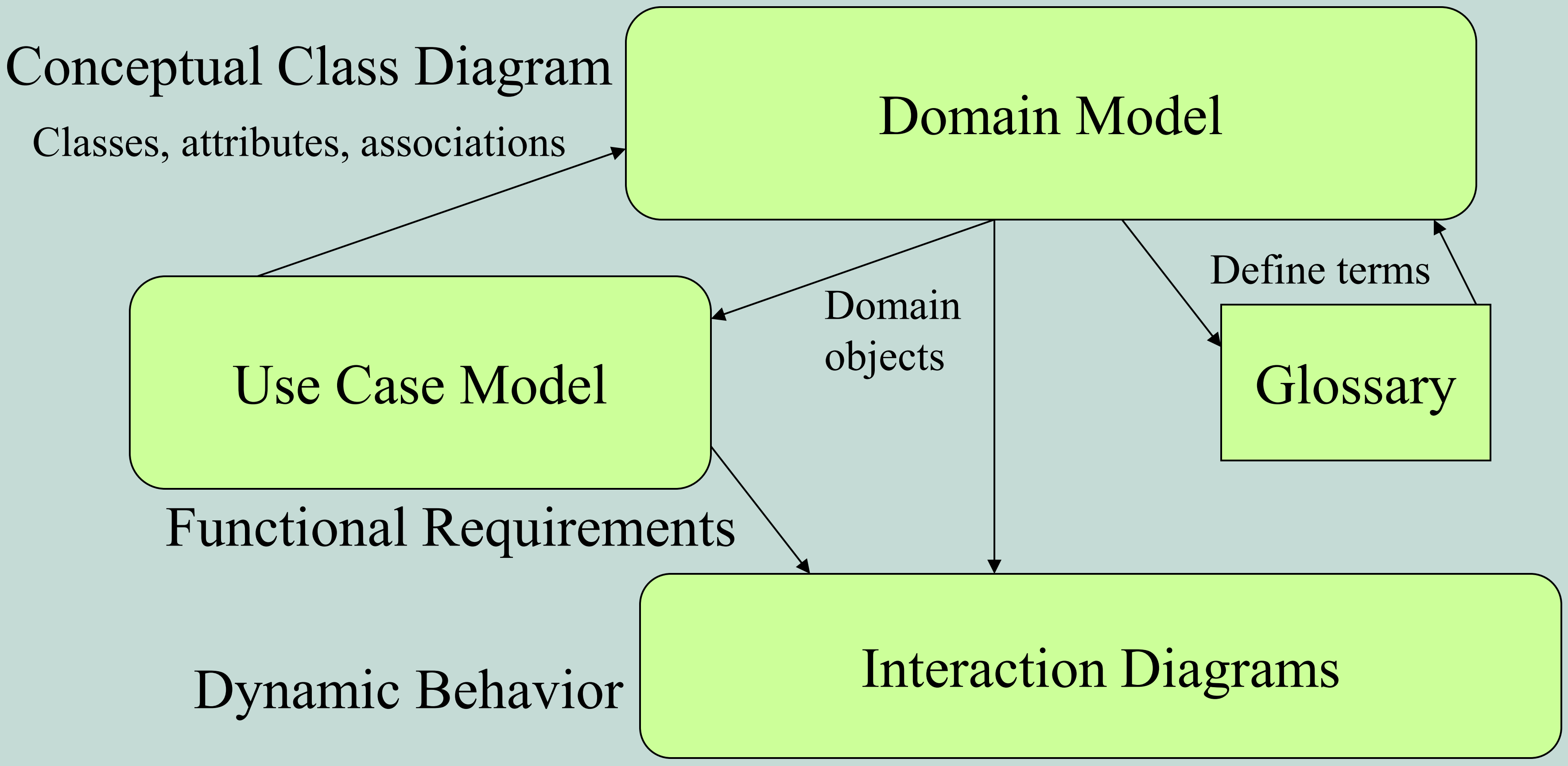
Conceptual Class:

Software Artifacts:



What's the difference?

Domain Model Relationships



What do you learn about when and how to create these models?

Why do a domain model?

- Gives a conceptual framework of the things in the problem space
- Helps you think – focus on semantics
- Provides a glossary of terms – noun based
- It is a static view - meaning it allows us convey time invariant business rules
- Foundation for use case/workflow modelling
- Based on the defined structure, we can describe the state of the problem domain at any time.

Features of a domain model

- **Domain classes** – each domain class denotes a type of object.
- **Attributes** – an attribute is the description of a named slot of a specified type in a domain class; each instance of the class separately holds a value.
- **Associations** – an association is a relationship between two (or more) domain classes that describes links between their object instances. Associations can have roles, describing the multiplicity and participation of a class in the relationship.
- **Additional rules** – complex rules that cannot be shown with symbolically can be shown with attached notes.

Domain classes?

- Each domain class denotes a type of object. It is a descriptor for a set of things that share common features. Classes can be:-
- ***Business objects*** - represent things that are manipulated in the business e.g. *Order*.
- ***Real world objects*** – things that the business keeps track of e.g. *Contact*, *Site*.
- ***Events that transpire*** - e.g. *sale* and *payment*.

How to Identify Domain Classes

- Reuse an existing domain model
  - There are many published, well-crafted domain models.
- Use a conceptual class category list
  - Make a list of all candidate conceptual classes
- Identify noun phrases
  - Identify nouns and phrases in textual descriptions of a domain (use cases, or other documents)

Conceptual Class Category List

- Physical or tangible objects
  - Register, Airplane
- Specifications, or descriptions of things
  - ProductSpecification, FlightDescription
- Places
  - Store, Airport
- Transactions
  - Sale, Payment, Reservation
- Transaction items
  - SalesLineItem
- Roles of people
  - Cashier, Pilot
- Containers of other things
  - Store, Hangar, Airplane
- Things in a container
  - Item, Passenger
- Computer or electro mechanical systems
  - CreditPaymentAuthorizationSystem, AirTrafficControl
- Catalogs
  - ProductCatalog, PartsCatalog
- Organizations
  - SalesDepartment, Airline

Where identify conceptual classes from noun phrases (NP)

- Vision and Scope, Glossary and Use Cases are good for this type of linguistic analysis
- However:
- Words may be ambiguous or synonymous
- Noun phrases may also be attributes or parameters rather than classes:
  - If it stores state information or it has multiple behaviors, then it's a class
  - If it's just a number or a string, then it's probably an attribute

e.g. From NPs to classes or attributes

Consider the following problem description, analyzed for Subjects, Verbs, Objects:

```
The ATM verifies whether the customer's card number and PIN are correct.
     SC    V                RO         O A         OA
If it is, then the customer can check the account balance, deposit cash, and withdraw cash.
                S R        V            O A        V     O A       V     OA
Checking the balance simply displays the account balance.
   SM         O A          V             O A
Depositing asks the customer to enter the amount, then updates the account balance.
    S M    V        O R      V         OA         V              O A
Withdraw cash asks the customer for the amount to withdraw; if the account has enough cash,
   SM     OA  V        O R            O A       V           SC    V          OA
the account balance is updated.   The ATM prints the customer’s account balance on a  receipt.
          OA           V          SC   V                     O A             O
```

Analyze each **subject** and **object** as follows:

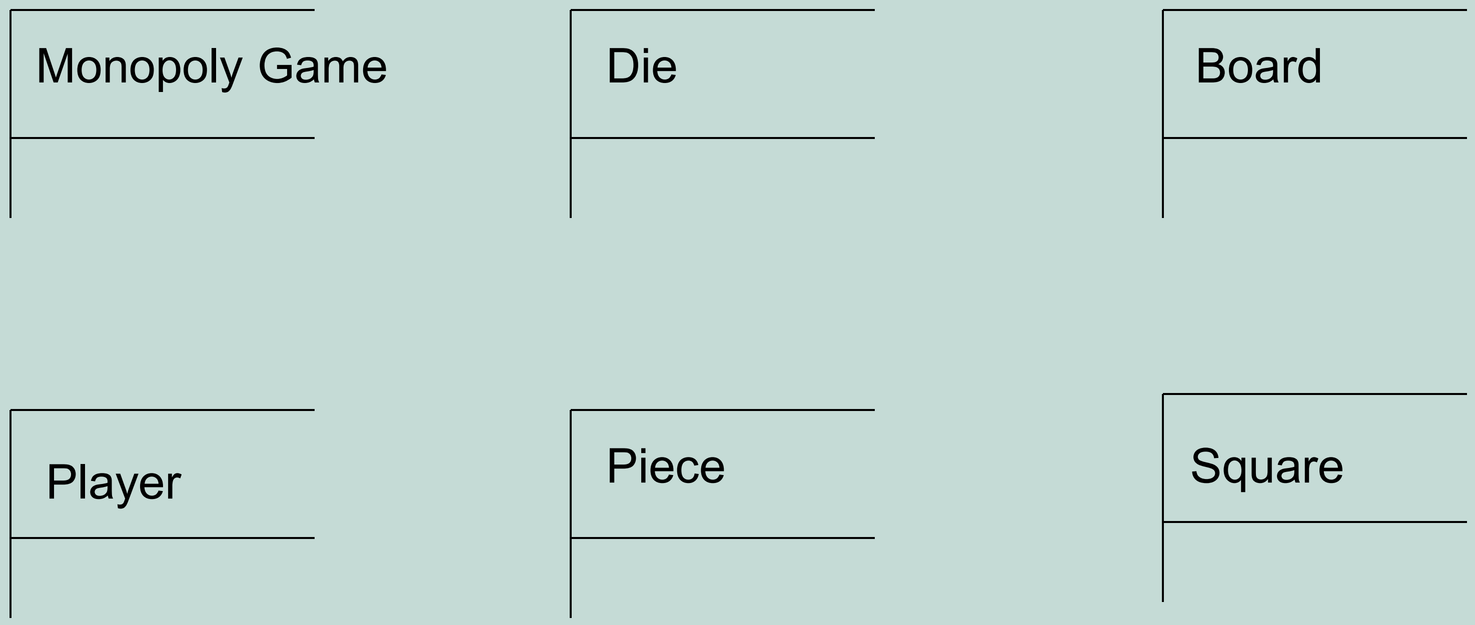
- Does it represent a person performing an action? Then it’s an actor, ‘**R**’.
- Is it also a verb (such as ‘deposit’)? Then it may be a method, ‘**M**’.
- Is it a simple value, such as ‘color’ (string) or ‘money’ (number)? Then it is probably an attribute, ‘**A**’.
- Which NPs are unmarked? Make it ‘**C**’ for class.
- Verbs can also be classes, for example:

  Deposit is a class if it retains state information

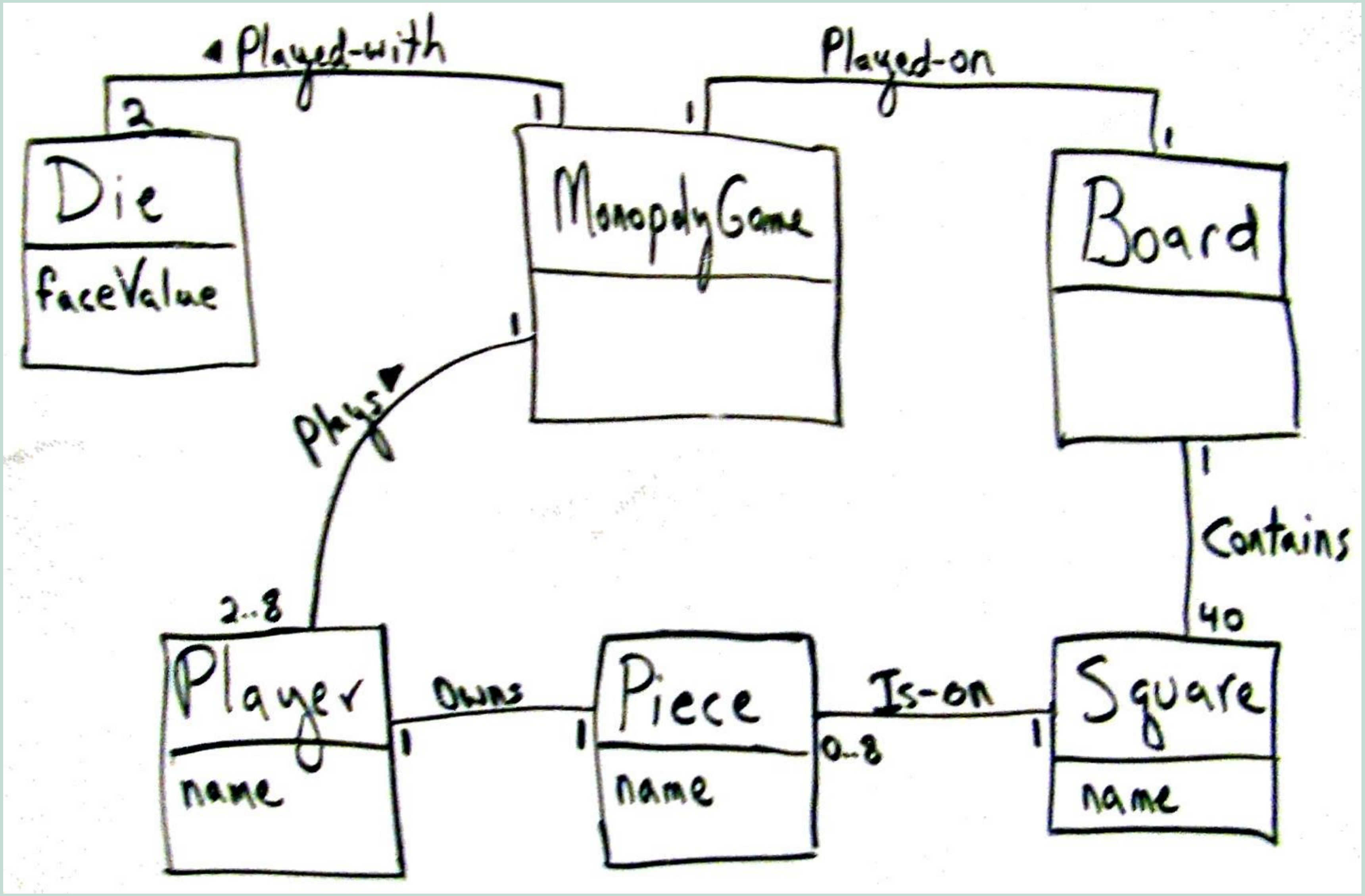
Steps to create a Domain Model

1. Identify candidate conceptual classes
2. Draw them in a UML domain model
3. Add associations necessary to record the relationships that must be retained
4. Add attributes necessary for information to be preserved
5. Use existing names for things, the vocabulary of the domain

Monopoly Game domain model (first identify concepts as classes)



Monopoly Game domain model
Larman, Figure 9.28

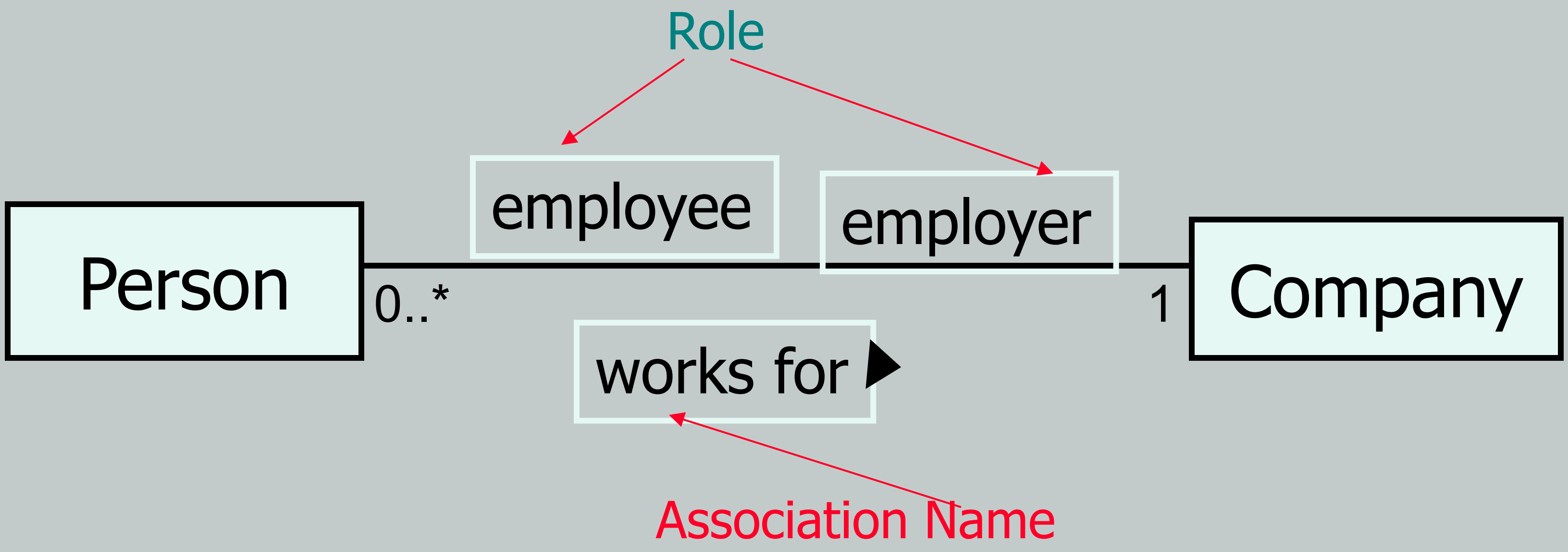


Class names

- **Class Name** creates the vocabulary of our analysis
  - Use nouns as class names, think of them as simple agents
  - Verbs can also be made into nouns, if they are maintain state
  - E.g., “reads card” suggests **CardReader**, managing bank cards
- Use pronounceable names:
  - If you cannot read aloud, it is not a good name
- Use capitalization to initialize Class names and demarcate multi-word names
  - E.g., CardReader rather than CARDREADER or card_reader
  - Why do most OO developers prefer this convention?
- Avoid obscure, ambiguous abbreviations
  - E.g., is TermProcess something that terminates
  - or something that runs on a terminal?
- Try *not* to use digits within a name, such as CardReader2
  - Better for instances than classes of objects

Associations

- A link between two classes ("has a")
  - Typically modeled as a member reference
  - Notation from Extended Entity Relation (EER) models
- A Person works for a Company



- Role names and multiplicity at association ends
- Direction arrow to aid reading of association name

Adding Association

- An association is a relationship between classes that indicates some meaningful and interesting connection.
- In the UML, associations are defined as “the semantic relationship between two or more classifiers that involve connections among their instances.”

Structure (association) analysis

- Lines connecting classes
- In UML, simple line is an **association**
  - Decorations for multiplicity, role names, constraints
- Aggregations and composition:
  - Arrow denotes navigability
  - A **black-filled** diamond denotes a **composition**
    - a part, **unique** to this whole
  - A **white-empty** diamond denotes an **aggregation**
    - a part, but not unique to this whole

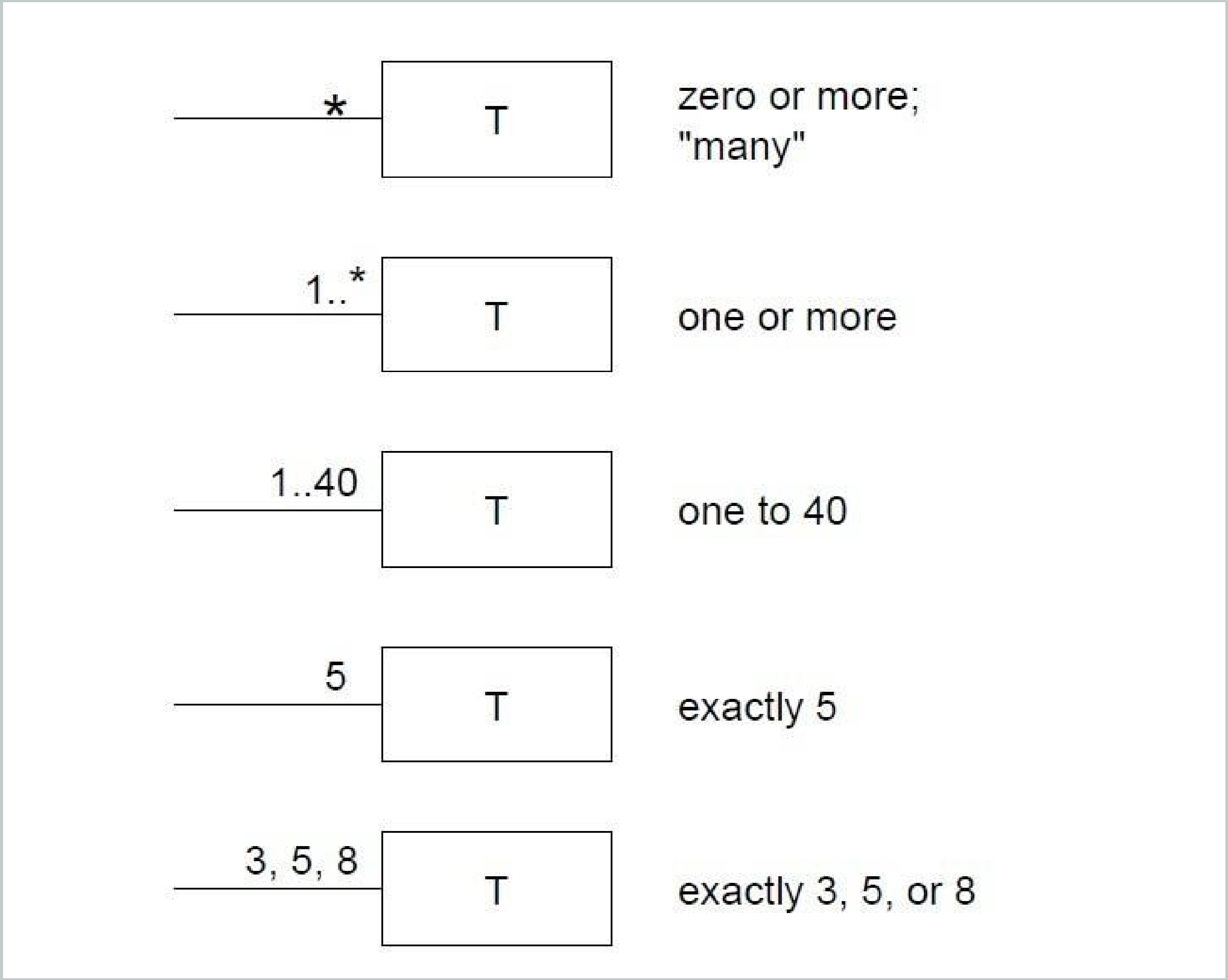
Common Associations

- A is subpart/member of B. (SaleLineItem-Sale)
- A uses or manages B. (Cashier –Register, Pilot-airplane)
- A communicates with B. (Student -Teacher)
- A is transaction related to B. (Payment -Sale)
- A is next to B. (SaleLineItem-SaleLineItem)
- A is owned by B. (Plane-Airline)
- A is an event related to B. (Sale-Store)

Roles and Multiplicity

- Each end of an association is called a role.
- Multiplicity defines how many instances of a class A can be associated with one instance of a class B.
- e.g.: a single instance of a Store can be associated with “many”(zero or more) Item instances.

Some examples of Multiplicity



Adding Attributes

- An attribute is a logical data value of an object.
- Include the following attributes in a domain model: Those for which the requirements suggest a need to remember information.
- An attribute can be a more complex type whose structure is unimportant to the problem, so we treat it like a simple type
- UML Attributes Notation: Attributes are shown in the second compartment of the class box

Point of Sale System (POS) [1]

Basic Flow:

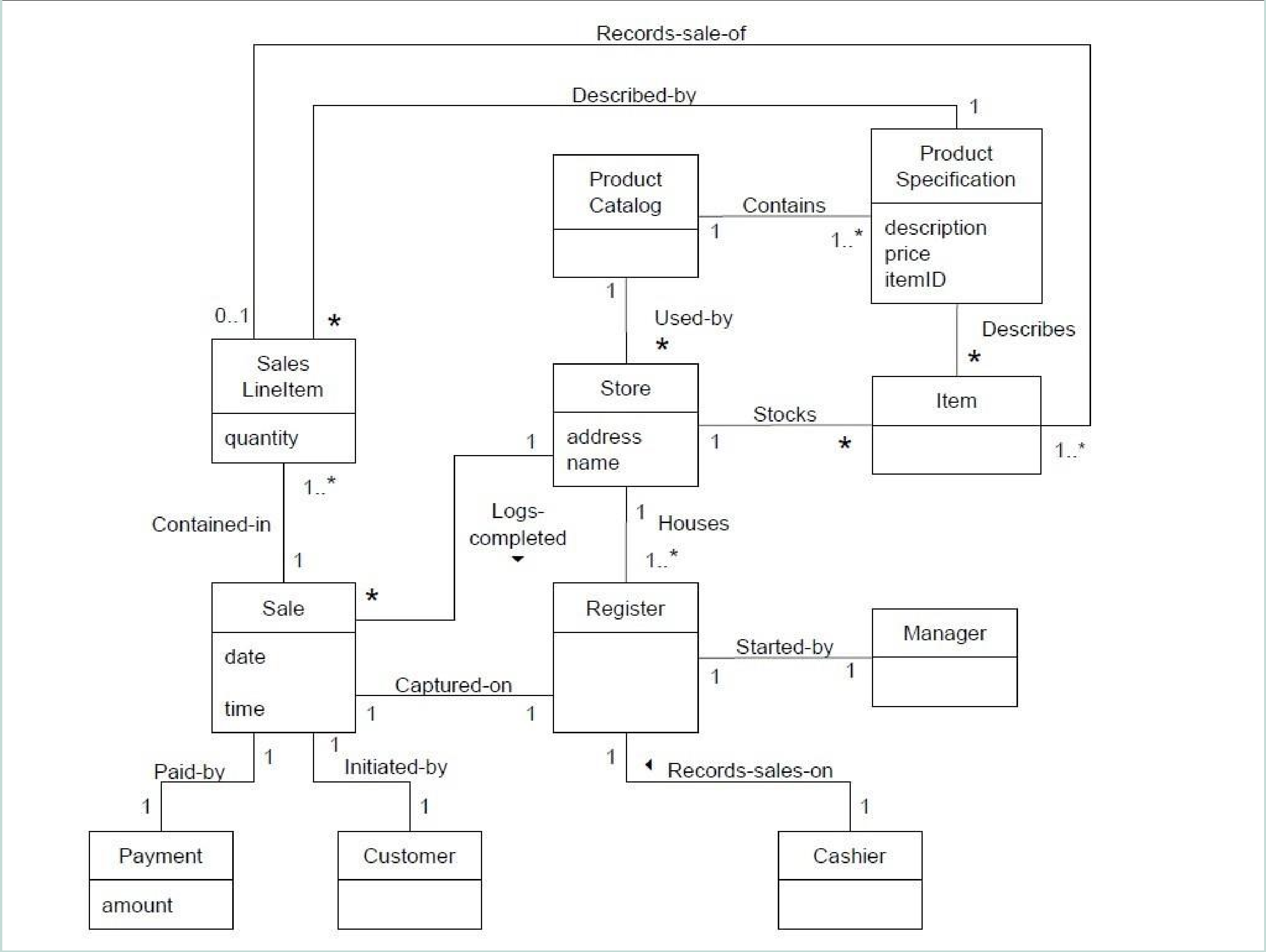
1. **Customer** arrives at a POS **checkout** with **goods** and/or **services** to purchase.
2. **Cashier** starts a new **sale**.
3. **Cashier** enters **item identifier**.
4. **System** records **sale line item** and presents **item description**, **price**, and running **total**. Price calculated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

Cashier repeats steps 2-3 until indicates done.

Point of Sale System (POS) [2]

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 the completed sale and sends sale and payment information to the external accounting (for accounting and commissions) and Inventory systems (to update inventory).
9. System presents receipt.
10. Customer leaves with receipt and goods (if any).

POS: Domain Model


Records-sale-of
Described-by
1
Product Catalog
Contains
1
1..*
Product Specification
description
price
itemID
1
Used-by
*
Describes
*
0..1
*
Sales LineItem
quantity
Store
address
name
Stocks
1
*
Item
1..*
1
1..*
Contained-in
1
Logs-completed
1
Houses
1..*
*
Sale
date
time
Register
Manager
Started-by
1
1
Captured-on
1
1
1
1
Paid-by
Initiated-by
1
Records-sales-on
1
1
1
Payment
amount
Customer
Cashier