DOMAIN MODELING EXAMPLE

The following are the requirements for a web-based system to computerize the management of the sale and rental of videos for a video shop.

- The system must be able to handle both physical and digital videos.
- It must be able to record which videos are sold and rented and by whom.
- For sold videos, the quantity sold should be recorded; for physical video rental, which copy is rented and when it is due back should be recorded.
- The system should keep track of overdue rentals of physical videos and send email notices to customers who have videos overdue.
- There will be a customer membership option for an annual fee, which will entitle a member to discounts (10%) on the sale and rental of videos.
- Members should be able to make reservations for physical video rentals either in person at the shop, by telephone or via the Web.
- A member can reserve at most five physical videos at any one time, but there is no limit on how many physical videos a member or nonmember can rent at any one time.
- As an added feature, the shop would like to allow customers (either members or nonmembers) to input, via the Web, mini-reviews (up to 100 words) and a rating (from 1, lowest, to 10, highest) of videos they have purchased or rented.

DOMAIN MODELING EXAMPLE (cont'd)

- These reviews should be anonymous if the customer so wishes (i.e., customers can specify whether they want their name to be made known when other customers browse the reviews).
- A sales clerk should be able to enter and update the following information about all customers (members or nonmembers): name, address, phone number, age, sex, and email address.
- Members are assigned a membership number by the shop when they become members and a password, which allows them to change their personal information and to buy and rent digital videos via the Web.
- The shop manager should be able to generate various reports on the sale and rental of videos.
- A sales clerk should be able to sell and rent physical videos and process the return of rented physical videos.
- When selling or renting physical videos, a sales clerk must be able to look up customer information and determine whether the customer is a member.
- A sales clerk must be able to enter basic information about a video (i.e., video id, title, leading actor(s), director, producer, genre, synopsis, release year, running time, selling price, and rental price).

DOMAIN MODELING EXAMPLE (cont'd)

From the video sale and rental shop requirements statement:

a) identify all the classes, attributes, association classes, associations, aggregations/compositions, generalizations and multiplicity constraints that are relevant to include in the domain model for the new system. *(Only those that are explicitly given in or implied by the requirements statement should be included.)*

b) Construct a class diagram showing how the classes identified in (a) are related by associations, aggregations/ compositions and generalizations. Show the *most likely multiplicities for all associations*, making reasonable assumptions where necessary. If a multiplicity cannot be inferred from the requirements statement or common real-world domain knowledge, then indicate this with a "?". *Do not show the attributes of the classes in the class diagram.*

DOMAIN MODELING EXAMPLE: ANALYSIS

We first analyze the requirements statement to determine the requirements for the domain model and then present the domain model.

- The system must be able to handle both physical and digital videos.

  classes: Video

  attributes: Video: isPhysical, isDigital

- It must be able to record which videos are sold and rented and by whom.

  classes & associations: Customer *Purchases* Video
  Customer *Rents* Video

- For sold videos, the quantity sold should be recorded; for physical video rental, which copy is rented and when it is due back should be recorded.

  classes & associations: Video *Has* RentalCopy
  Customer *RentsPhysical* RentalCopy

  attributes: Purchases: quantity;
  RentalCopy: copyNumber, returnDate

DOMAIN MODELING EXAMPLE: ANALYSIS

- The system should keep track of overdue rentals of physical videos and send email notices to customers who have videos overdue.

  attributes: Customer: email

- There will be a customer membership option for an annual fee, which will entitle a member to discounts (10%) on the sale and rental of videos.

  generalization: Member *is a kind of* Customer
  → Customer *Generalizes* Member

- Members should be able to make reservations for physical video rentals either in person at the shop, by telephone or via the Web.

  classes & associations: Member *Reserves* RentalCopy

- A member can reserve at most five physical videos at any one time, but there is no limit on how many physical videos a member or nonmember can rent at any one time.

  constraint: max-card(Member, *Reserves*) = 5
  max-card(Customer, *RentsPhysical*) = *

DOMAIN MODELING EXAMPLE: ANALYSIS

- As an added feature, the shop would like to allow customers (either members or nonmembers) to input, via the Web, mini-reviews (up to 100 words) and a rating (from 1, lowest, to 10, highest) of videos they have purchased or rented.

  classes & associations: Customer *Provides* Review *IsFor* Video
  → Customer *Provides* Review
  Review *IsFor* Video

  attributes: Review: reviewText, rating

- These reviews should be anonymous if the customer so wishes (i.e., customers can specify whether they want their name to be made known when other customers browse the reviews).

  attributes: Review: anonymous

- A sales clerk should be able to enter and update the following information about all customers (members or nonmembers): name, address, phone number, age, sex, and email address.

  attributes: Customer: name, address, phoneNumber, age, sex, email

DOMAIN MODELING EXAMPLE: ANALYSIS

- Members are assigned a membership number by the shop when they become members and a password, which allows them to change their personal information and to buy and rent digital videos via the Web.

  attributes: Member: memberNumber, password

- The shop manager should be able to generate various reports on the sale and rental of videos.

  functional requirement: no new domain model requirements

- A sales clerk should be able to sell and rent physical videos and process the return of rented physical videos.

  functional requirement: no new domain model requirements

- When selling or renting physical videos, a sales clerk must be able to look up customer information and determine whether the customer is a member.

  functional requirement: no new domain model requirements

DOMAIN MODELING EXAMPLE: ANALYSIS

- A sales clerk must be able to enter basic information about a video (i.e., video id, title, leading actor(s), director, producer, genre, synopsis, release year, running time, selling price, and rental price).

  attributes: Video: videoId, title, leadingActor[0..*], director, producer, genre, synopsis, releaseYear, runningTime, sellingPrice, rentalPrice

DOMAIN MODELING EXAMPLE: ANALYSIS

Classes and Associations

Customer *Purchases* Video

Customer *Rents* Video

Video *Has* RentalCopy

Customer *RentsPhysical* RentalCopy

Customer *Provides* Review

Review *IsFor* Video

Member *Reserves* RentalCopy

Association Classes

Purchases: quantity

Generalizations

Customer *Generalizes* Member

Constraints

max-card(Member, *Reserves*) = 5

max-card(Customer, *RentsPhysical*) = *

Attributes

Customer: name, address, phoneNumber, age, sex, email

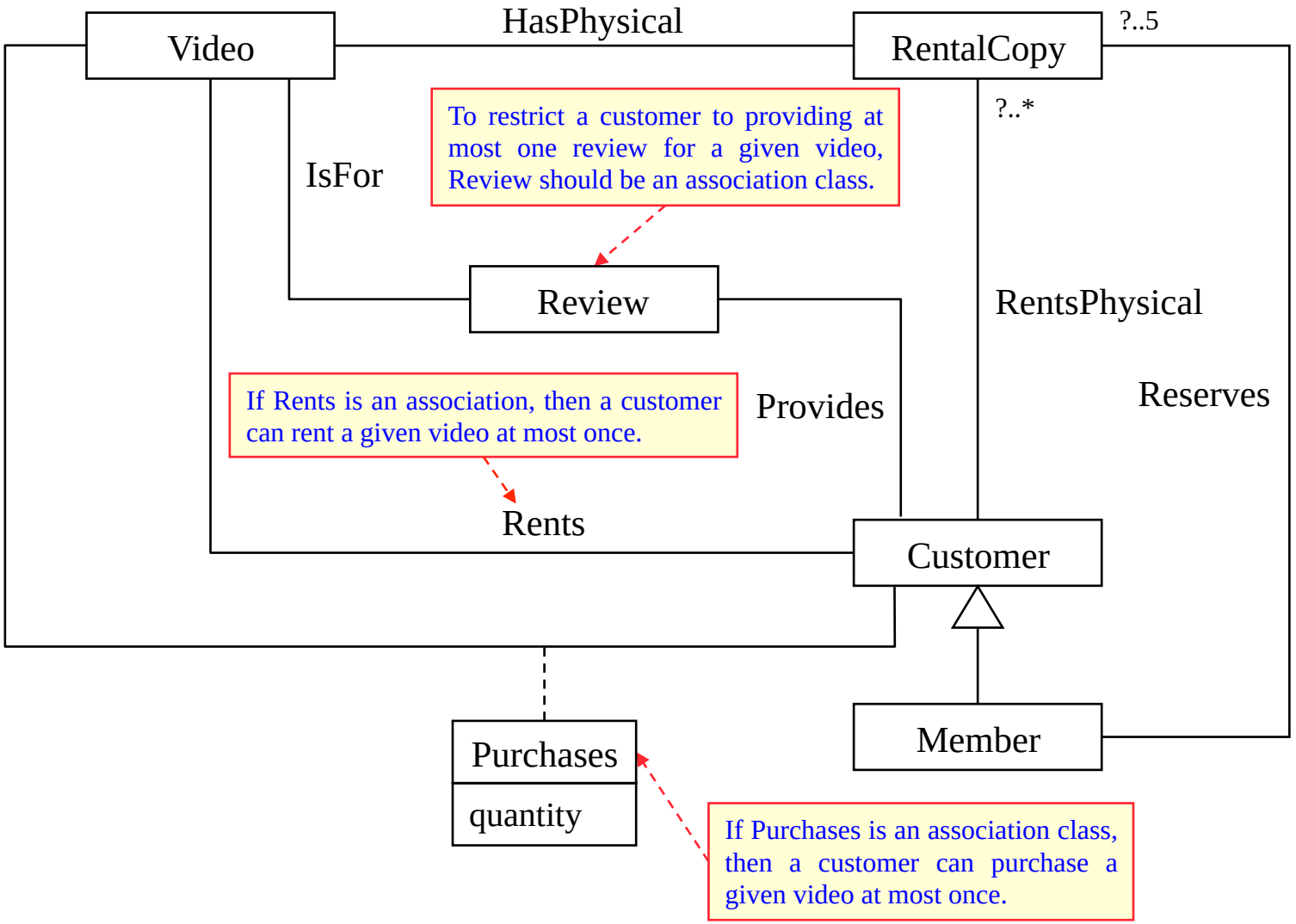
Member: memberNumber, password

Video: videoId, title, leadingActor[0..*], director, producer, genre, synopsis, releaseYear, runningTime, sellingPrice, rentalPrice, isPhysical, isDigital

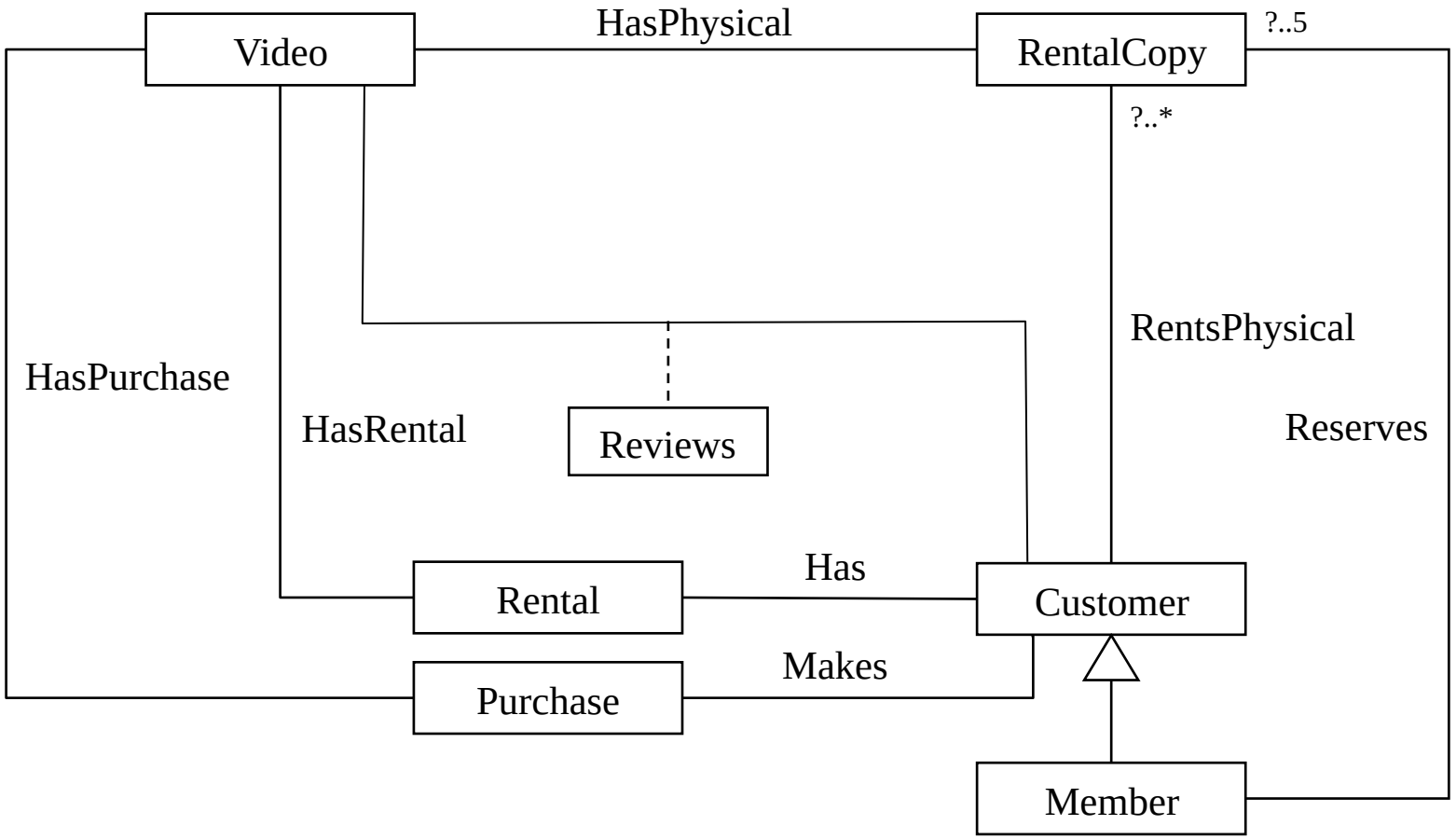
RentalCopy: copyNumber, returnDate

Review: reviewText, rating, anonymous

DOMAIN MODELING EXAMPLE: SOLUTION



DOMAIN MODELING EXAMPLE: SOLUTION



DOMAIN MODELING EXAMPLE: ANALYSIS

Constraints from Real World Knowledge

A member may not have reserved any physical rental copy.

min-card(Member, *Reserves*) = 0

A physical rental copy may not currently be reserved by any member, but it can be reserved by at most one member at a time.

min-card(RentalCopy, *Reserves*) = 0
max-card(RentalCopy, *Reserves*) = 1

A customer may not currently have rented any physical rental copies.

min-card(Customer, *RentsPhysical*) = 0

A physical rental copy may not currently be rented by any customer, but it can be rented by at most one customer at a time.

min-card(RentalCopy, *RentsPhysical*) = 0
max-card(RentalCopy, *RentsPhysical*) = 1

A video can have no or it can have many physical rental copies.

min-card(Video, *HasPhysical*) = 0
max-card(Video, *HasPhysical*) = *

DOMAIN MODELING EXAMPLE: ANALYSIS

A physical rental copy is a copy of exactly one video.

min-card(RentalCopy, *HasPhysical*) = 1
max-card(RentalCopy, *HasPhysical*) = 1

A video can have no or many reviews.

min-card(Video, *Reviews*) = 0
max-card(Video, *Reviews*) = *

A customer can provide no or many reviews.

min-card(Customer, *Reviews*) = 0
max-card(Customer, *Reviews*) = *

A customer can have no or many rentals.

min-card(Customer, *Has*) = 0
max-card(Customer, *Has*) = *

Each rental is for exactly one customer.

min-card(Rental, *Has*) = 1
max-card(Rental, *Has*) = 1

DOMAIN MODELING EXAMPLE: ANALYSIS

A video can have no or many rentals.

min-card(Video, *HasRental*) = 0
max-card(Video, *HasRental*) = *

A rental is for exactly one video.

min-card(Rental, *HasRental*) = 1
max-card(Rental, *HasRental*) = 1

A customer can make no or many purchases.

min-card(Customer, *Makes*) = 0
max-card(Customer, *Makes*) = *

A purchase is made by exactly one customer.

min-card(Purchase, *Makes*) = 1
max-card(Purchase, *Makes*) = 1

A video can have no or many purchases.

min-card(Video, *HasPurchase*) = 0
max-card(Video, *HasPurchase*) = *

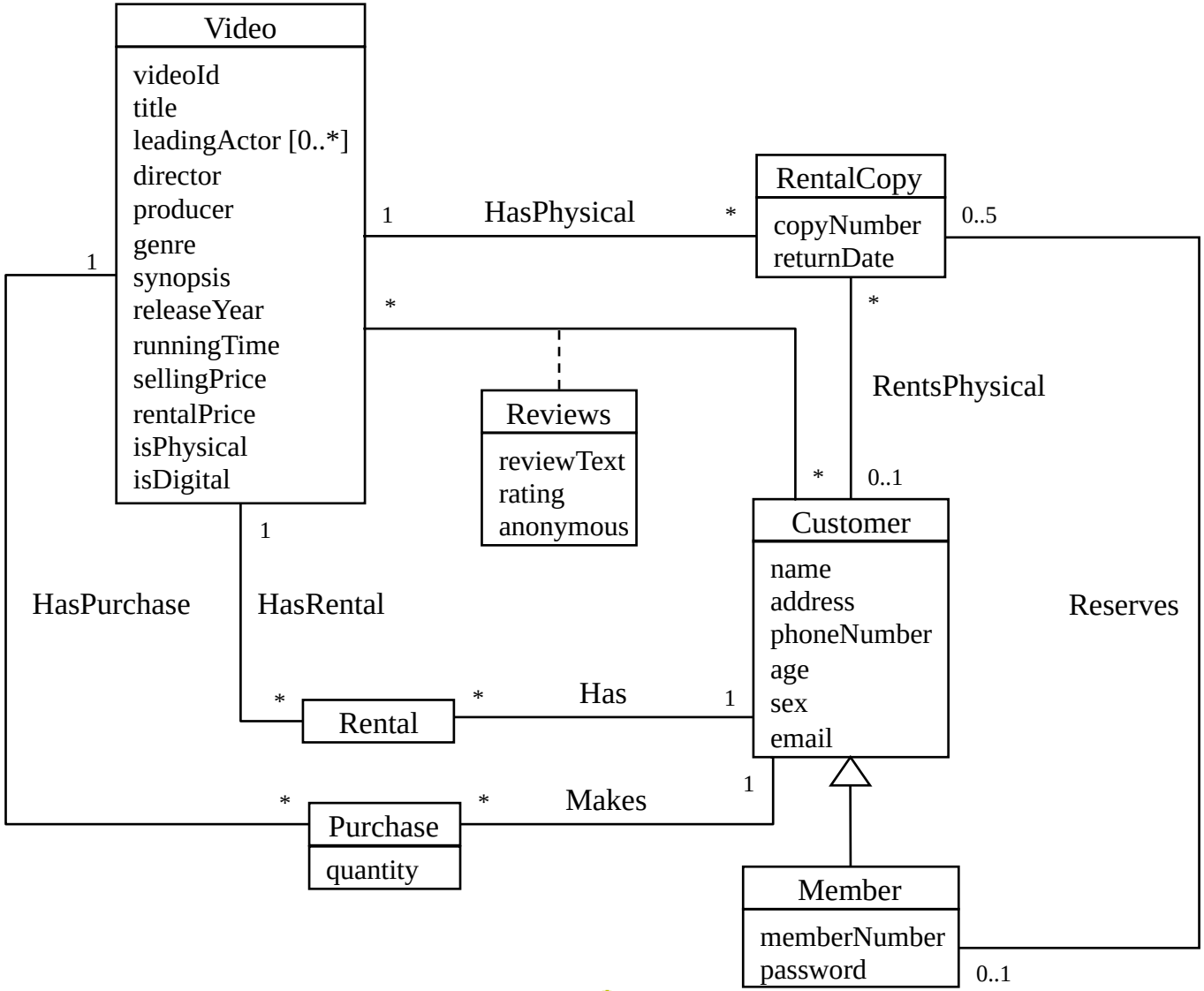
DOMAIN MODELING EXAMPLE: ANALYSIS

Each purchase is for exactly one video.

min-card(Purchase, *HasPurchase*) = 1
max-card(Purchase, *HasPurchase*) = 1

Remark: An instance of the class Video *does not* represent an instance of a physical copy of the video, but a description of the video. Hence, the same instance of Video (i.e., the description) can be related to many rental copies, rentals and purchases).

DOMAIN MODELING EXAMPLE: SOLUTION



DOMAIN MODELING EXAMPLE: COMMON ERRORS

- Using “ids” to relate classes
- Representing the client/organization (e.g., Shop)
- Incorrect use/overuse of generalization
  (e.g., Person, Nonmember, PhysicalVideo, DigitalVideo)
- Incorrect use/overuse of aggregation/composition
  (e.g., Video<>——RentalCopy, Video<>——Review,
  Customer<>——Member)
- Incorrect use of association class
- Incorrect constraints (e.g., XOR)

DOMAIN MODELING EXAMPLE: COMMON ERRORS

- Representing operations
  (e.g., generates, browses, enters, looks up, etc.)
- Storing reports
- Representing implementation aspects
  (e.g., System, Web, telephone, reports)
- Over specifying the model
  (e.g., sales clerk, manager)

Key question: What information about things/ procedures needs to be persistent (i.e., in files or a database)?