细线：一个实体—多个关系(一个实体可以有 多个也可以没有关系)
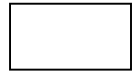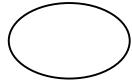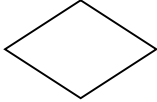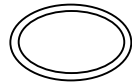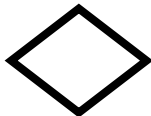
粗线：一个实体—多个关系(一个实体至少有一个关系)

指向关系的箭头：一个实体～一个关系

CS101: Tutorial 01

(HKCU DB System)

Review on E-R Diagram

- **Rectangle** – entity set

- **Ellipse** – attribute

- **Diamond** – relationship set

- **Double ellipse** – multi-valued attribute

- **Dashed ellipse** – derived attribute

- **Thick line** – total participation

- **Arrow** – key constraint

- **Thick rectangle** – weak entity set

- **Thick diamond** – relationship set for weak entity set

2

Exercise 1

- A university registrar's office maintains data about the following entities:

  a) **course**, including number, title, credits, syllabus, and prerequisites; *[recursive relationship]*

  b) **course offering** *[weak entity]*, including course number, year, semester, section number, instructor(s), timings, and classroom; (course offering depends on the course that university provided) *[dependence]*

  c) **student**, including student-id, name, and program;

  d) **instructor**, including identification number, name, department, and title.

  - Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled.

- Construct an E-R diagram for the registrar's office. Document all assumptions that you make about the cardinality constraints and participation constraints.

Entity sets

"A university registrar's office maintains data about the following entity sets:"

(a) course (b) course offering (c) student (d) instructor

course-offering

student

instructor
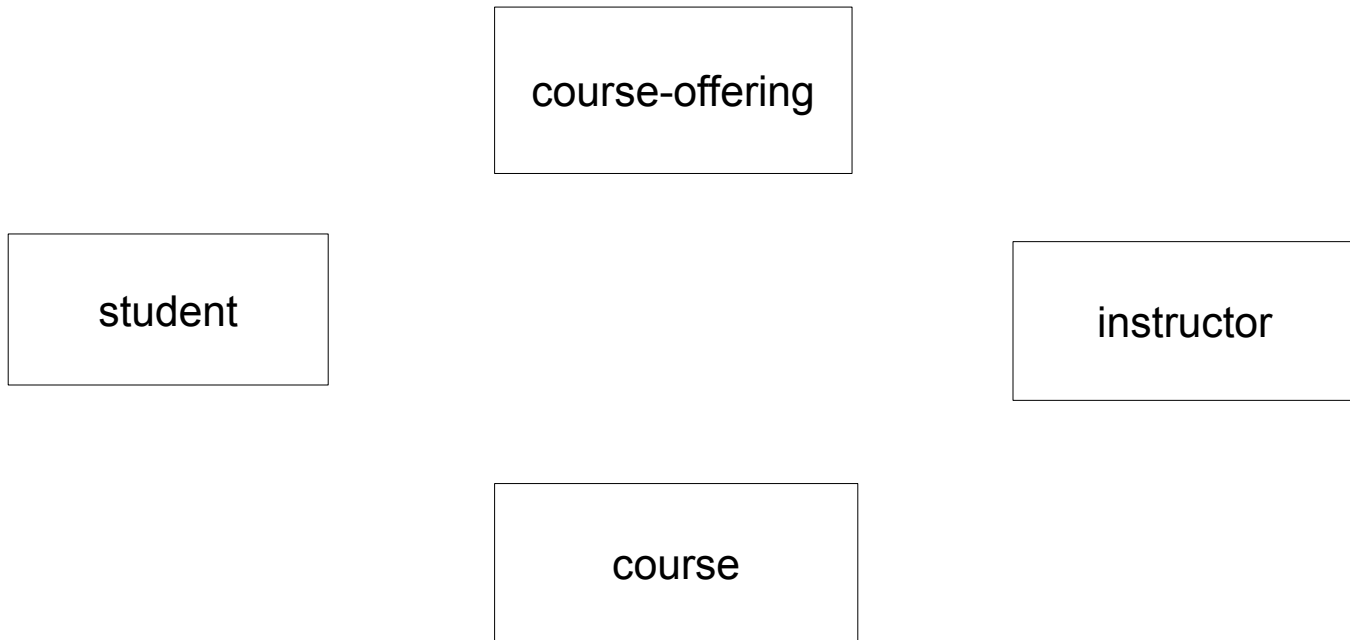
course

Course

- "**course** including number, title, credits, syllabus, and
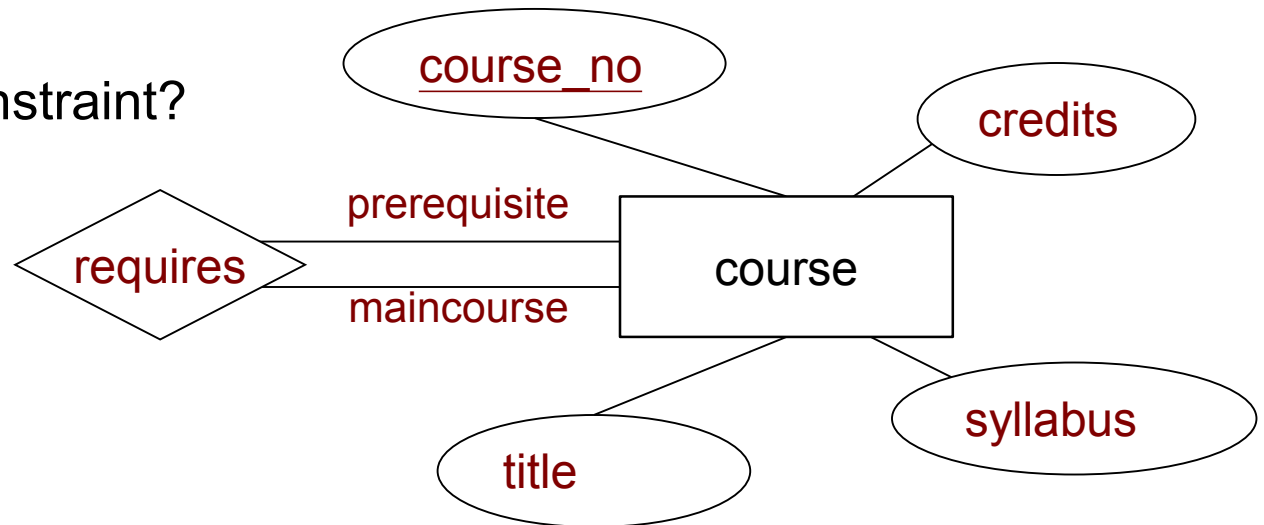
  prerequisites" You can attend the main course if you
  pass prerequisite

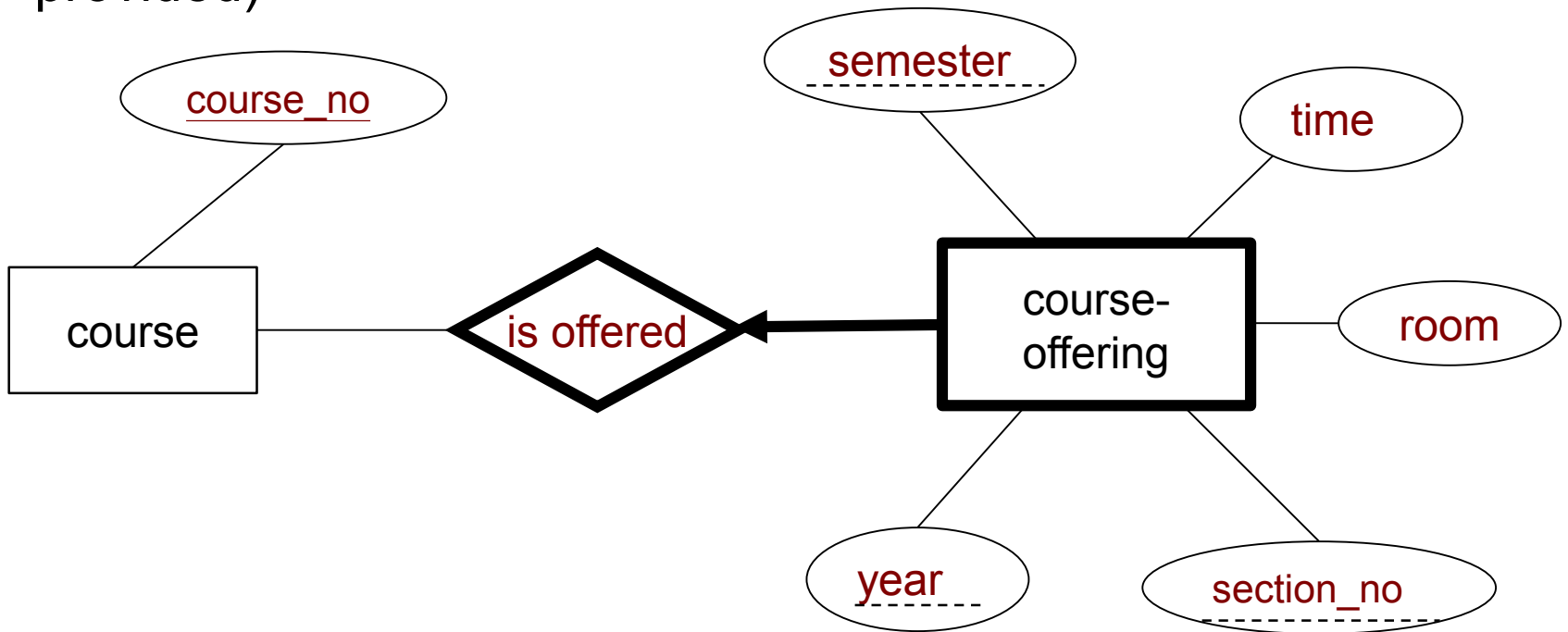 Entity set? Attribute?

  Relationship set? Roles?

  Cardinality constraint?

  Participation constraint?

Course Offering

- "**course offering**, including course number, year, semester, section number, instructor(s), timings, and classroom"

- (course offering depends on the course that university provided)

Weak Entity Set

- A **weak entity set** can be identified uniquely only by considering the primary key of another (owner) entity set
  - Owner entity set and weak entity set must participate in **one-to-many** relationship set (one owner, many weak entities).
  - Weak entity set must have **total participation** in this identifying relationship set.
- Difference between weak entity and existence dependency
  - WE implies ED but not the other way round.
  - WE has only a partial key but ED may have a primary key

Student, Instructor

- **"student**, including student-id, name, and program"

- **"instructor**, including identification number, name, department, and title"

Enrollment

- "Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled."
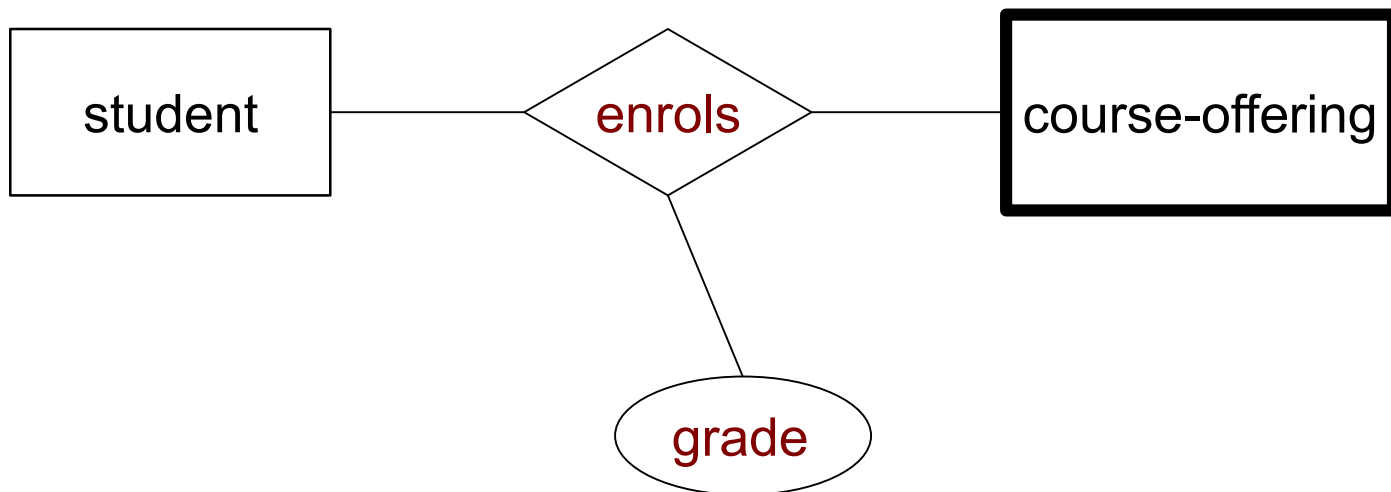
Requestment

- A university registrar's office maintains data about the following entities:
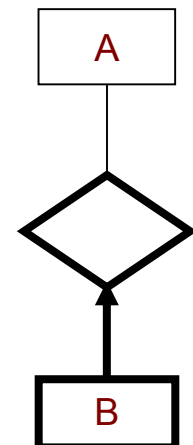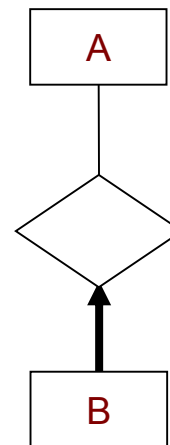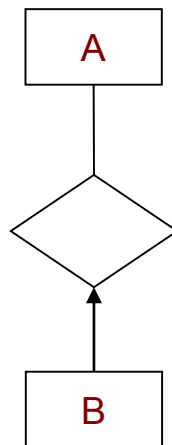
  a) **course**, including number, title, credits, syllabus, and prerequisites;

  b) **course offering**, including course number, year, semester, section number, instructor(s), timings, and classroom; (course offering depends on the course that university provided)
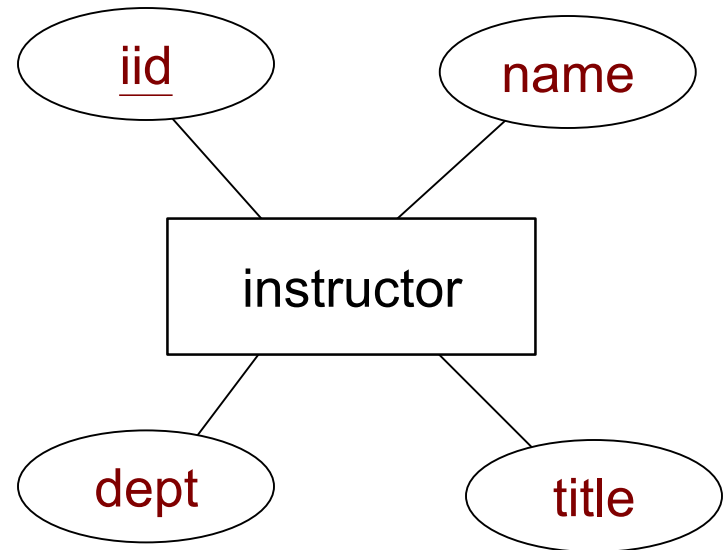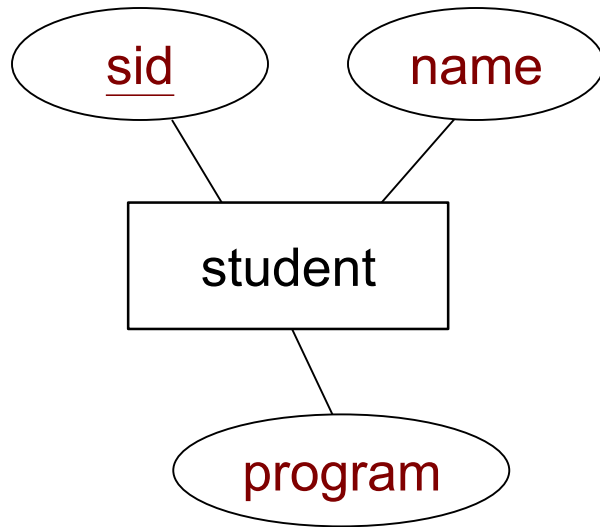
  c) **student**, including student-id, name, and program;

  d) **instructor**, including identification number, name, department, and title.

  - Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled.

- Construct an E-R diagram for the registrar's office. Document all assumptions that you make about the cardinality constraints and participation constraints.

Anymore ?

- Instructor teaches course…..
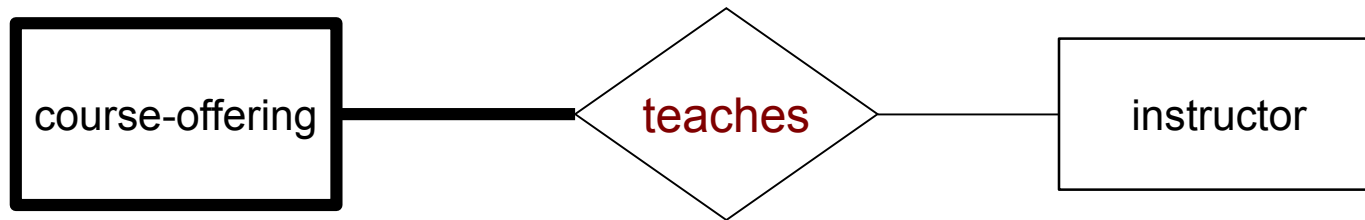
~~A course-offering does not have to have an instructor.~~

~~Partial participation~~

A course-offering has to have an instructor.

Total participation
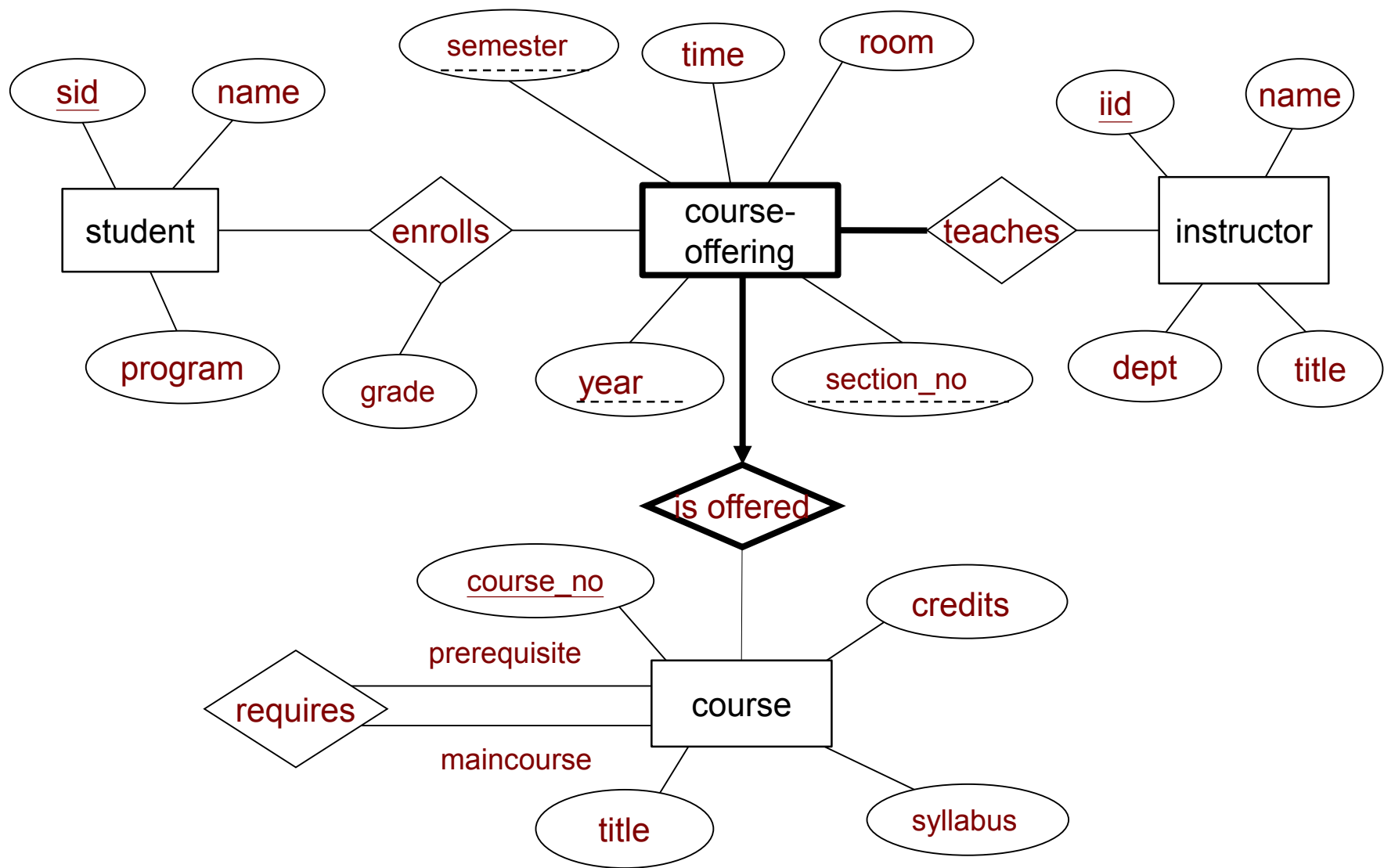
Figure 1 E-R diagram for a university registrar office.

More …

Based on **Figure 1**, modify the E-R Diagram so as to present the following information.
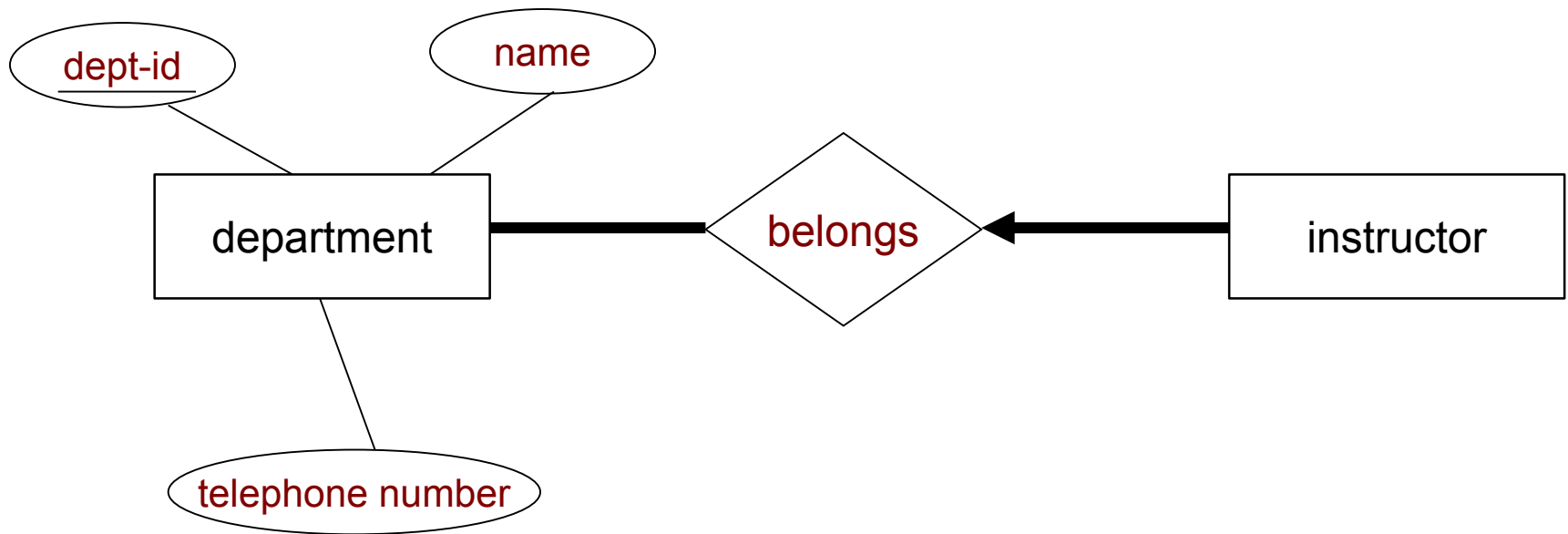
- Each instructor must belong to exactly one department.

- Each department includes dept-id, name, telephone number.

- Each department must have at least one instructor.

Department

- Each instructor **must** belong to **exactly one** department

- Each department **must** have **a least one** instructor.

Exercise 2

- Design a database to organize the information about a factory and the products that are manufactured there. The relevant information is as follows:
  a) The factory has a number of **employees**. For each employee you need to store the name, employee number, and salary.
  b) Each employee must be an **administrative staff** or a **worker**, but not both.
  c) Administrative employees **must** take **seminars**. For each seminar we keep its id, name and date. For the administrative staff, you must store the grade received, for each seminar taken.
  d) The factory manufactures a number of **products** and each product is identified by a product id and has a name.
  e) Each worker is assigned to work on **exactly** one product; a product has multiple (**one or more**) workers assigned to it.
  f) A large number of **items** are manufactured for each product. Each item has a serial number and a color. Different items of the same product have different serial numbers. However, two items that belong to different products may have the same serial number.

Employee, Administrative Staff, Worker

a) The factory has a number of **employees**. For each employee you need to store the name, employee number, and salary.

b) Each employee must be an **administrative staff** or a **worker**, but not both.

Employee

Overlap: Disjoint
Cover: Total

ISA

Administrative staff

Worker
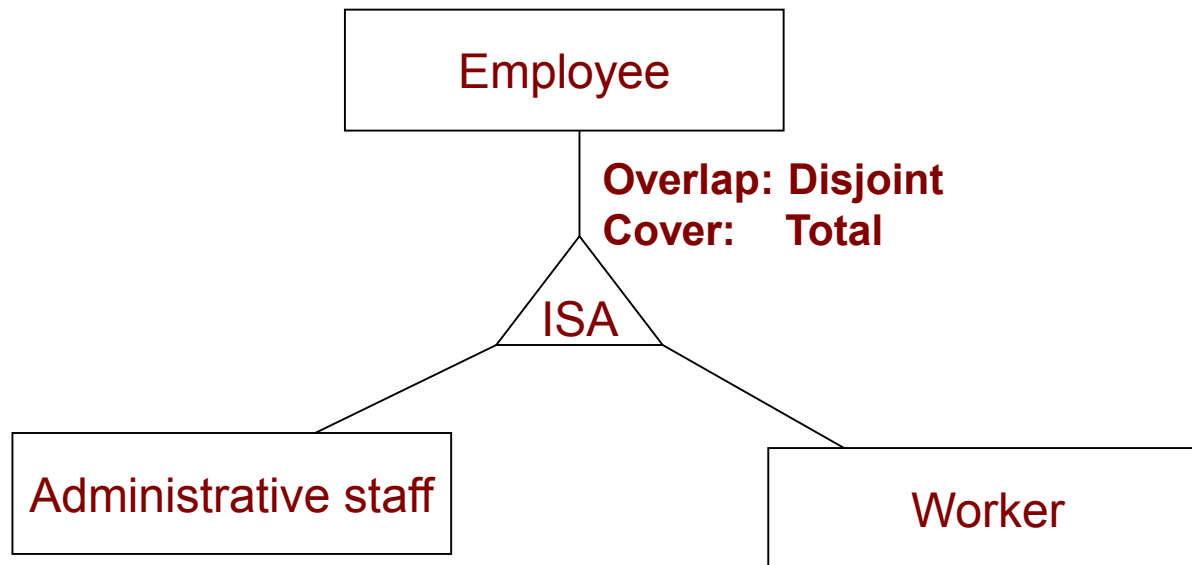
Seminar

a) Administrative employees must take **seminars**. For each seminar we keep its id, name and date. For the administrative staff, you must store the grade received, for each seminar taken.
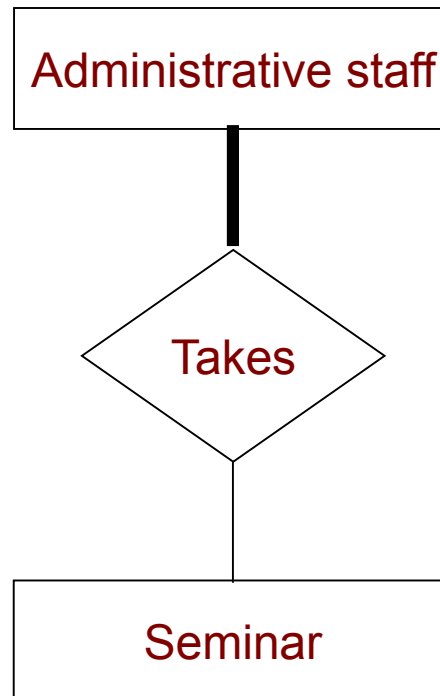
Product

a) The factory manufactures a number of **products** and each product is identified by a product id and has a name.

b) Eash worker is assigned to work on exactly one product; a product has multiple (one or more) workers assigned to it.

```
┌─────────────┐
│   Worker    │
└─────────────┘
       │
       ▼
      ◇
  Works for
      ◇
       │
┌─────────────┐
│   Product   │
└─────────────┘
```

Item

a) A large number of **items** are manufactured for each product. Each item has a serial number and a color. Different items of the same product have different serial numbers. However, two items that belong to different products may have the same serial number.

Product — consists of → Item

Employee

name · e_no · salary

Overlap: Disjoint
Cover: Total

ISA

Administrative staff

Worker

grade — Takes

Works for

Seminar

Product — consists of — Item

id · name · date

pname · p_id
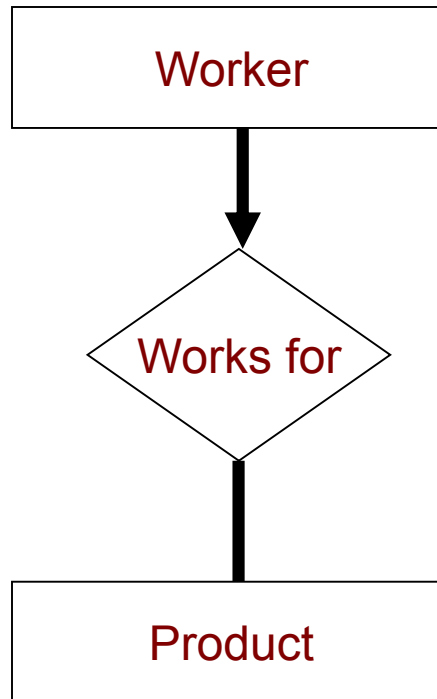
serial_no · color
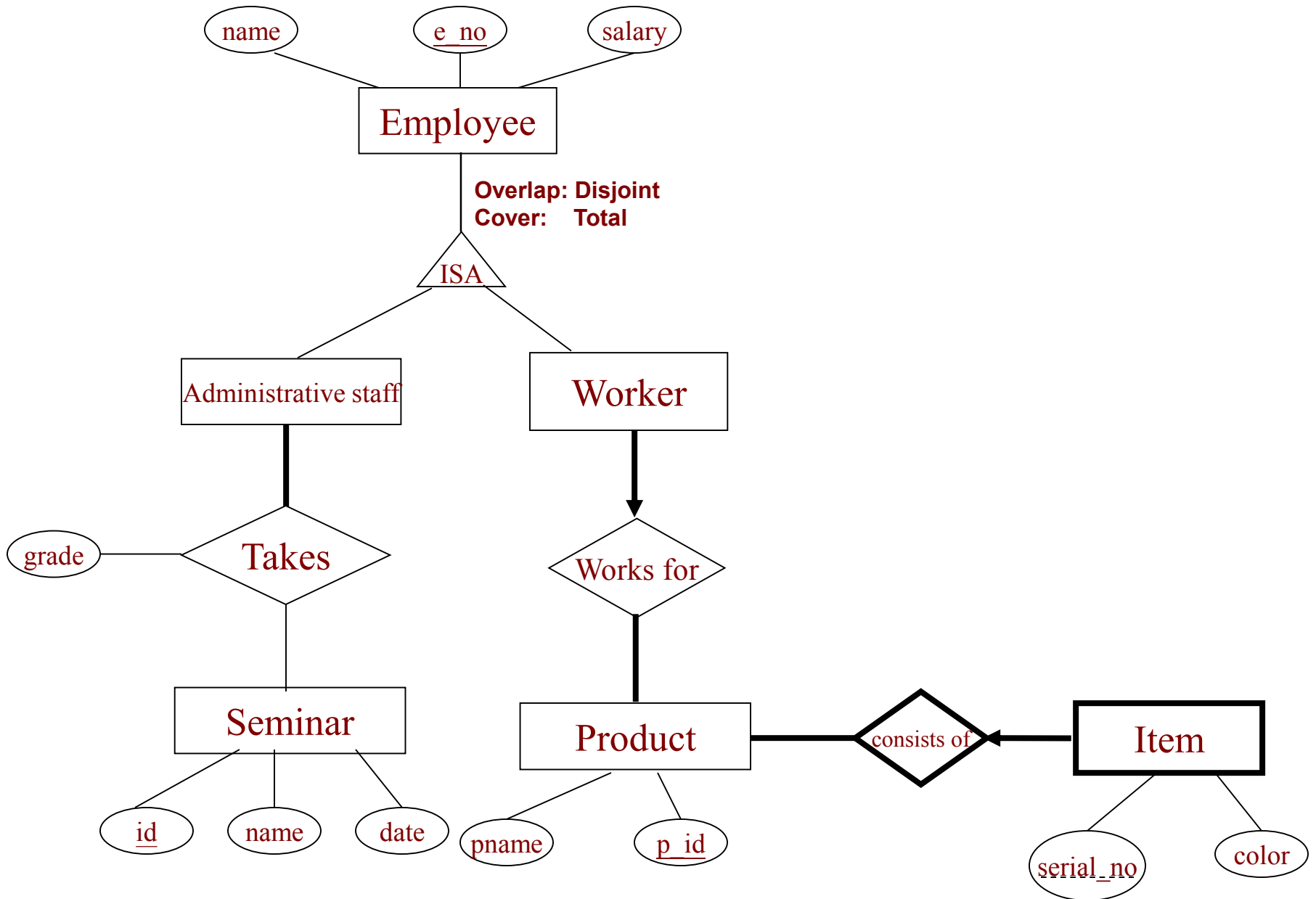
Question 1

- We want to create a very simple database for MUST in which to record information about professors, students and classes.

    - For each professor we need to store the p-id, name and office number.

    - For each student we need to store the student-id and name

    - For each class the id (e.g., CS231) and the name.

    - Each class is taught by exactly one professor.

    - Each student must take at least one class.

    - For each class that a student took we need to give the grade

    - *Simplifying assumptions: there is only one lecture for each class and only one semester in the database.*

Question 2

We want to create database for a bank in which we store:

- Customers (<u>id</u>, name, city).

- Accounts (<u>number</u>, balance)

- Loans (<u>number</u>, amount)

- Branches (<u>name</u>, city, assets)

- Each customer can have any number of accounts and loans

- Each account and loan is associated with one branch.

- A customer must have either one account or loan in order to be in the database

- The balance in each account should be >$100.

The last two constraints cannot be expressed by the ER diagram.

Conclusion

- Notations of E-R Diagram

- Generally, we construct an E-R diagram, by identifying:

  - Entity sets

    - What should be entities?

    - Strong or weak entity set?

  - Relationship sets

    - Need to label roles?

  - Attributes

    - Can be inherited? (generalization or specification)

  - Participation constraints:

    - Total participation or partial participation?

  - Cardinality constraints

    - One to one, one to many or many to many?

Q&A
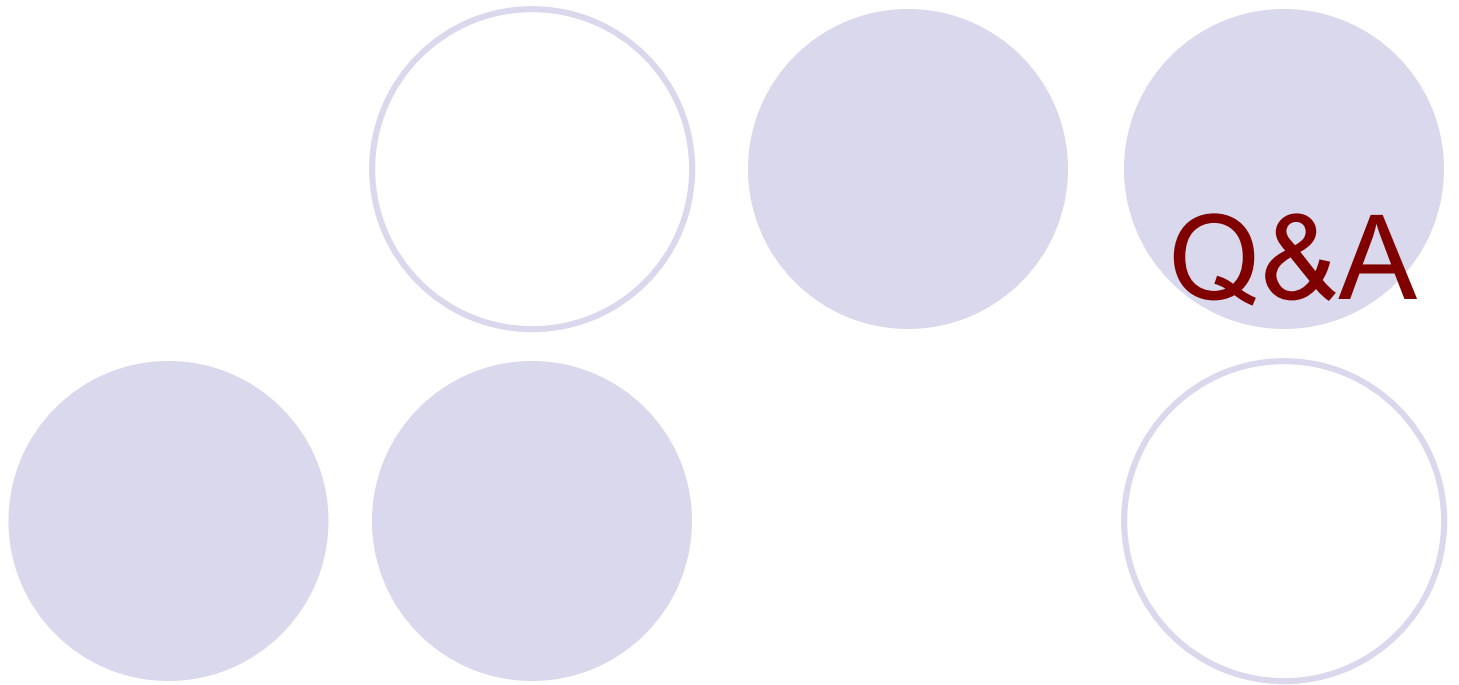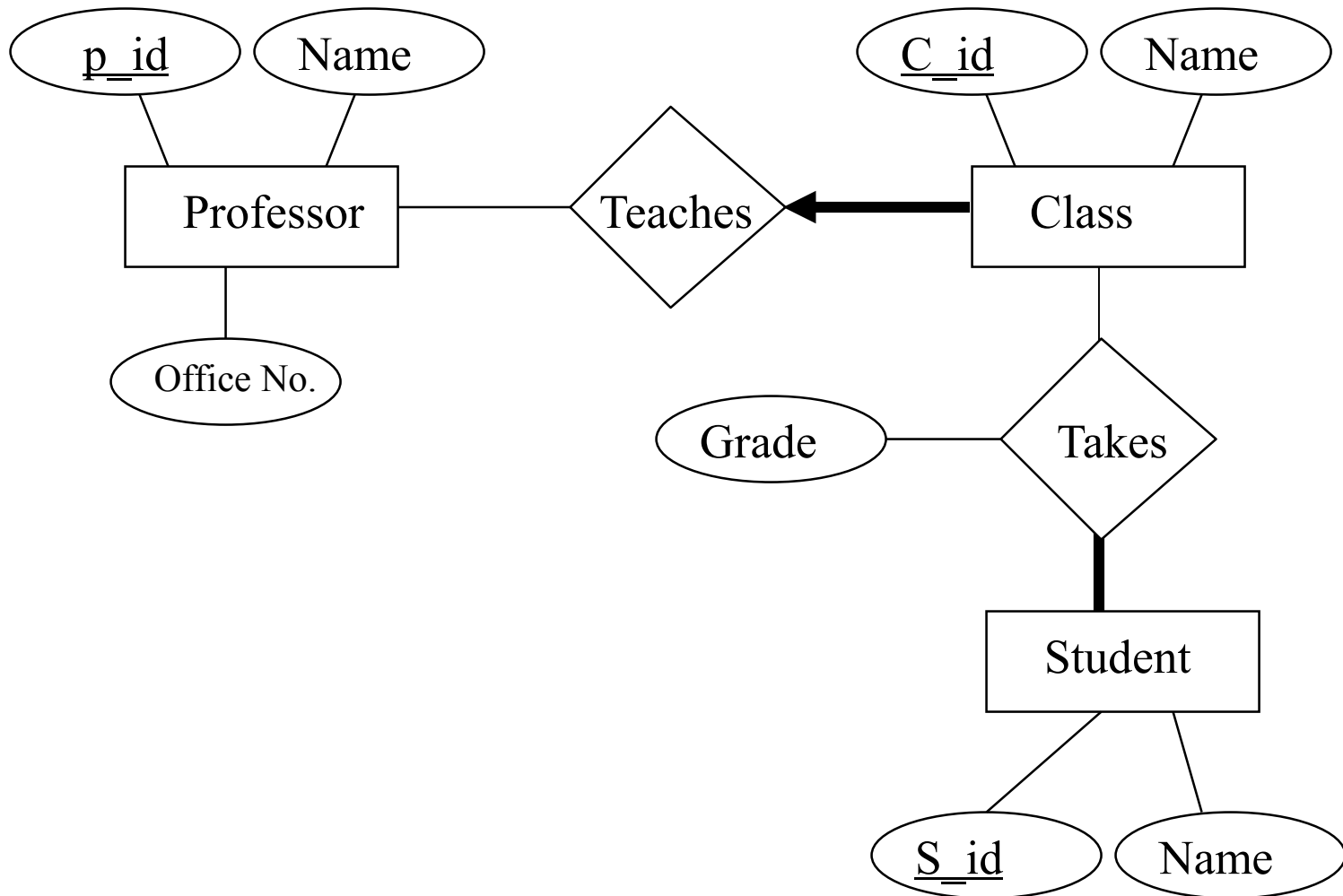
Answer

Answer
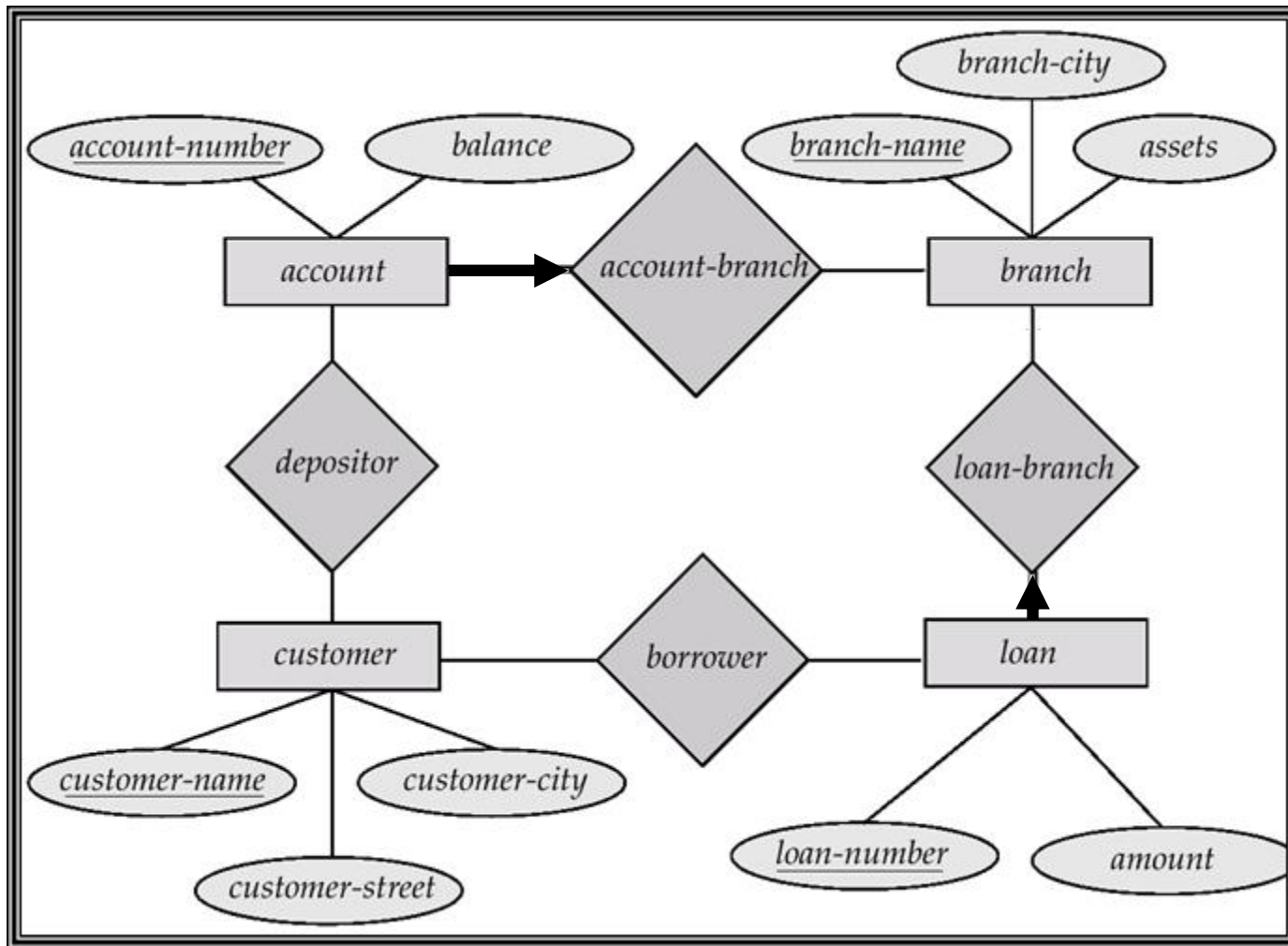
Example

- A bus company wants to keep track of its bus routes and schedules. Design an ER diagram for the database according to the following description. Identify all constraints and keys:

- Each bus route has a route number, a departure station and a destination station.

- For each bus route, there is a schedule, which records the departure times of buses.

- For each departure time of each route, a driver and a bus can be assigned (however this is not necessary - information about the driver or the bus may sometimes be missing)

- A driver has an employee Id, a name and a phone number.

- A bus is identified by its license number. The database also records the seating capacity of each bus.

Solution