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HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Database
Lesson 7. Entity Relationship Model

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Learning Map

Sequence	Title
1	Introduction to Databases
2	Relational Databases
3	Relational Algebra
4	Structured Query Language – Part 1
5	Structured Query Language – Part 2
6	Constraints and Triggers
7	Entity Relationship Model
8	Functional Dependency
9	Normalization
10	Storage - Indexing
11	Query Processing
12	Transaction Management – Part 1
13	Transaction Management – Part 2

Outline

- Introduction
- How to create an ER
- Mapping from ER to relational schema

Objectives

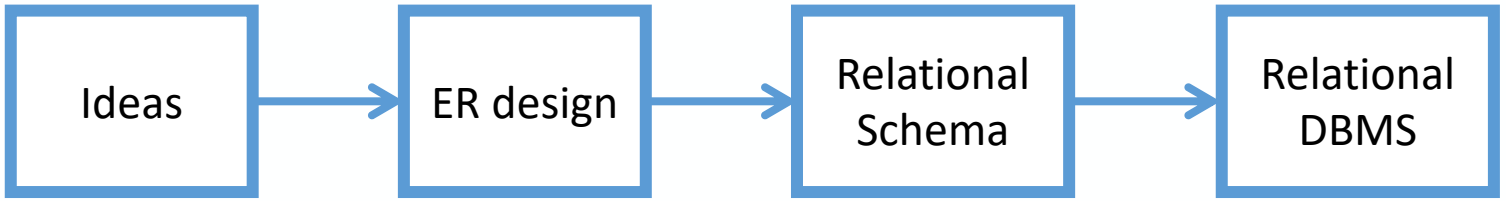
- Upon completion of this lesson, students will be able to:
  - Know what the entity relationship model is
  - Know how to create an ER from a real-world problem
  - Transform from ER into relational schema

1. Introduction

- Introduction
- Entity sets
- Attributes
- Key
- Relationships

1.1. Introduction

- Two approaches to DB designing
  - Top - down: Entity Relationship model (ER)
  - Bottom – up: Functional Dependencies and Normalization
- ER model is used in DB design



1.1. Introduction

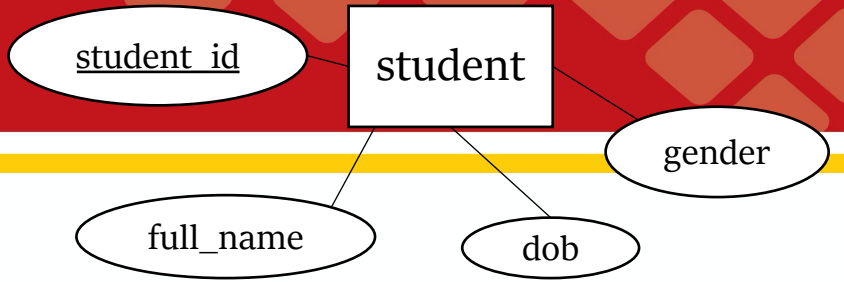
- The structure of data is represented graphically: ER
- Three principal element types:
  - Entity sets
  - Attributes
  - Relationships

1.2. Entity sets

- Entity
  - is a thing in the real world with an independent existence.
  - An entity may be an object with a physical existence (a particular person, car, house, or employee) or it may be an object with a conceptual existence (a company, a job, or a university course).
- Entity sets
  - a collection of similar entities forms an entity set.

- Weak entity type vs. strong entity type
  - Weak entity type do not have key attributes of their own while strong entity type do have a key attribute
  - a weak entity can not be identified without an owner entity.
- In ER, rectangular boxes represent for entity sets

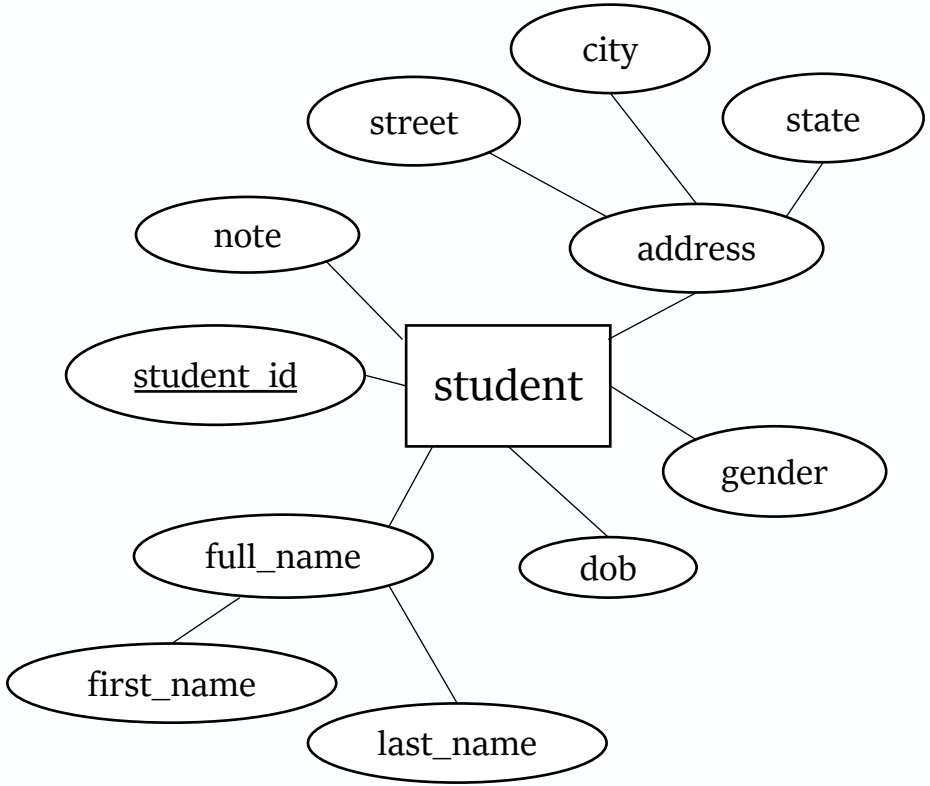
1.3. Attributes



- Attributes
  - Entity sets have associated attributes, which are properties of the entities in that set.
  - For instance, each entity "student" has some properties such as student_id, first_name, last_name, dob, gender, address, and so on.
  - In ER, ovals represent for attributes
- Value domain of an attribute
  - Each simple attribute of an entity type is associated with a value set (or domain of values).
  - For example: domain(gender) = {male, female}; domain(dob) = {date}; domain(last_name) = {char(30)}.

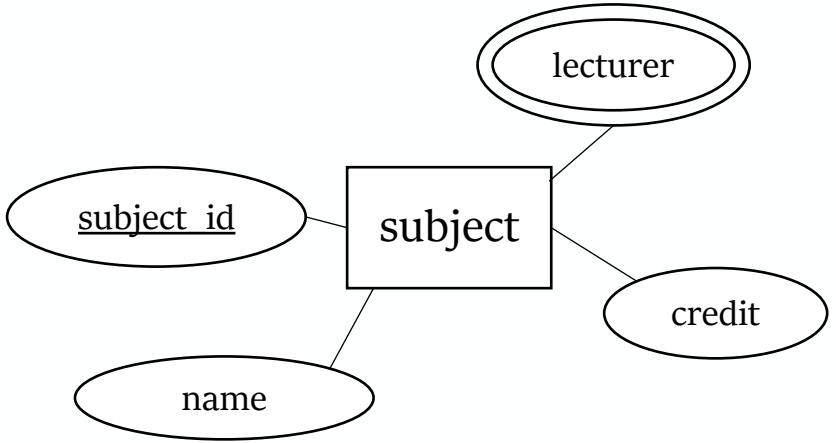
1.3. Attributes

- Some types of attributes
  - Simple/atomic attributes: Attributes that are not divisible.
  - Composite attributes: attributes can be divided into smaller subparts, which represent more basic attributes with independent meanings.



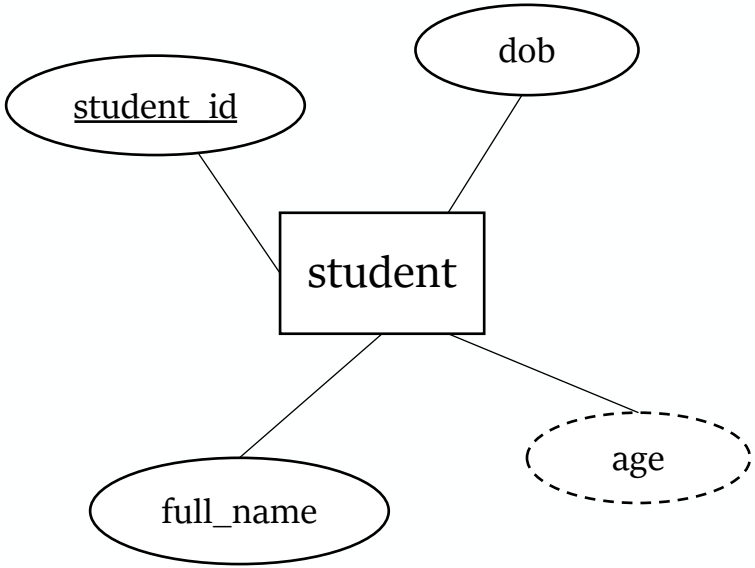
1.3. Attributes

- Some types of attributes
  - Single-valued attributes: have a single value for a particular entity
  - Multi-valued attributes: can have different numbers of values



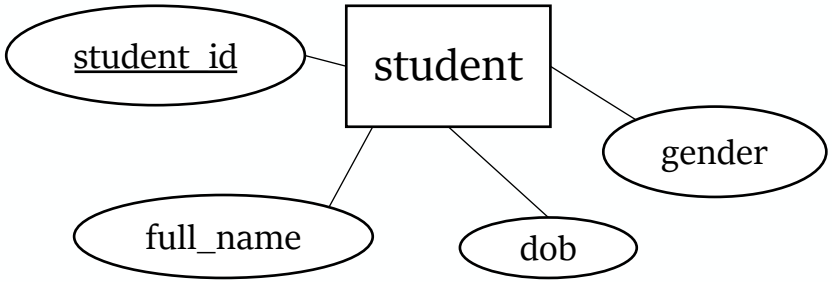
1.3. Attributes

- Some types of attributes
  - Stored attributes vs. Derived attributes: age attribute is called a derived attribute and is said to be derivable from the dob attribute, which is called a stored attribute.



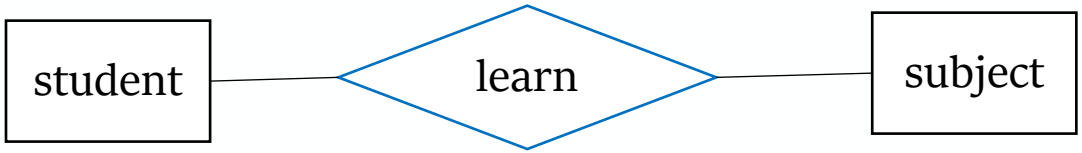
1.4. Key

- One or more attributes whose values are distinct for each individual entity in the entity set. Such an attribute is called a key attribute, and its values can be used to identify each entity uniquely.
- Each entity can have some keys. We choose one of them to be primary key.
- In ER diagrammatic notation, each key attribute has its name underlined inside the oval.

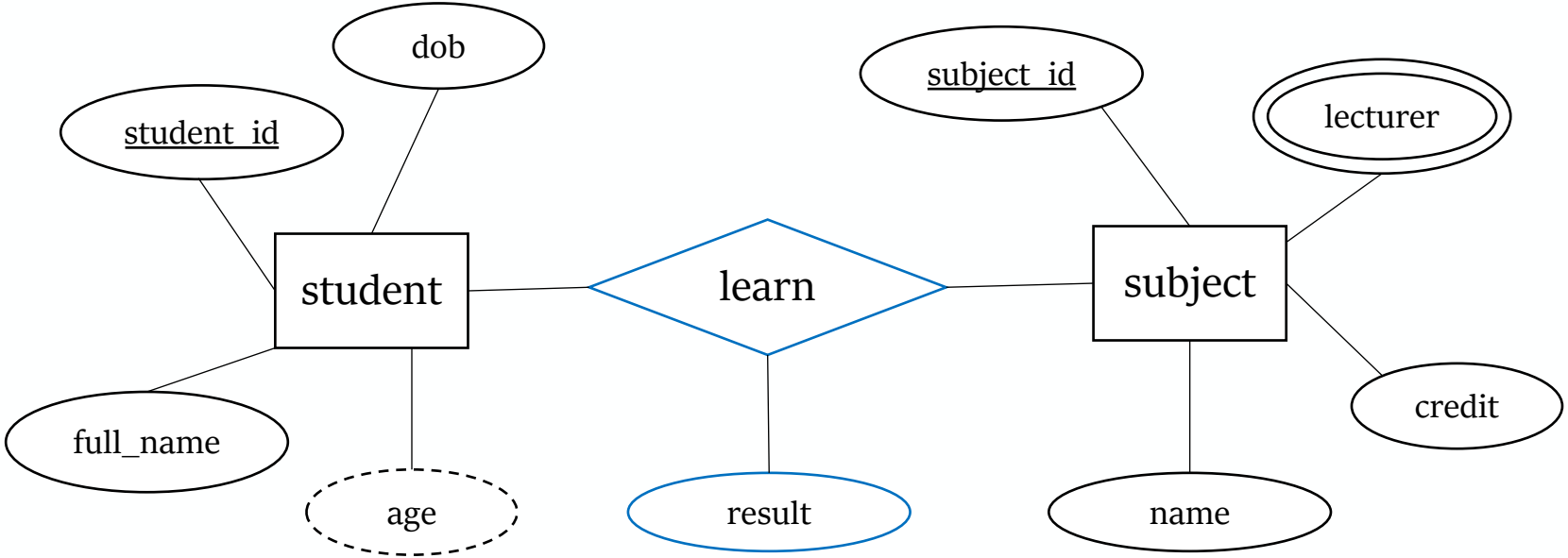


1.5. Relationships

- Relationships are connections among two or more entity sets.
- In ER diagrams, relationship types are displayed as diamond-shaped boxes,
  - which are connected by straight lines to the rectangular boxes representing the participating entity types.
  - The relationship name is displayed in the diamond-shaped box.

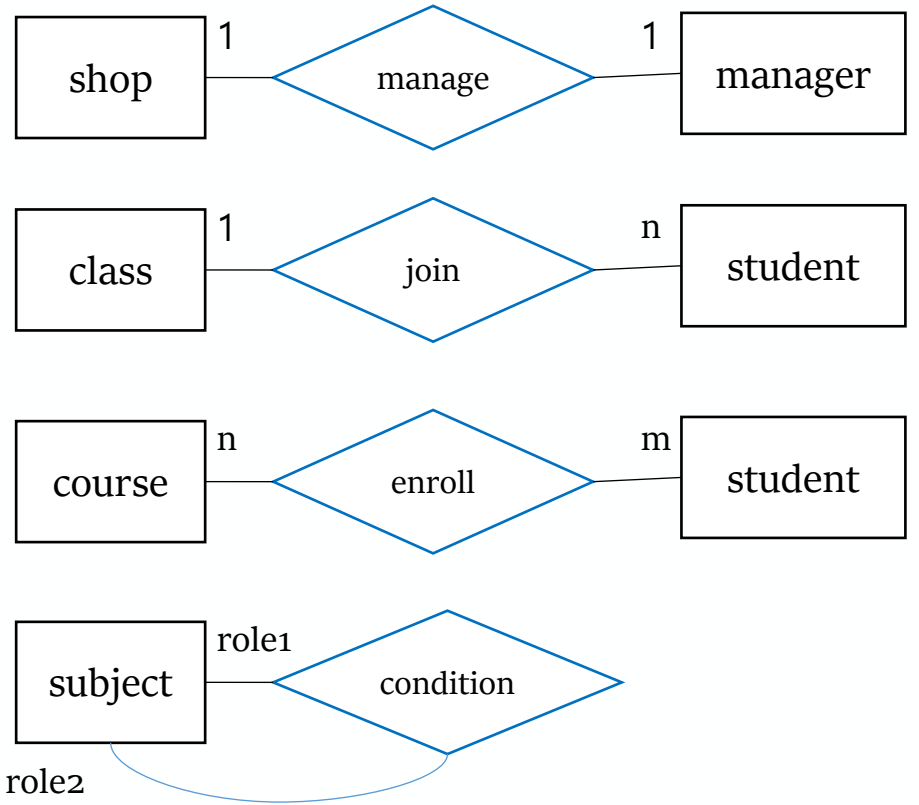


1.5. Relationships



1.5. Relationships

- Type of relationships
  - 1 – 1
  - 1 – n
  - n – m
  - recursive



2. How to create an ER

- ER process
- Example

2.1. ER process

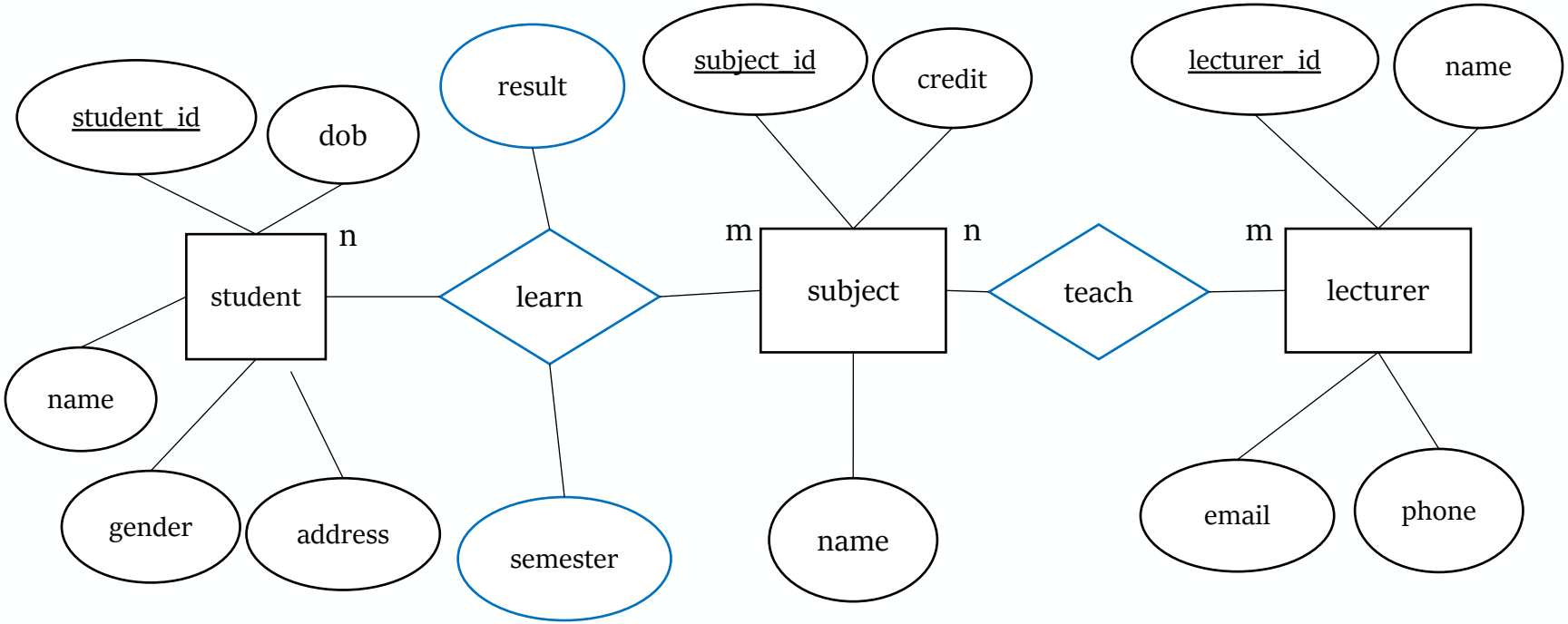
- Step 1: Identify all entity sets
  - Notice concepts, nouns
- Step 2: Identify all relationships among entity sets
  - Notice verbs
  - Type and degree of relationships

2.2. An example

- Read carefully the following scenario:
  - The information about students includes student identification (uniquely identify each student), name, gender, date of birth and address.
  - During the education time at school, students must study a lot of subjects. A subject can be learnt by students. A subject should be contained information such as subject identification, name and credit.
  - A lecturer can teach some subjects, and a subject can be taught by a group of lecturers. The information about lecturers should include lecturer identification, name, phone, email.
  - Students learn subjects at some semester, and their results should be stored.

2.2. An example

- We can draw this ER diagram



3. Mapping from ER to relational schema

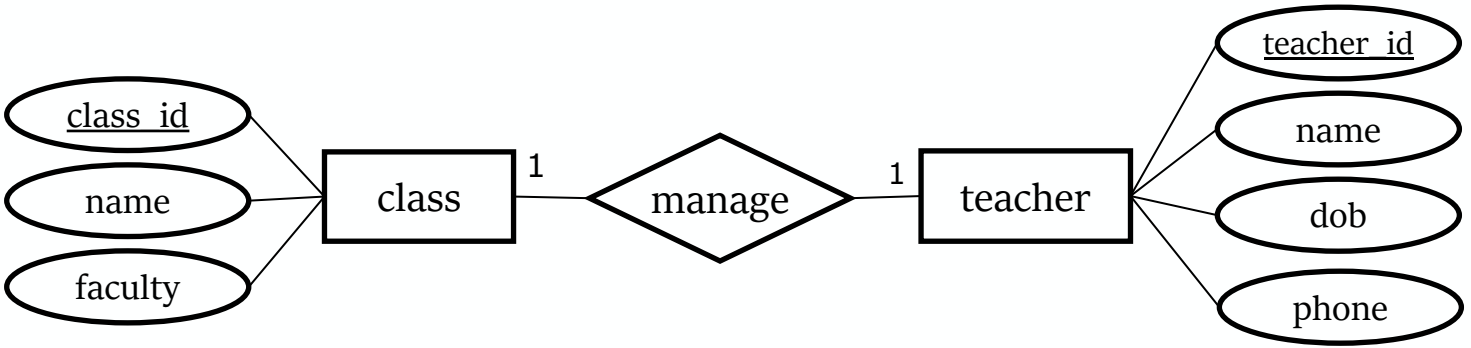
- Mapping process
- Example

3.1. Mapping process

- Mapping of strong entity sets
  - For each entity set, create a relation that includes all the simple attributes of that entity set.
  - PK of entity set becomes PK of the relation

    class(class_id, name, faculty)

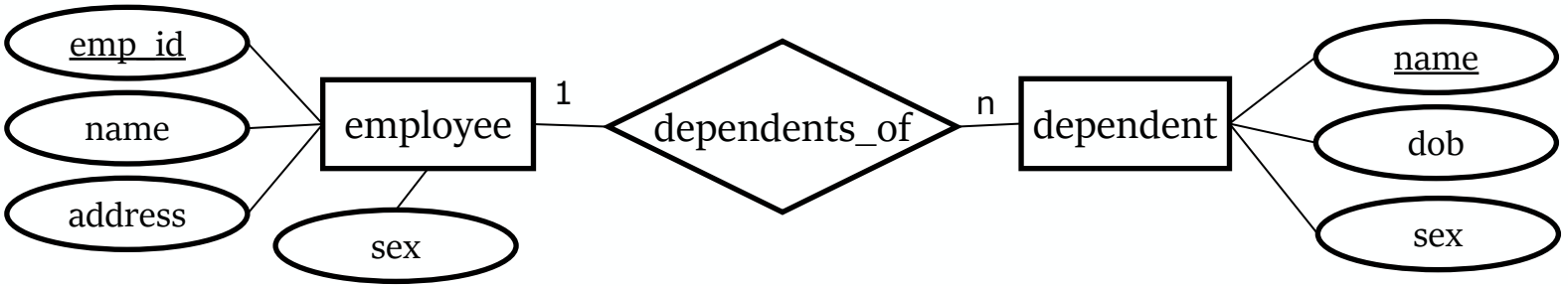
    teacher(teacher_id, name, dob, phone)



3.1. Mapping process

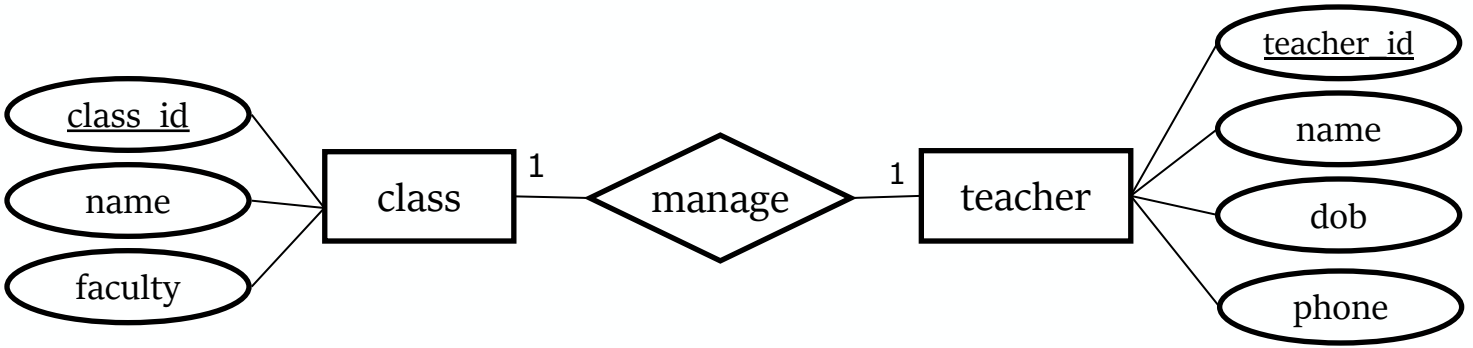
- Mapping of weak entity sets
  - For each entity set, create a relation that includes all the simple attributes of that entity set.
  - PK of strong entity set should be included in PK of the relation

    dependent(emp_id, name, dob, sex)



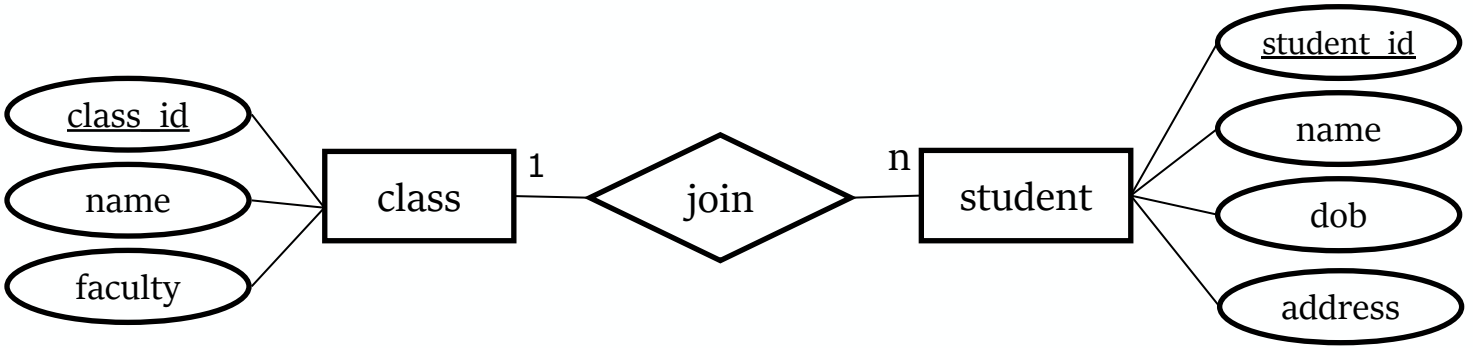
3.1. Mapping process

- Mapping of 1 - 1 relationships
  - Create a new relation which has all prime-attributes of both entity sets
    manage(class_id, teacher_id)
  - Use foreign key
    class(class_id, name, faculty, teacher_id)



3.1. Mapping process

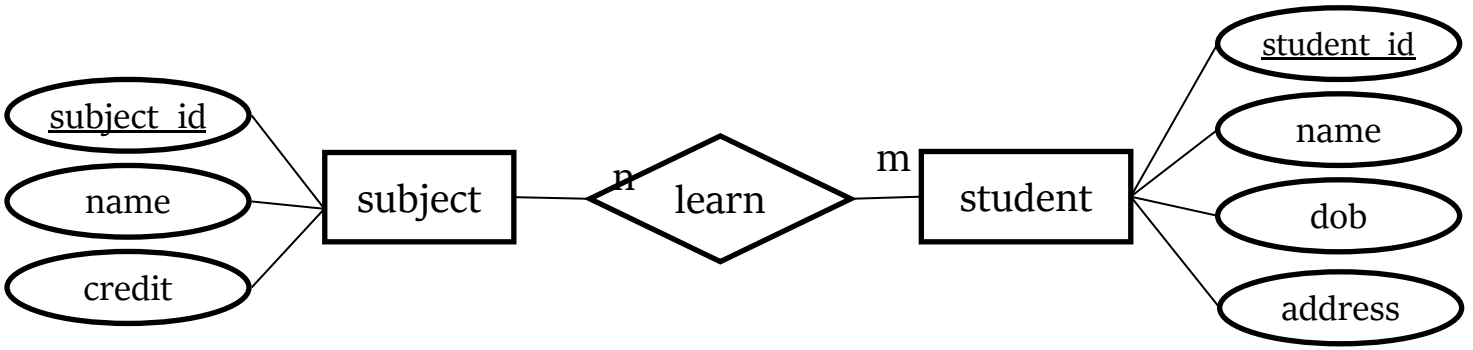
- Mapping of 1 - n relationships
  - Create a new relation which has all prime-attributes of both entity sets
    join(class_id, student_id)
  - Use foreign key
    student(student_id, name, dob, address, class_id)



3.1. Mapping process

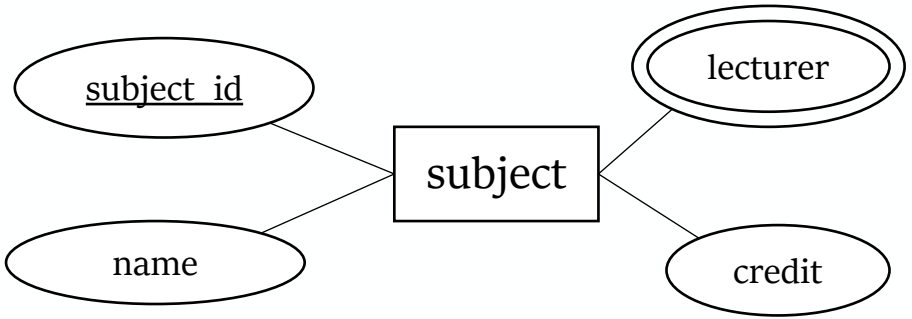
- Mapping of n - m relationships
  - Create a new relation which has all prime-attributes of both entity sets

    learn(subject_id, student_id)



3.1. Mapping process

- Mapping of multivalued attributes
  - For each multivalued attribute A, create a new relation R including an attribute corresponding to A, plus the primary key attribute K (as a foreign key in R) of the corresponding entity set
  - The primary key of R is the combination of A and K.
    - subject_lecturer(subject_id, lecturer)



3.2. Example

- student(student_id, name, gender, dob, address)
- subject(subject_id, name, credit)
- lecturer(lecturer_id, name, phone, email)
- learn(student_id, subject_id, semester, result)
- teach(lecturer_id, subject_id)

Remark

- ERD: an approach to DB designing
- Entity sets, attributes, key, relationships
- How to create an ERD
- Mapping from ERD to relational schema

Summary

- Introduction
  - ERD in DB designing, and its components
- How to create an ERD
  - discover entity sets, attributes and relationships among entity sets
- Mapping from ERD to relational schema
  - transform from ERD into a set of tables

Next lesson: Functional Dependency

- Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom. Database Systems: The Complete Book. Pearson Prentice Hall. the 2nd edition. 2008: Chapter 7
- Nguyen Kim Anh, Nguyên lý các hệ cơ sở dữ liệu, NXB Giáo dục. 2004: Chương 7