Entity Relationship Model

Learning Maps

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

Intro > Overview

☐ A : Voice and PPT Overview
☐ B : Text-based Overview
■ C : Video and PPT Overview

Opening Message	→ In this lesson, we will study one approach to design DB, the entity relationship model, how to create an ER model and map them to relational model
Lesson topic	1. Introduction 2. How to create an ERD 3. Mapping from ERD to relational schema
Learning Goals	Upon completion of this lesson, students will be able to: 1. Know what entity relationship model is 2. Know how to create an ERD from a real-world problem 3. Tranform from ERD to relational schema

Intro > Keywords

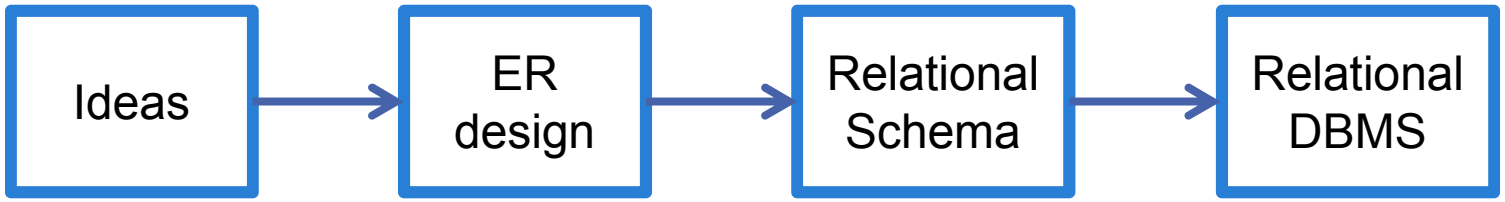
Keyword	Description
ERD	Entity Relationship Diagram
Entity	is a *thing* in the real world with an independent existence
Entity Set	a collection of similar entities forms an entity set
Attributes	are properties of the entities
key	One or more attributes whose values are distinct for each individual entity in the entity set
Relationships	are connections among two or more entity sets
Mapping from ERD to Relational schema	Create relations from ERD

Lesson > Topic 1: Introduction

- 1.1. Introduction
- 1.2. Entity sets
- 1.3. Attributes
- 1.4. Key
- 1.5. 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 (cont.)

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

1.2. Entity sets

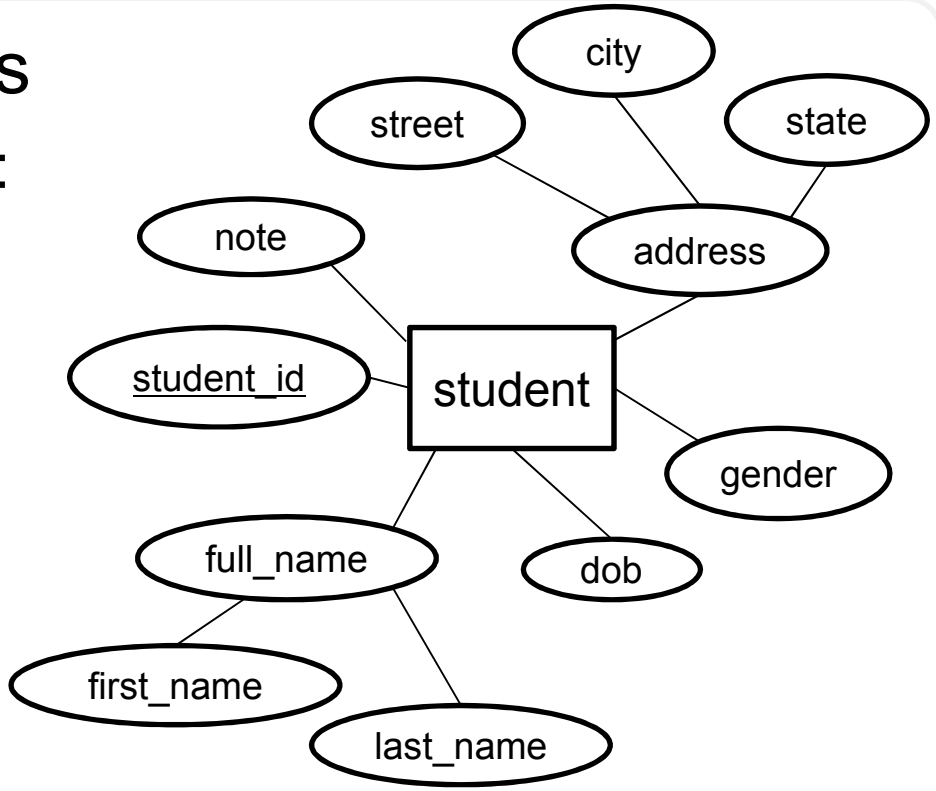
- Entity:
  - is a *thing* in the real world with an independent existence.
  - An entity may be an object with a physical existence (a particular person, car, house, or employee) or it may be an object with a conceptual existence (a company, a job, or a university course)
- Entity sets:
  - a collection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

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.
- Value Domain of attributes
  - 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)}

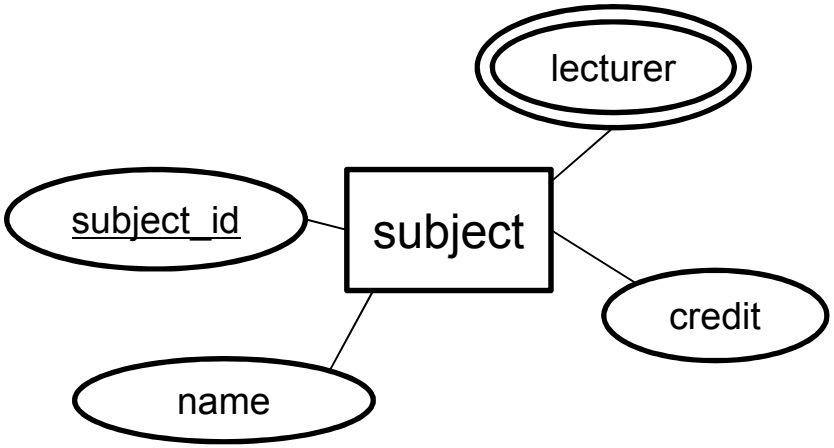
1.3. Attributes (cont.)

- 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.



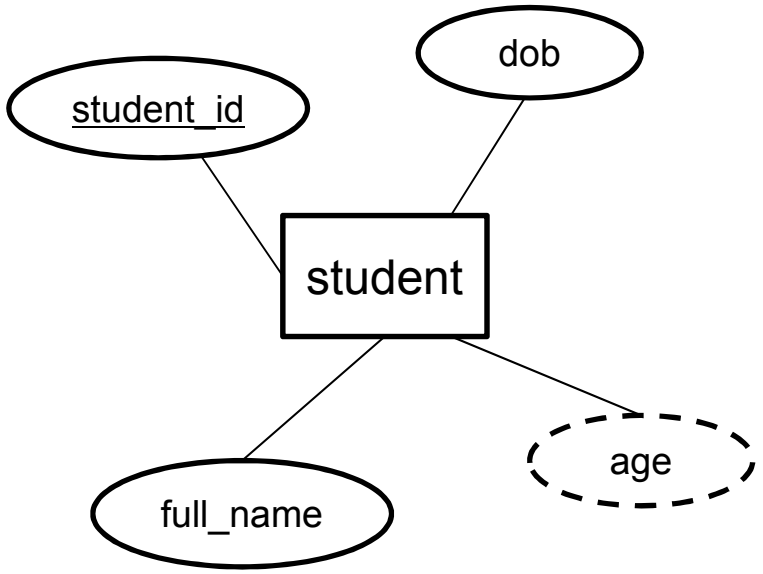
1.3. Attributes (cont.)

- 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 (cont.)

- 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.



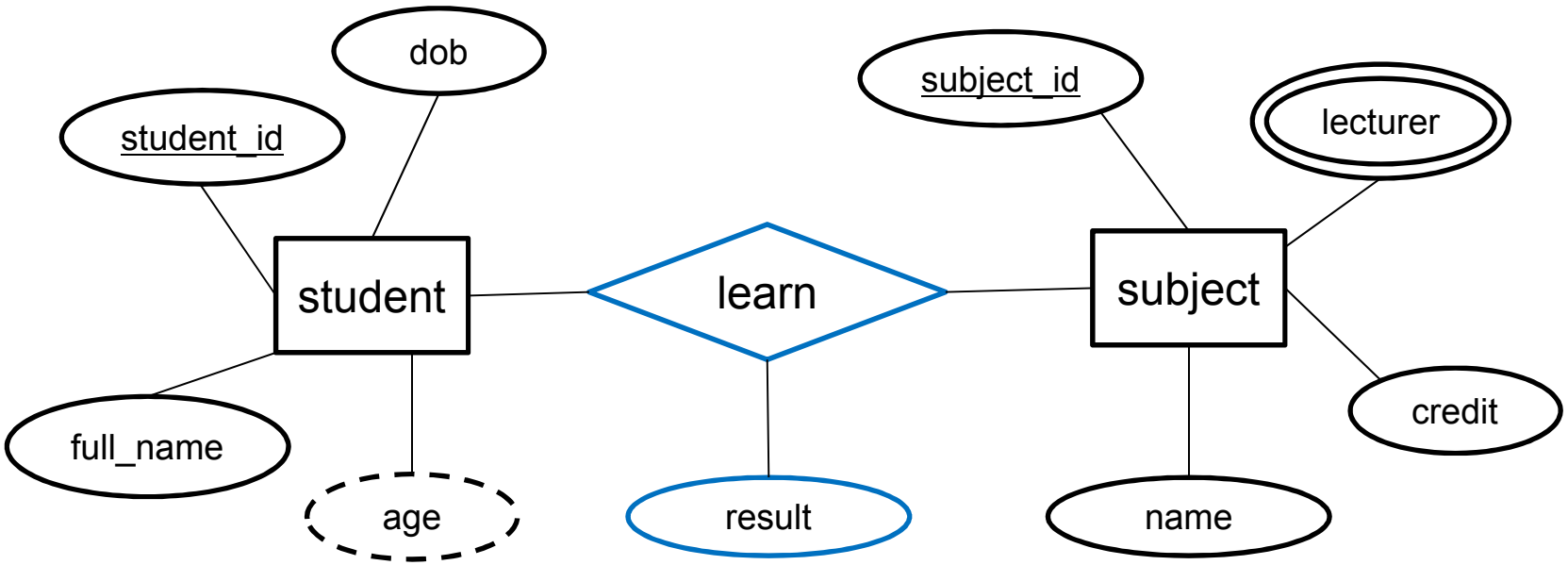
1.4. Key

- 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

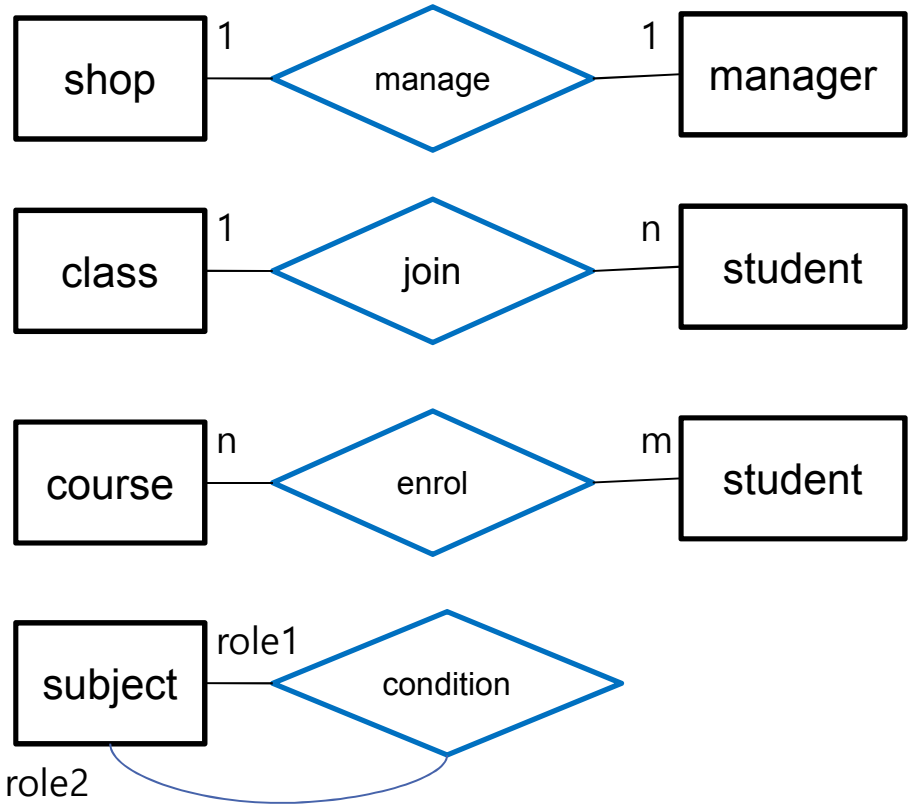
- Relationships are connections among two or more entity sets.
- In ER diagrams, relationship types are displayed as diamond-shaped boxes, which are connected by straight lines to the rectangular boxes representing the participating entity types. The relationship name is displayed in the diamond-shaped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

1.5. Relationships (cont.)



1.5. Relationships (cont.)

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



Lesson > Topic 2: How to create an ERD

- 2.1. Steps
- 2.2. An example

2.1. Steps

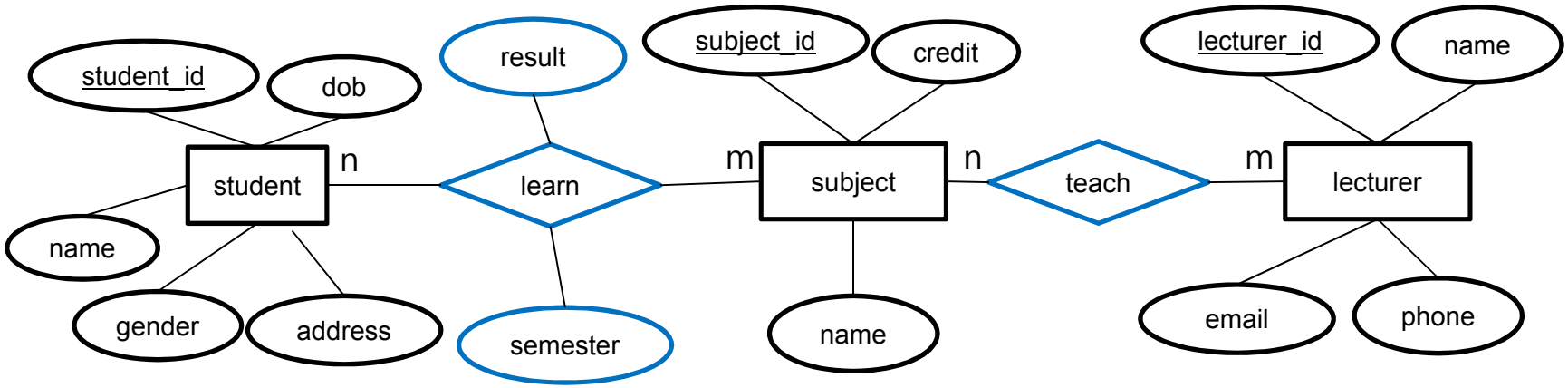
- Step 1: Identify all entity sets
  - Notice concepts, nouns
- Step 2: Identify all relationships among entity sets
  - Notice verbs
  - Type and degree of relationships

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. 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 (cont.)

- We can draw this ER diagram



Lesson > Topic 3: Mapping from ERD to relational schema

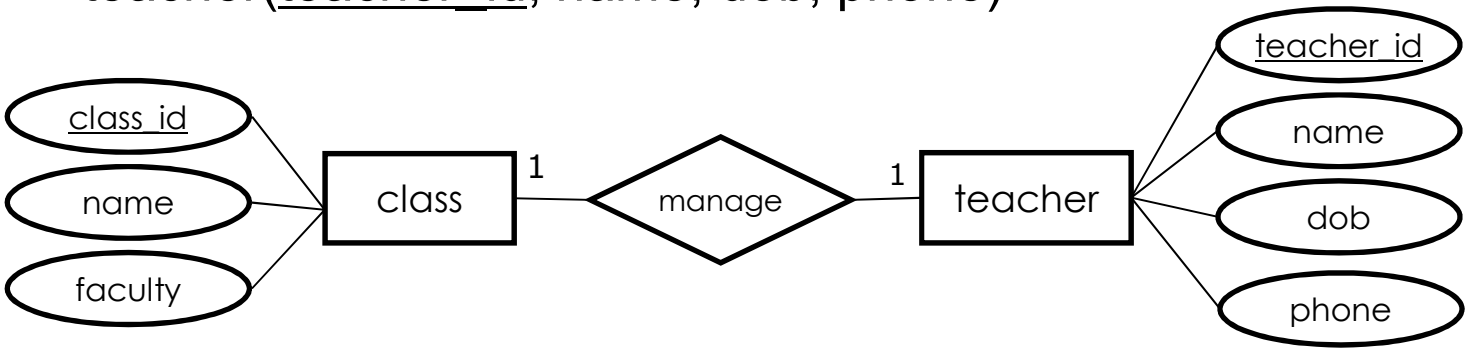
- 3.1. Steps
- 3.2. An example

3.1. Steps

- Mapping of 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)

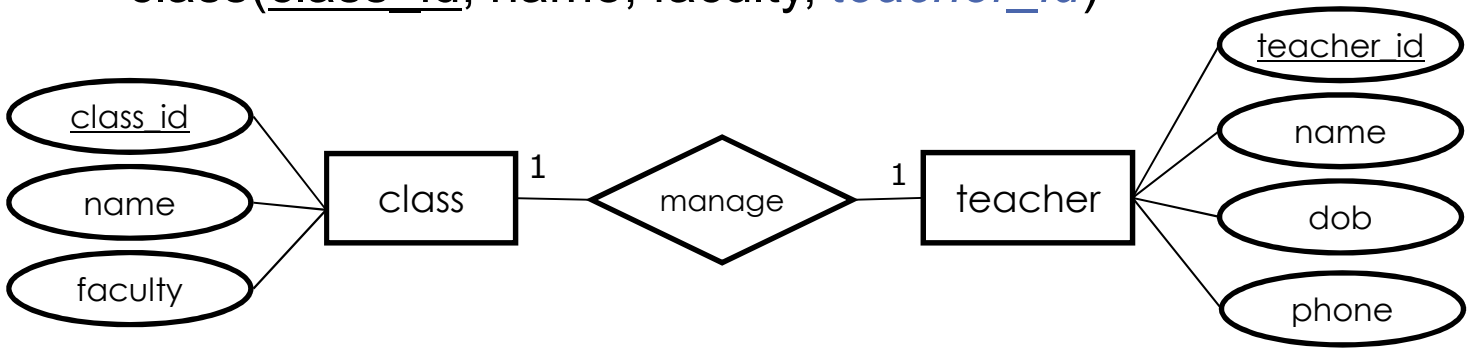


3.1. Steps (cont.)

- Mapping of 1 - 1 relationships
  - Create a new relation which has all prime-attributes of both entity sets

    manage(<u>class_id, teacher_id</u>)
  - Use foreign key

    class(<u>class_id</u>, name, faculty, *teacher_id*)

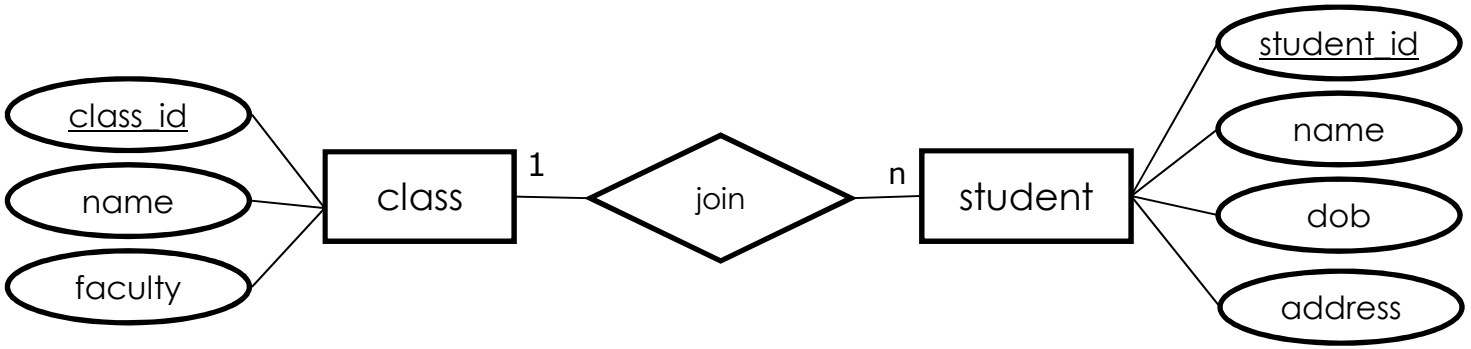


3.1. Steps (cont.)

- Mapping of 1 - n relationships
  - Create a new relation which has all prime-attributes of both entity sets

    join(<u>class_id, student_id</u>)
  - Use foreign key

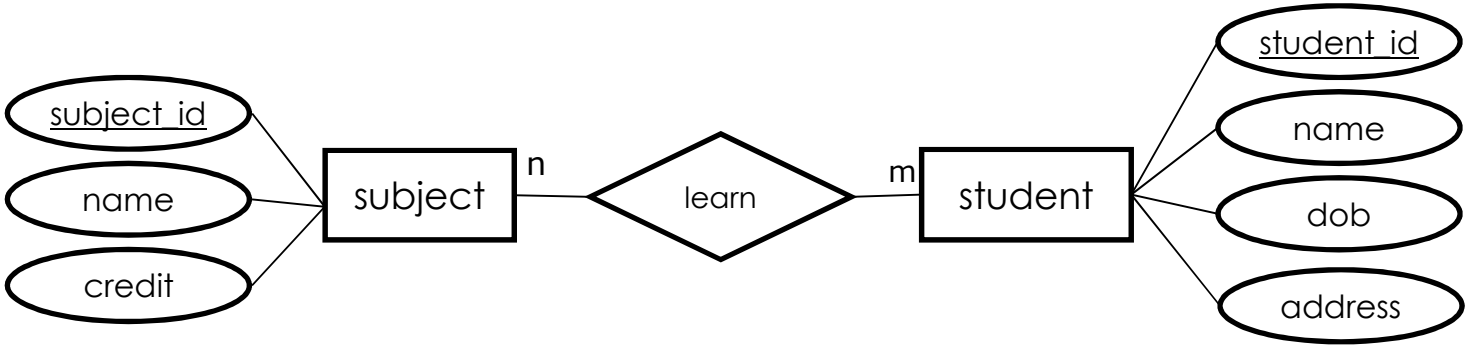
    student(<u>student_id</u>, name, dob, address, *class_id*)



3.1. Steps (cont.)

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

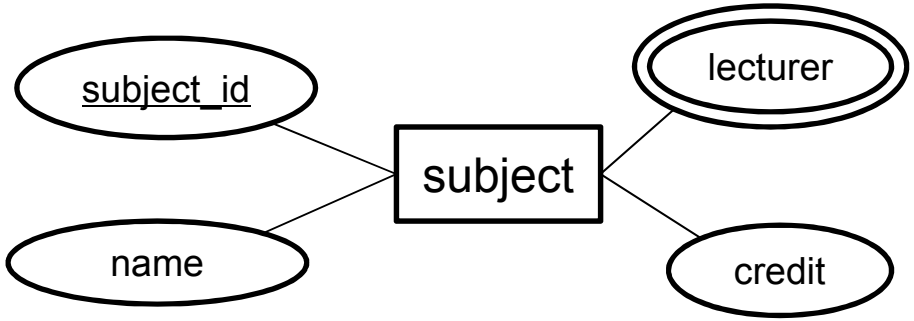
    learn(subject_id, student_id)



3.1. Steps (cont.)

- 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. An 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)

Remarks

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

Quiz

No	Question (Multiple Choice)	Answer (1,2,3,4)	Commentary
1	How many kinds of relationship have we just studied? 1. 1 2. 2 3. 3 4. 4	4	1-1, 1-n, n-m, recursive
2	What is the type of attributes denoted by double ovals in ERD? 1. Multivalued attributes 2. Atomic attributes 3. Composite attributes 4. Derived attributes	1	Reaction rate: $\frac{1}{6}\frac{d[CO_2]}{dt} = -\frac{1}{2}\frac{d[C_3H_6]}{dt}$ Formation rate of CO_2: $R_{CO_2} = \frac{d[CO_2]}{dt}$ Consumption rate of C_3H_6 $R_{C_3H_6} = -\frac{d[C_3H_6]}{dt}$
3			

Outro > Summary

No	Topic	Summary
1		
2		
3		
4		

→You have just learnt the following topics:
ERD: an approach to DB designing

Entity sets, attributes, key, relationships
How to create an ERD
Mapping from ERD to relational schema

Next lesson:

Functional Dependency