Entity Relationship Model

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Outline

- Introduction
- How to create an ERD
- Mapping from ERD 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 ERD from a real-world problem
  - Transform from ERD into relational schema

1. Introduction
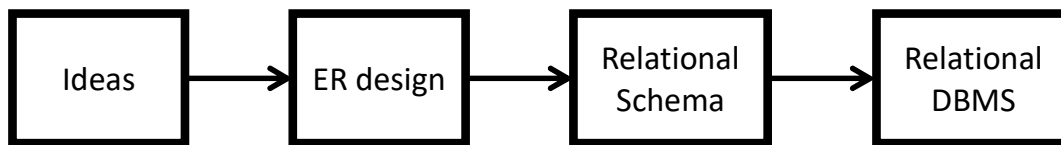
1. Introduction
2. Entity sets
3. Attributes
4. Key
5. Relationships

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

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[ Ideas ] → [ ER design ] → [ Relational Schema ] → [ Relational DBMS ]
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1.1. Introduction

- The structure of data is represented graphically: ERD
- 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.

  student

- 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.
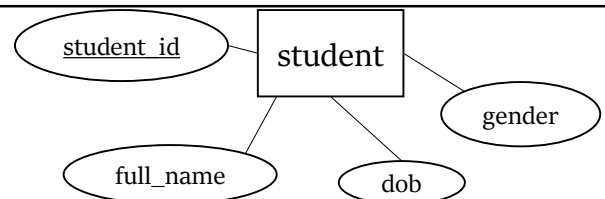- In ERD, rectangular boxes represent for entity sets

1.3. Attributes

student_id student gender

full_name dob

- 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 ERD, 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)}.
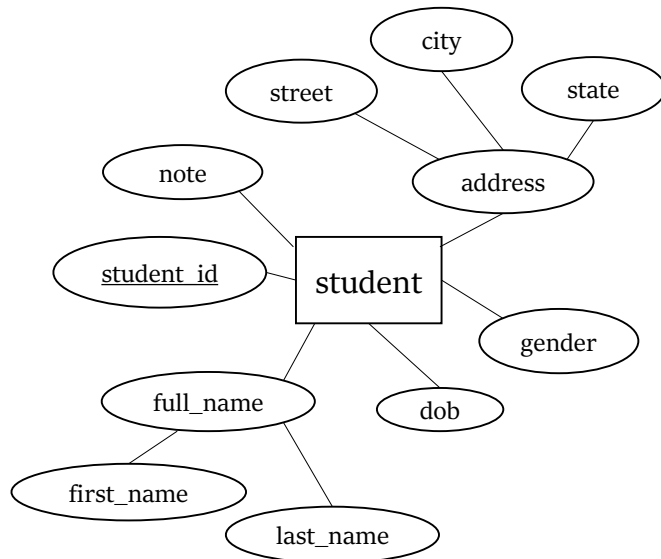
1.3. Attributes

- 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.
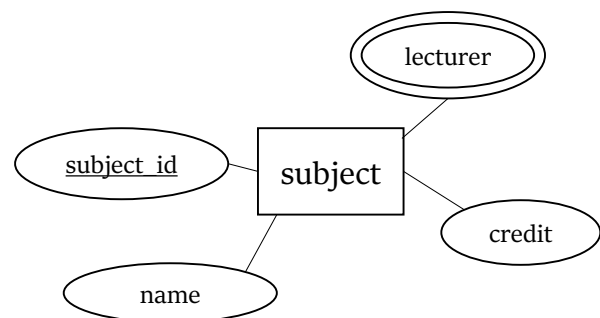

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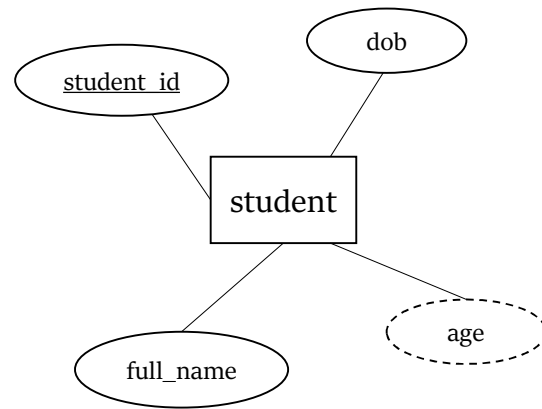
1.3. Attributes

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

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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.
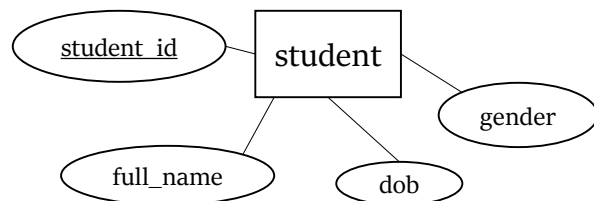
1.4. Key

- 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.
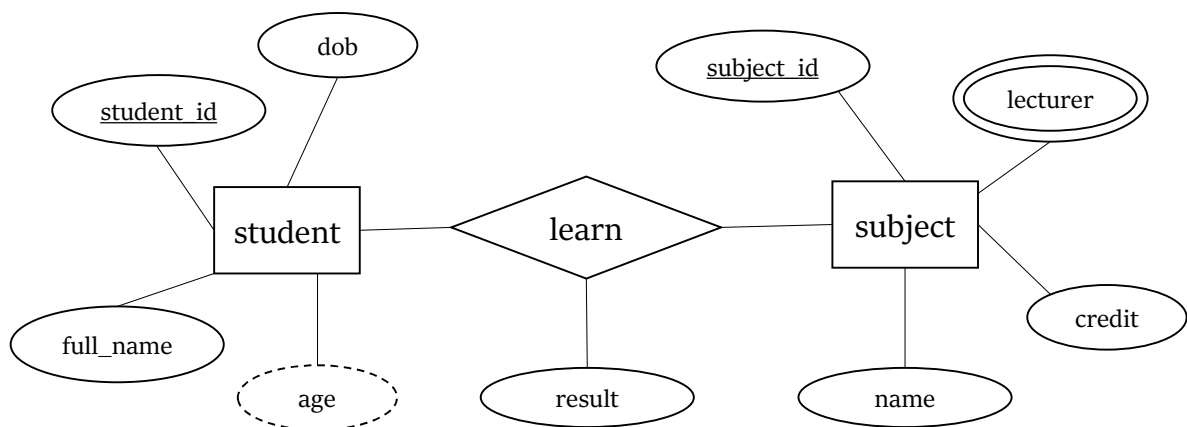
1.5. Relationships

- 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.
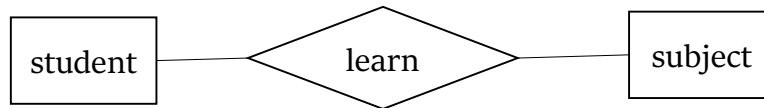
1.5. Relationships
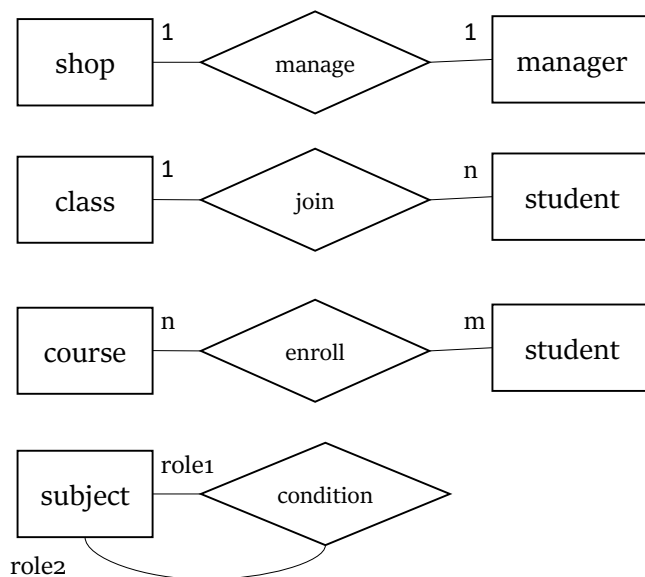
Relational schema(s)

- learn(student_id, full_name, dob, subject_id, name, lecturer, credit)

- Subject_lecturer(<u>subject_id, lecturer</u>)

- student(student_id, full_name, dob, age, subject_id)
- subject(subject_id, name, credit, lecturer)

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1.5. Relationships

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

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2. How to create an ERD

1. ERD process
2. Example

2.1. ERD 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
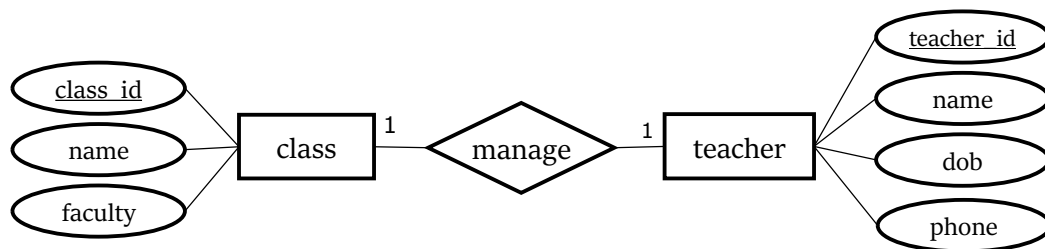
3. Mapping from ERD to relational schema

1. Mapping process
2. 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)

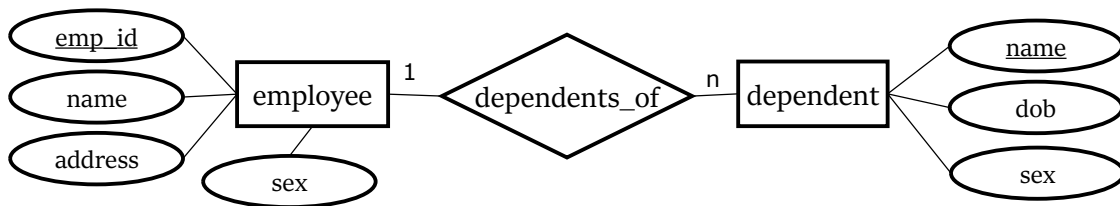 teacher(teacher_id, name, dob, phone)

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

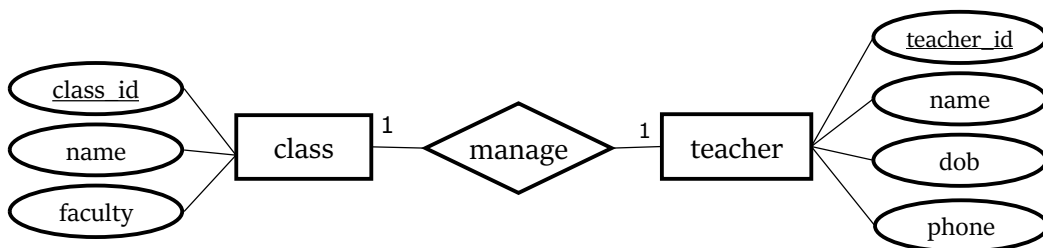 dependent(emp_id, name, dob, sex)

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

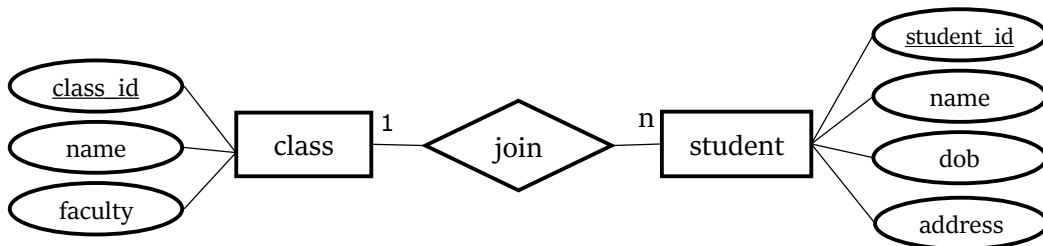 class(class_id, name, faculty, teacher_id)

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
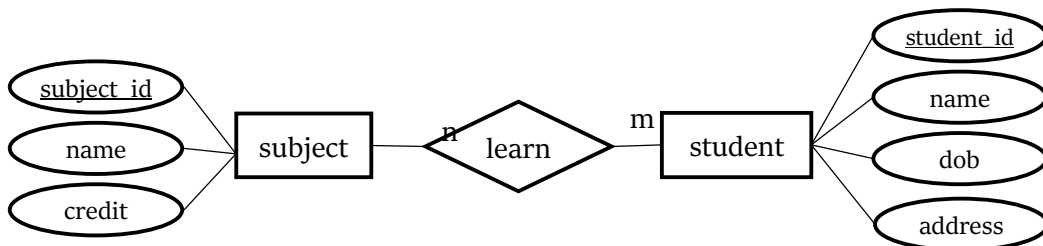 student(student_id, name, dob, address, class_id)

3.1. Mapping process

- Mapping of n - m relationships
  - Create a new relation which has all prime-attributes of both entity sets
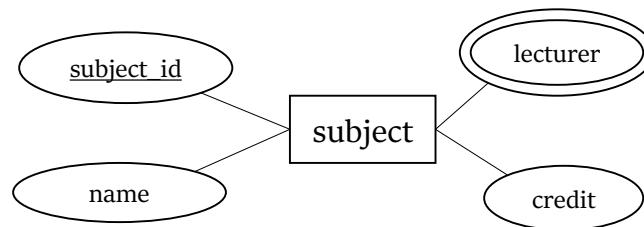 learn(subject_id, student_id)

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

Remark

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

Quiz 1.

Quiz Number	1	Quiz Type	OX	Example Select
Question	How many kinds of relationship have we just studied?			
Example	A. 1 B. 2 C. 3 D. 4			
Answer				
Feedback	1-1, 1-n, n-m, recursive			

Quiz 2.

Quiz Number	2	Quiz Type	OX	Example Select
Question	What is the type of attributes denoted by double ovals in ERD?			
Example	A. Multivalued attributes B. Atomic attributes C. Composite attributes D. Derived attributes			
Answer				
Feedback				

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