



ER Diagram

Keys

- A **super key** of an entity set is a set of one or more attributes whose values uniquely determine each entity
- A **candidate key** of an entity set is a minimal **super key**
 - **customer-id** is candidate key of **customer**
 - **account-number** is candidate key of **account**
- Although several **candidate keys** may exist, one of the **candidate keys** is selected to be the **primary key**
- **Primary keys** provide a way to specify how entities and relations are distinguished
- We will consider:
 - Entity sets
 - Relationship sets
 - Weak entity sets

Primary Key for Entity Sets

- By definition, individual entities are distinct
- From database perspective, the differences among them must be expressed in terms of their attributes
- The values of the attribute values of an entity must be such that they can uniquely identify the entity
 - No two entities in an entity set are allowed to have exactly the same value for all attributes
- A **key** for an entity is a set of attributes that suffice to distinguish entities from each other

Primary Key for Relationship Sets

- To distinguish among the various relationships of a relationship set we use the individual **primary keys** of the entities in the relationship set
 - Let ***R*** be a relationship set involving entity sets ***E1, E2, ..., En***
 - The primary key for ***R*** consists of the union of the primary keys of entity sets ***E1, E2, ..., En***
 - If the relationship set ***R*** has attributes ***a1, a2, ..., am*** associated with it, then the **primary key** of ***R*** also includes the attributes ***a1, a2, ..., am***
- Example: relationship set ***advisor***
 - The **primary key** consists of ***instructor.ID*** and ***student.ID***
- The choice of the **primary key** for a relationship set depends on the mapping cardinality of the relationship set

Choice of Primary Key for Binary Relationship

- **Many-to-Many relationships:** The preceding union of the **primary keys** is a minimal **super key** and is chosen as the **primary key**
- **One-to-Many relationships:** The **primary key** of the *many* side is a minimal **super key** and is used as the **primary key**
- **Many-to-one relationships:** The **primary key** of the *many* side is a minimal **super key** and is used as the **primary key**
- **One-to-one relationships:** The **primary key** of either one of the participating entity sets forms a minimal **super key**, and either one can be chosen as the **primary key**

Weak Entity Sets

- Consider a **section** entity, which is uniquely identified by a **course_id**, **semester**, **year**, and **sec_id**
- Clearly, **section** entities are related to **course** entities
- Suppose we create a relationship set **sec_course** between entity sets **section** and **course**
- Note that the information in **sec_course** is redundant, since **section** already has an attribute **course_id**, which identifies the **course** with which the **section** is related
- One option to deal with this redundancy is to get rid of the relationship **sec_course**
- However, by doing so the relationship between **section** and **course** becomes implicit in an attribute, which is not desirable



Weak Entity Sets

- An alternative way to deal with this redundancy is to not store the attribute **course_id** in the section entity and to only store the remaining attributes **section_id**, **year**, and **semester**
 - However, the entity set **section** then does not have enough attributes to identify a particular **section** entity uniquely
- To deal with this problem, we treat the relationship **sec_course** as a special relationship that provides extra information, in this case, the **course_id**, required to identify **section** entities uniquely
- A **weak entity** set is one whose existence is dependent on another entity, called its **identifying entity**
- Instead of associating a **primary key** with a **weak entity**, we use the **identifying entity**, along with extra attributes called **discriminator** to uniquely identify a **weak entity**
- An entity set that is not a **weak entity** set is termed a **strong entity set**
- Every **weak entity** must be associated with an identifying entity; that is, the **weak entity** set is said to be existence dependent on the **identifying entity** set
- The **identifying entity** set is said to own the **weak entity set** that it identifies
- The relationship associating the **weak entity** set with the **identifying entity** set is called the **identifying relationship**
- The relational schema we eventually create from the entity set section **does have** the attribute **course_id**, for reasons that will become clear later, even though we have dropped the attribute **course_id** from the entity set **section**

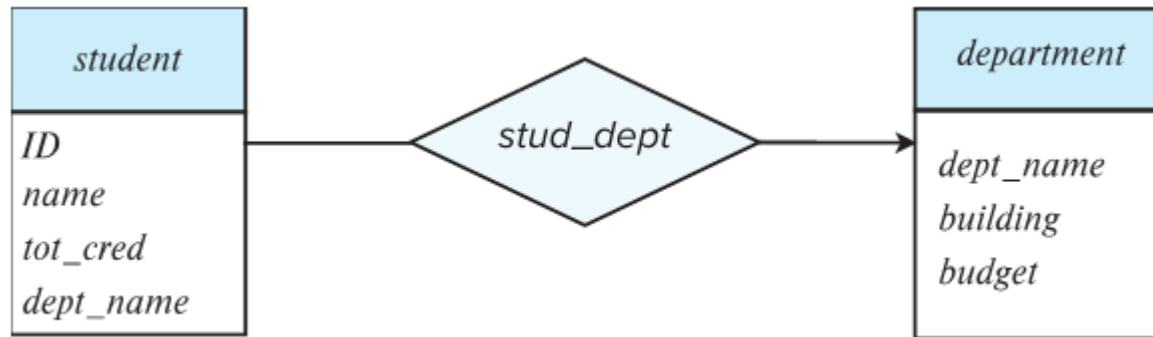
Expressing Weak Entity Sets

- In ER diagrams, a **weak entity** set is depicted via a double rectangle
- We underline the **discriminator** of a **weak entity** set with a dashed line
- The relationship set connecting the **weak entity** set to the **identifying strong entity** set is depicted by a double diamond
- The **primary key** for **section** is (**course_id**, **sec_id**, **semester**, **year**)

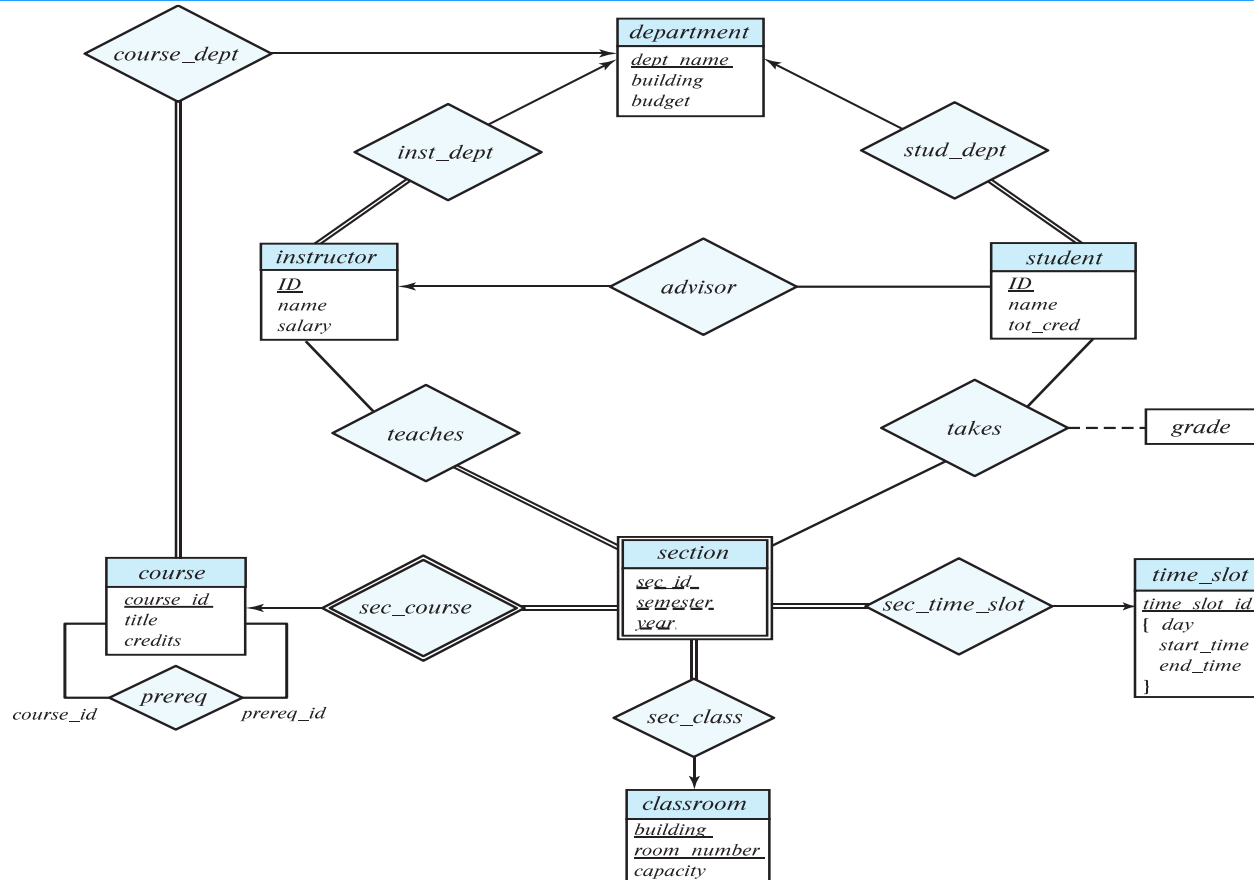


Redundant Attributes

- Suppose we have entity sets:
 - ***student*** (*ID*, *name*, *tot_cred*, *dept_name*)
 - ***department*** (*dept_name*, *building*, *budget*)
- We model the fact that each ***student*** has an associated ***department*** using a relationship set ***stud_dept***
- The attribute ***dept_name*** in ***student*** below replicates information present in the relationship and is therefore redundant
 - And needs to be removed
- BUT: when converting back to tables, in some cases the attribute gets reintroduced



ER Diagram for a University Enterprise



Next Lecture

ER Diagram to Relational Schemas

Thank you for your attention...

Any question?

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