IF2140 – Pemodelan Basis Data / IF2240 – Basis Data

Reducing E-R Diagrams to Relational Schemas

Modified form Silberschatz's slides, Database System Concept, 7th edition

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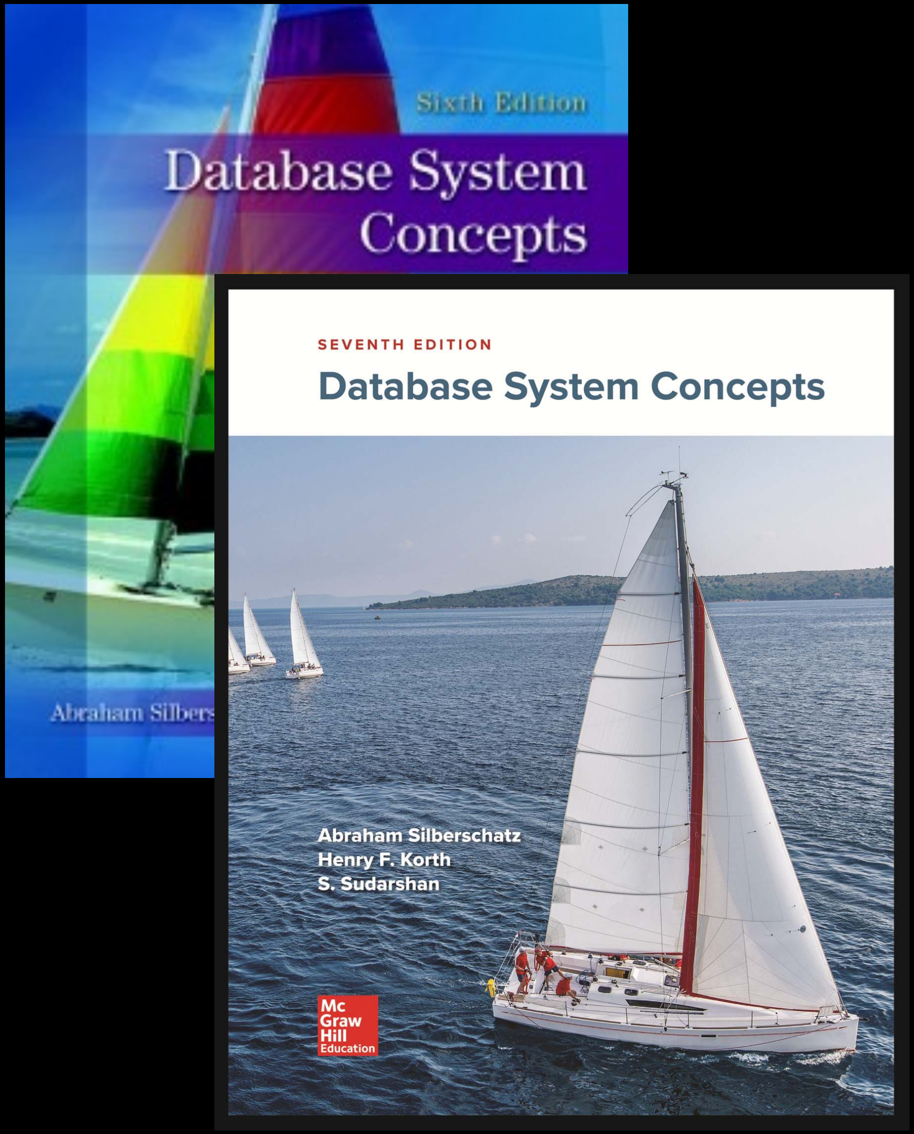

References

Abraham Silberschatz, Henry F. Korth, S. Sudarshan : "**Database System Concepts**", 6th Edition

- Chapter 7: Database Design and the E-R Model

Abraham Silberschatz, Henry F. Korth, S. Sudarshan : "**Database System Concepts**", 7th Edition

- Chapter 6: Database Design using E-R Model

Type of Mapping from ER to Relational Model

ER to Relational Mapping Algorithm:

- Mapping of Regular Entity Type
- Mapping of Weak Entity Type
- Mapping of Binary 1-1 Relationship
- Mapping of Binary 1-N Relationship
- Mapping of Binary M-N Relationship
- Mapping of Multivalued Attributes
- Mapping of N-ary Relationship

Mapping EER Model Constructs to Relations

- Options for mapping specialization or generalization
- Mapping of aggregation

Correspondence of Relational Model with E-R Model

Relations (tables) correspond with entity types and with many-to-many relationship types

Rows correspond with entity instances and with many-to-many relationship instances

Columns correspond with attributes

NOTE: The word ***relation*** (in relational database) is NOT the same as the word ***relationship*** (in E-R model)

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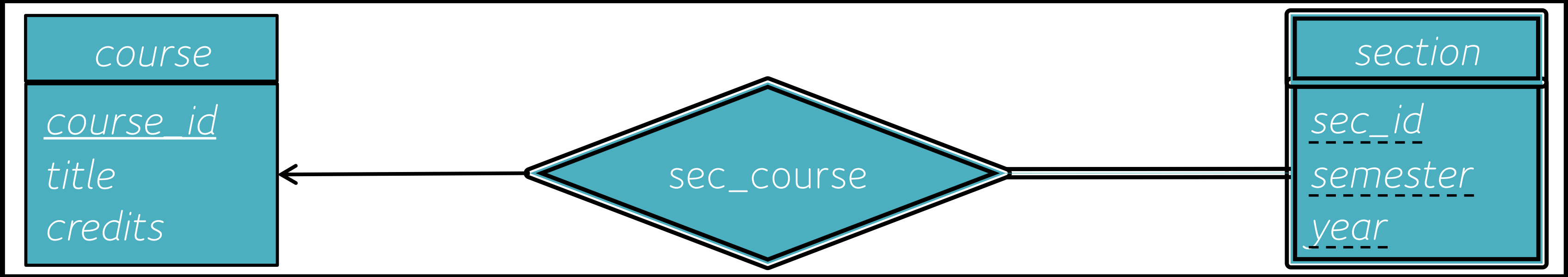
Representing Entity Sets

- A **strong entity** set reduces to a schema with the same attributes
- A **weak entity** set becomes a relation schema that includes a column for the primary key of the identifying strong entity set

Example:



Strong entity:
course (*course_id*, *title*, *credits*)

Weak entity:
section (*course_id*, *sec_id*, *sem*, *year*)

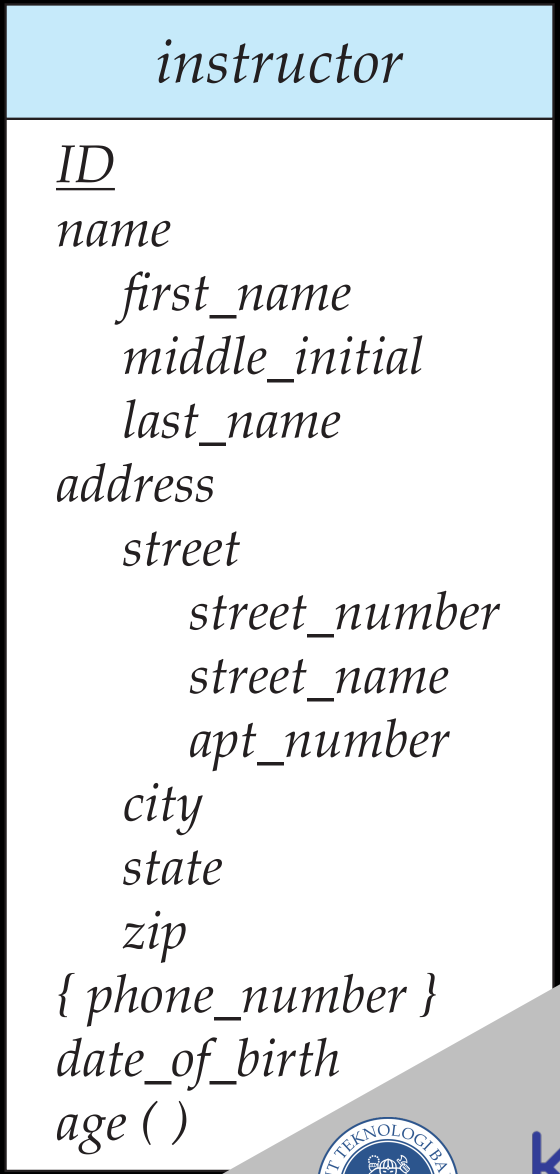
Representation of Entity Sets with Composite Attributes

Composite attributes are flattened out by creating a separate attribute for each component attribute

- Example: given entity set *instructor* with composite attribute *name* with component attributes *first_name* and *last_name* the schema corresponding to the entity set has two attributes *name_first_name* and *name_last_name*
  - Prefix omitted if there is no ambiguity (*name_first_name* could be *first_name*)

Ignoring multivalued attributes and omitted derived attributes, extended *instructor* schema is

instructor(<u>*ID*</u>,
first_name, middle_initial, last_name,
street_number, street_name,
apt_number, city, state, zip,
date_of_birth)



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Representation of Entity Sets with Multivalued Attributes

A multivalued attribute *M* of an entity *E* is represented by a separate schema *EM*

Schema *EM* has attributes corresponding to the primary key of *E* and an attribute corresponding to multivalued attribute *M*

Example: Multivalued attribute *phone_number* of *instructor* is represented by a schema:

inst_phone= (<u>*ID*</u>, <u>*phone_number*</u>)

Each value of the multivalued attribute maps to a separate tuple of the relation on schema *EM*

- For example, an *instructor* entity with primary key *22222* and phone numbers *456-7890* and *123-4567* maps to two tuples:
  (22222, 456-7890) and *(22222, 123-4567)*

instructor

<u>*ID*</u>
name
    first_name
    middle_initial
    last_name
address
    street
        street_number
        street_name
        apt_number
    city
    state
    zip
{ phone_number }
date_of_birth
age ( )

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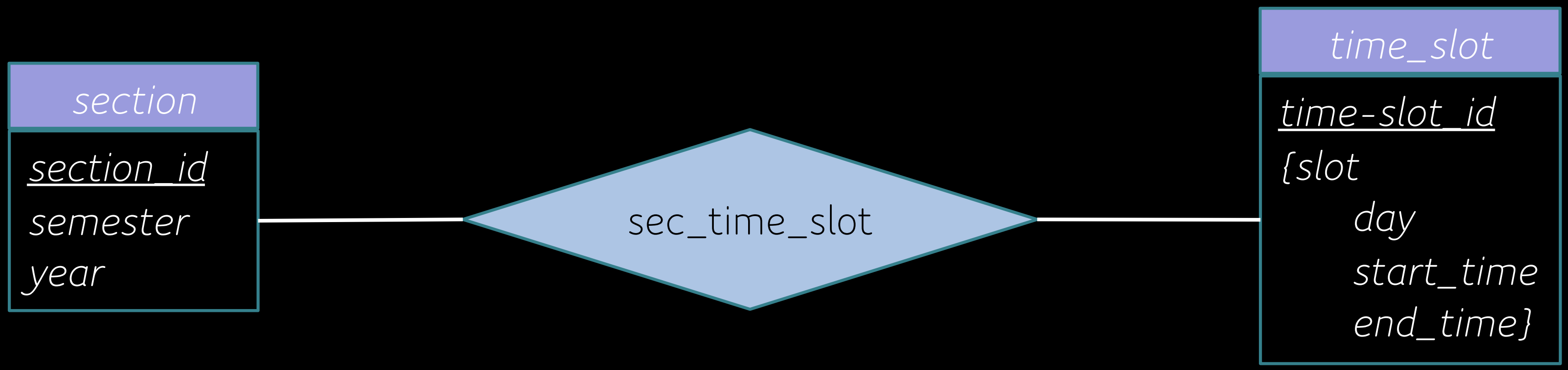
Multivalued Attributes – Special Case



Entity *time_slot* has only one attribute other than the primary-key attribute, and that attribute is multivalued

- Optimization: No need to create the relation corresponding to the entity, just create the one corresponding to the multivalued attribute
  - *time_slot = (time_slot_id, day, start_time, end_time)*
- Caveat: *time_slot* attribute of *section* (from *sec_time_slot*) cannot be a foreign key due to this optimization. Why?

Derived Attributes

Derived attributes are omitted, they are not implemented in the relational schema

- Derived attributes are presented using *views*

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Reducing E-R Diagrams to Relational Schemas – Representing Relationship Sets

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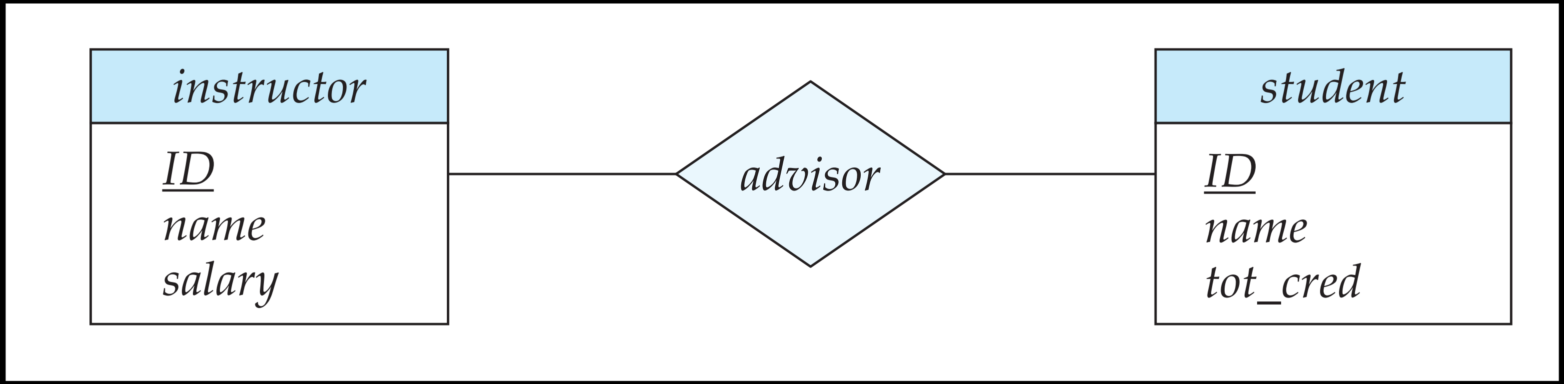
Representing Relationship Sets

A **many-to-many relationship** set is represented as a schema with attributes for the primary keys of the two participating entity sets, and any descriptive attributes of the relationship set.

Example: schema for relationship set *advisor*

Example:



Many-to-many relationship set:
advisor = (*s_id*, *i_id*)

Redundancy of Schemas

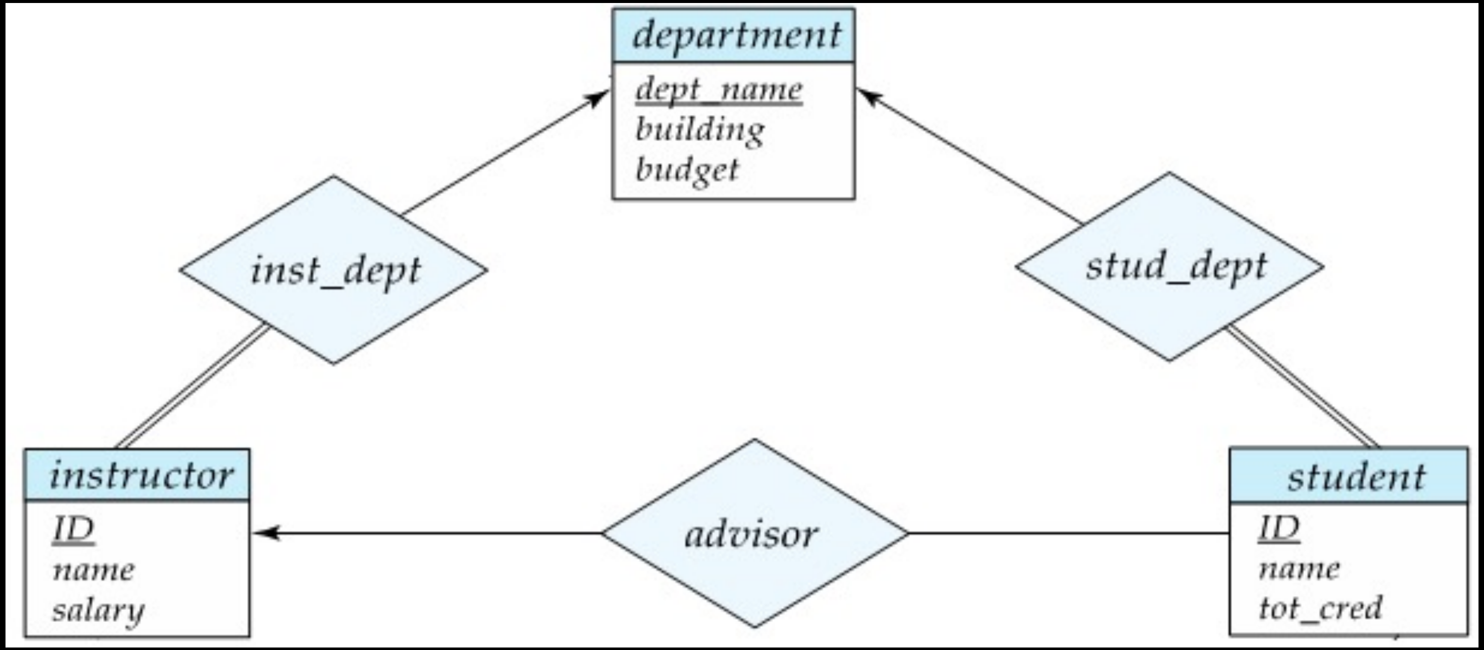
Many-to-one and one-to-many relationship sets that are total on the many-side can be represented by adding an extra attribute to the "many" side, containing the primary key of the "one" side

For one-to-one relationship sets, either side can be chosen to act as the "many" side

- That is, an extra attribute can be added to either of the tables corresponding to the two entity sets

If participation is partial on the "many" side, replacing a schema by an extra attribute in the schema corresponding to the "many" side could result in null value

Example:

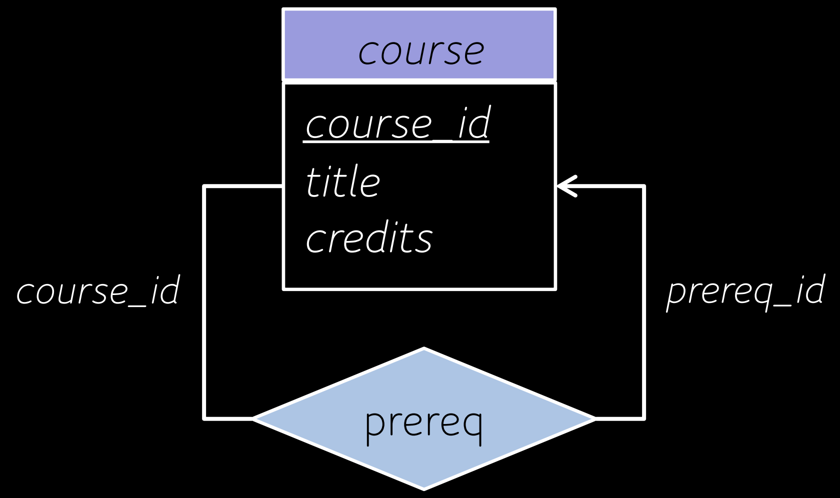


Example: Instead of creating a schema for relationship set *inst_dept*, add an attribute *dept_name* to the schema arising from entity set *instructor*

Instructor = (<u>ID</u>, name, salary, dept_name)

Representing Unary Relationship (1/2)

Example: One-to-Many: Recursive foreign key in the same relation



course = (*course_id*, *title*, *credits*, *prereq_id*)

prereq_id is the recursive foreign key that refers to primary key of *course* (*course_id*)

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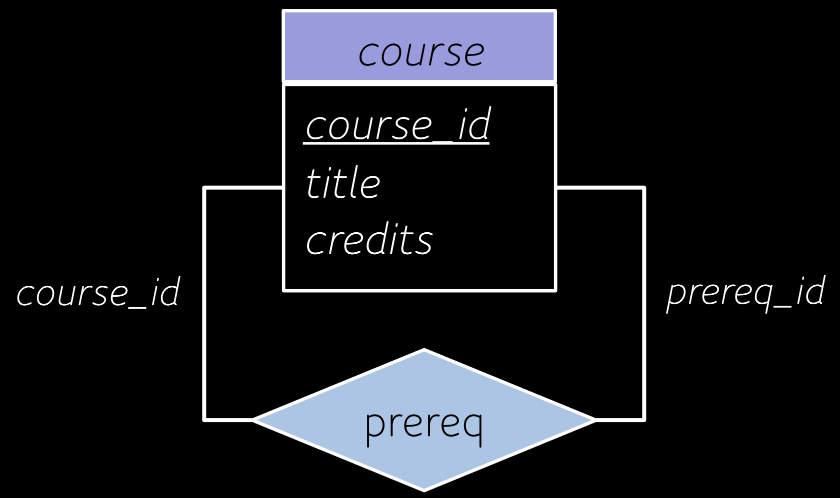
Representing Unary Relationship (2/2)

Many-to-Many: Two relations

- One for the entity set
- One for the relationship in which the primary key has two attributes, both taken from the primary key of the entity set



course = (*course_id, title, credits*)
prereq = (*course_id, prereq_id*)

course_id and *prereq_id* are both foreign keys that refer to primary key of *course* (*course_id*)

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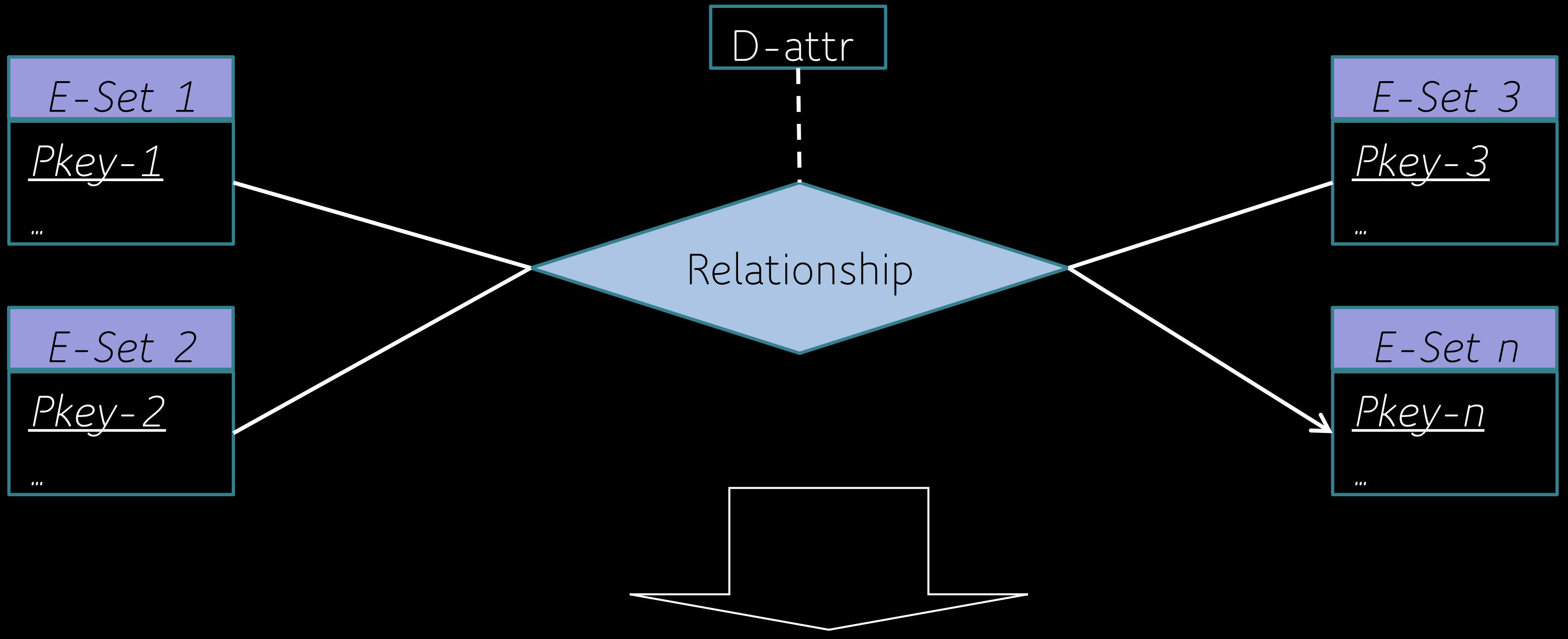
Representing Ternary (and n-ary) Relationships

One relation for each entity set and one for the relationship set

The relation from the relationship set has foreign keys to each entity set in the relationship set



Pkey 1	Pkey-2	Pkey-3	Pkey-n	D-attr
9999	8888	7777	6666	Yes
1234	5678	9012	3456	No

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Reducing E-R Diagrams to Relational Schemas – Extended Feature

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Representing Specialization via Schemas

Method 1:

- Form a schema for the higher-level entity
- Form a schema for each lower-level entity set, include primary key of higher-level entity set and local attributes

schema	attributes
person	ID, name, street, city
student	ID, tot_cred
employee	ID, salary

- <u>Drawback</u>: getting information about, an *employee* requires accessing two relations, the one corresponding to the low-level schema and the one corresponding to the high-level schema

Representing Specialization as Schemas (Cont.)

Method 2:

- Form a schema for each entity set with all local and inherited attributes

schema	attributes
person	ID, name, street, city
student	ID, name, street, city, tot_cred
employee	ID, name, street, city, salary

- If specialization is total, the schema for the generalized entity set not required to store information
  - Can be defined as a "view" relation containing union of specialization relations
  - But explicit schema may still be needed for foreign key constraints
- Drawback: *name, street* and *city* may be stored redundantly for people who are both students and employees

Reducing Aggregation to Relational Schemas

To represent aggregation, create a schema containing

- Primary key of the aggregated relationship,
- The primary key of the associated entity set
- Any descriptive attributes

In our example:

- The schema *eval_for* is:

  eval_for (s_ID, project_id, i_ID, evaluation_id)

- The schema *proj_guide* is redundant.