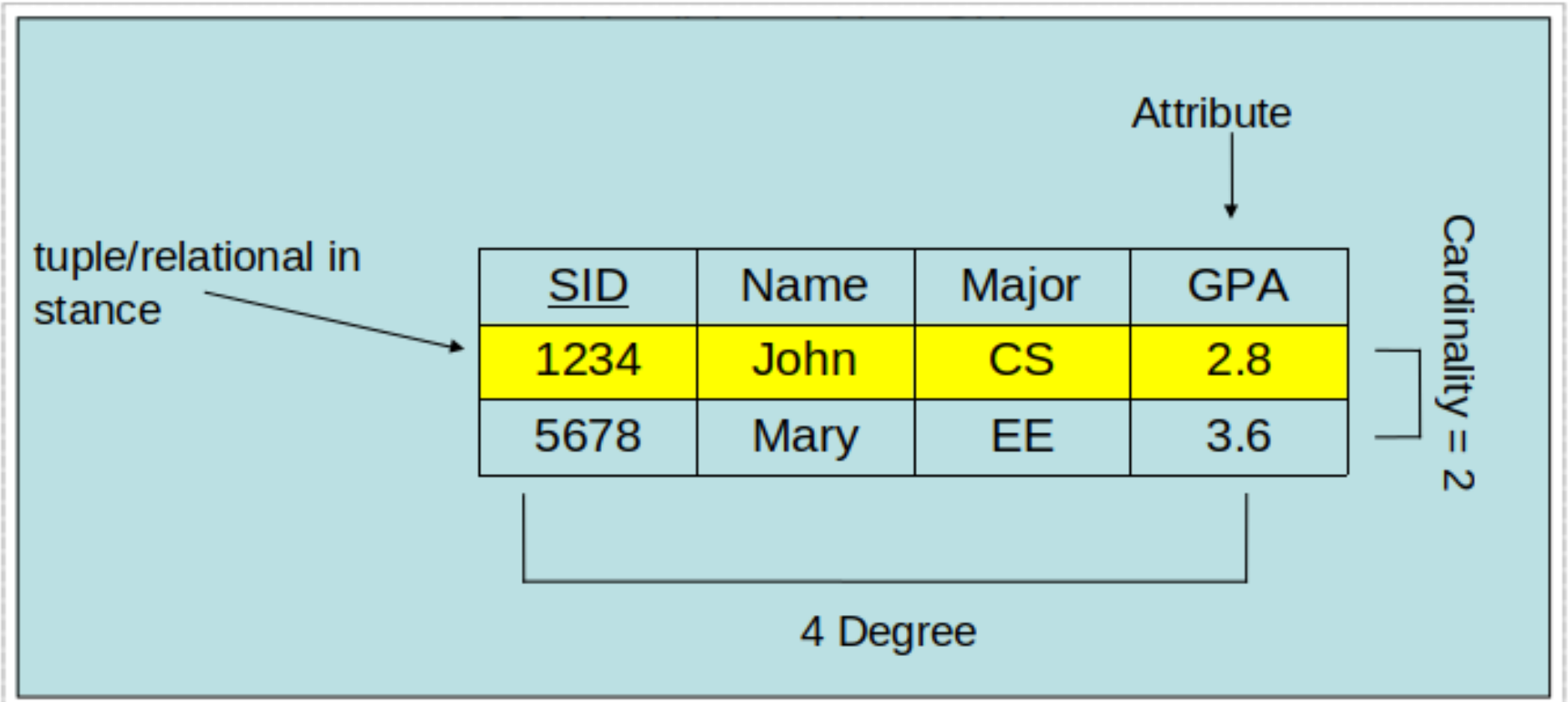
Reduction of E-R Diagram to Relational Schema

Relational Model is made up of tables

- A row of table = a relational instance/tuple
- A column of table = an attribute
- A table = a schema/relation
- Cardinality = number of rows
- Degree = number of columns

Review - Example



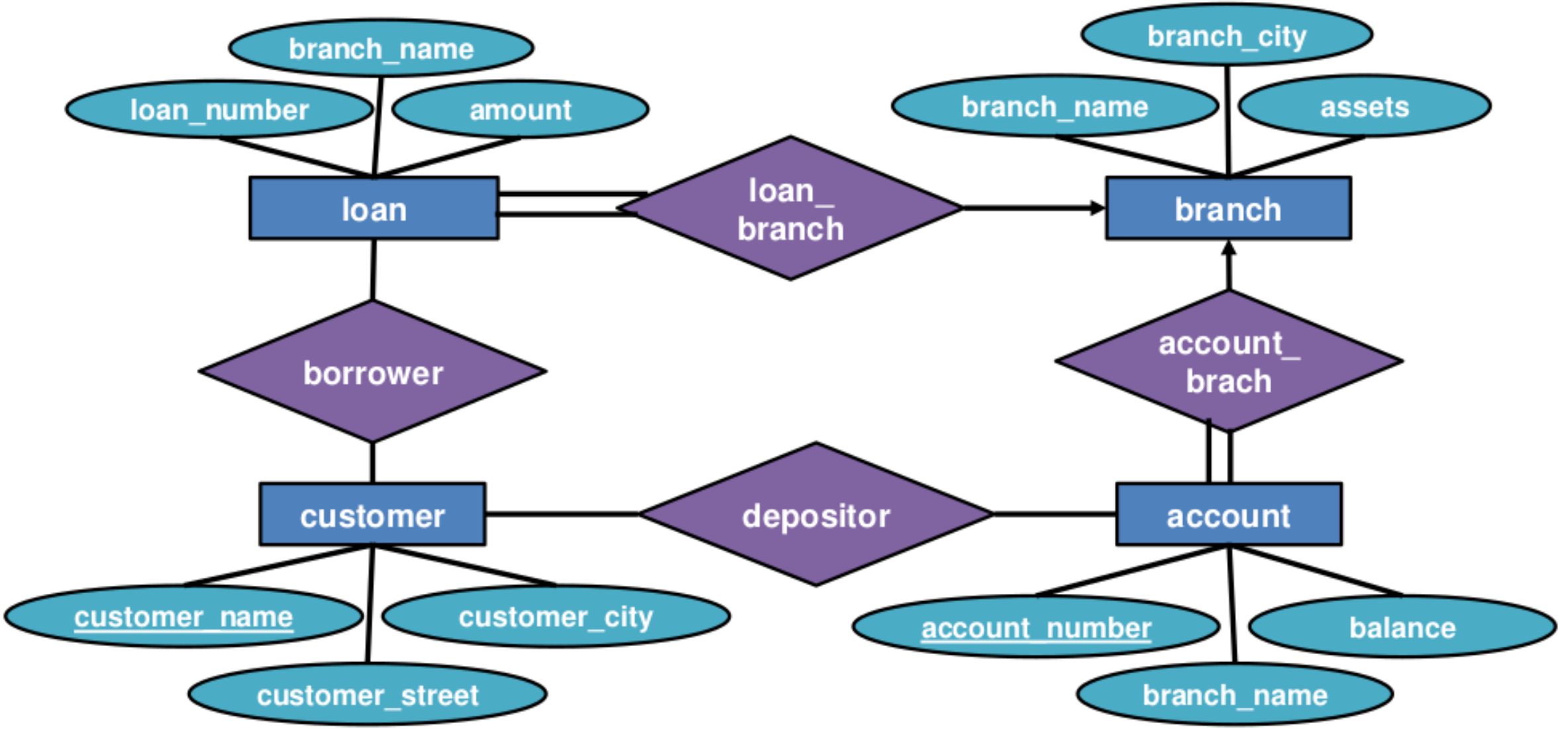
A Schema / Relation

From ER Model to Relational Model

Basic Ideas

- Build a table for each entity set
- Build a table for each relationship set if necessary (more on this later)
- Make a column in the table for each attribute in the entity set
- Indivisibility Rule and Ordering Rule
- Primary Key

E-R Diagram for Banking Example

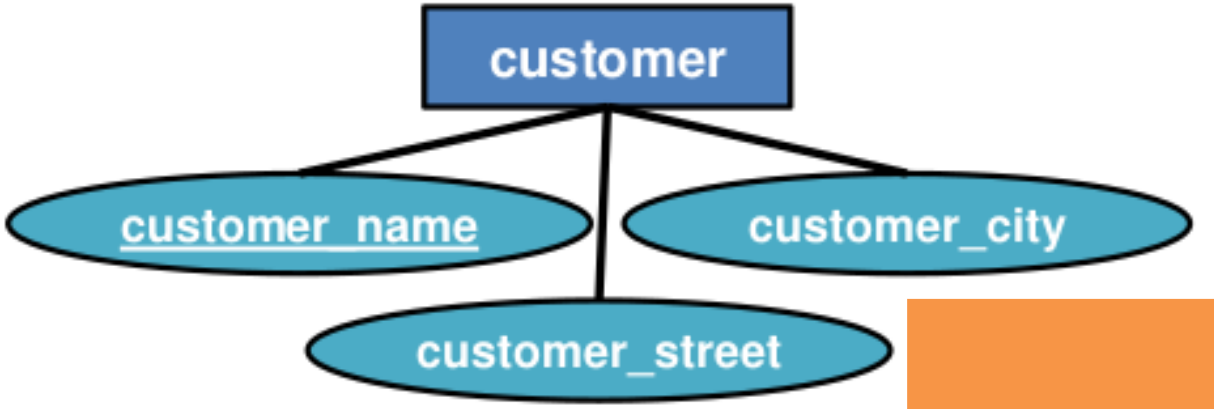


Reduction of an E-R Diagram to Relational Schemas

- **Representation of Strong Entity Sets**
  - ✓ Let *E* be a strong entity set with descriptive attributes *a*1, *a*2, . . . , *an*.
  - ✓ We represent this entity by a table called *E* with *n* distinct columns, each of which corresponds to one of the attributes of *E*. Each row in this table corresponds to one entity of the entity set *E*.

Reduction of an E-R Diagram to Relational Schemas

- **Representation of Strong Entity Sets**
  - ✓ Example



customer_name	customer_street	customer_city

The relation ***customer***

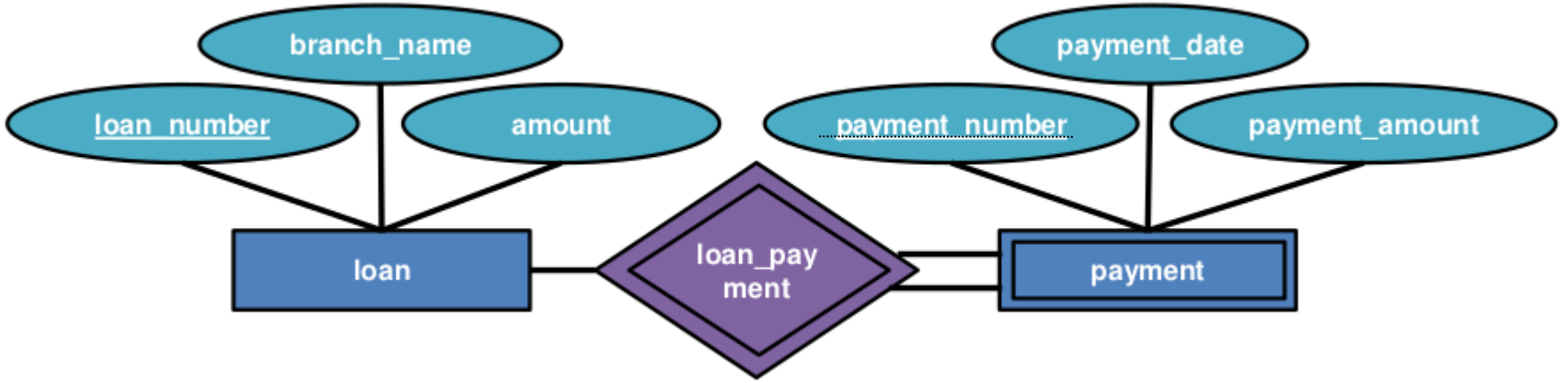
Reduction of an E-R Diagram to Relational Schemas

- **Representation of Weak Entity Sets**
  - ✓ Let *A* be a weak entity set with attributes *a*1, *a*2, . . . , *am*. Let *B* be the strong entity set on which *A* depends.
  - ✓ Let the primary key of *B* consist of attributes *b*1, *b*2, . . . , *bn*. We represent the entity set *A* by a table called *A* with one column for each attribute of the set:

    $\{a1, a2, \ldots, am\} \cup \{b1, b2, \ldots, bn\}$

Reduction of an E-R Diagram to Relational Schemas

- **Representation of Weak Entity Sets**
  - ✓ **Example**



loan_number	payment_number	payment_date	payment_amount

The relation *payment*

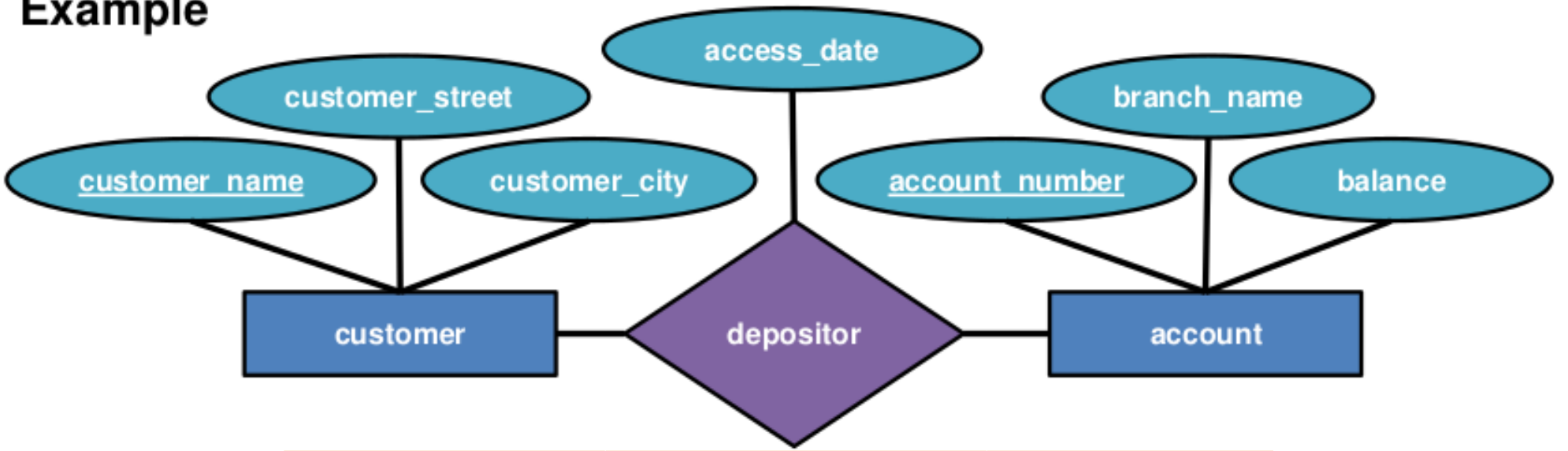
Reduction of an E-R Diagram to Relational Schemas

- **Tabular Representation of Relationship Sets**
  - ✓ Let R be a relationship set, let $a_1, a_2, \ldots, a_m$ be the set of attributes formed by the union of the primary keys of each of the entity sets participating in R, and let the descriptive attributes (if any) of R be $b_1, b_2, \ldots, b_n$.
  - ✓ We represent this relationship set by a table called R with one column for each attribute of the set:

    $\{a_1, a_2, \ldots, a_m\} \cup \{b_1, b_2, \ldots, b_n\}$

Reduction of an E-R Diagram to Relational Schemas

- **Tabular Representation of Relationship Sets**
  - ✓ **Example**



customer_name	account_number	access_date
The relation *depositor*		

Reduction of an E-R Diagram to Relational Schemas

- **Tabular Representation of Relationship Sets**
  - ✓ The **primary key** chosen as follows:
    - For binary **many-to-many** relationship, the union of the primary key attributes from the participating entity set become the primary key.
    - For binary **one-to-one** relationship set, the primary key of either entity set can be chosen as the primary key for the relationship.
    - For binary **one-to-many** or **many-to-one** relationship set, the primary key of entity set on the “many” side of the relationship set serves as the primary key for the relationship.

Representing Relationship Set
Unary/Binary Relationship

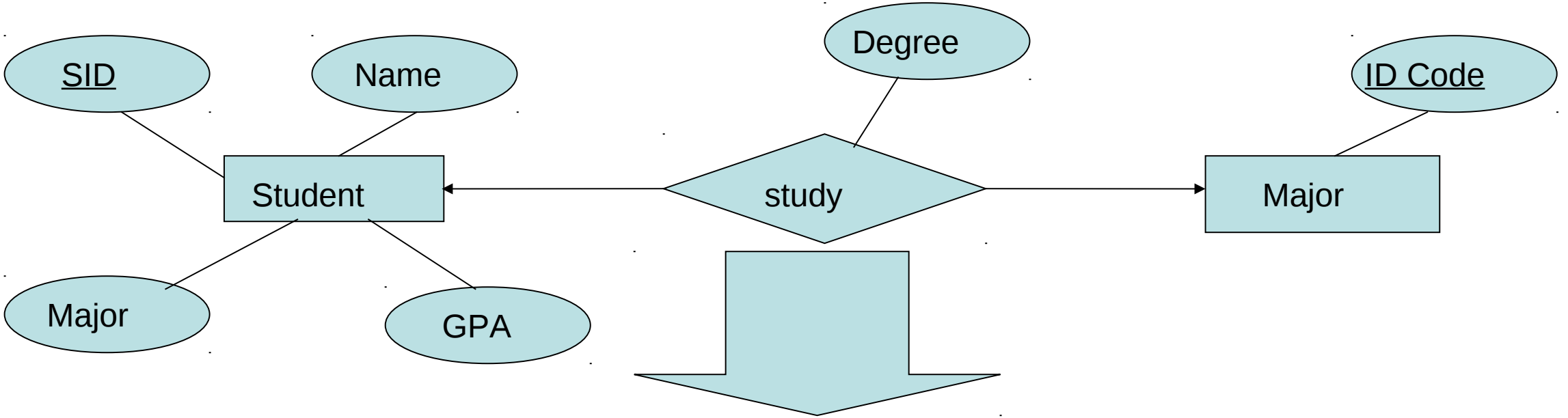
✓ For one-to-one relationship w/out total participation

Build a table with two columns, one column for each participating entity set's primary key. Add successive columns, one for each descriptive attributes of the relationship set (if any).

✓ For one-to-one relationship with one entity set having total participation

Augment one extra column on the right side of the table of the entity set with total participation, put in there the primary key of the entity set without complete participation as per to the relationship.

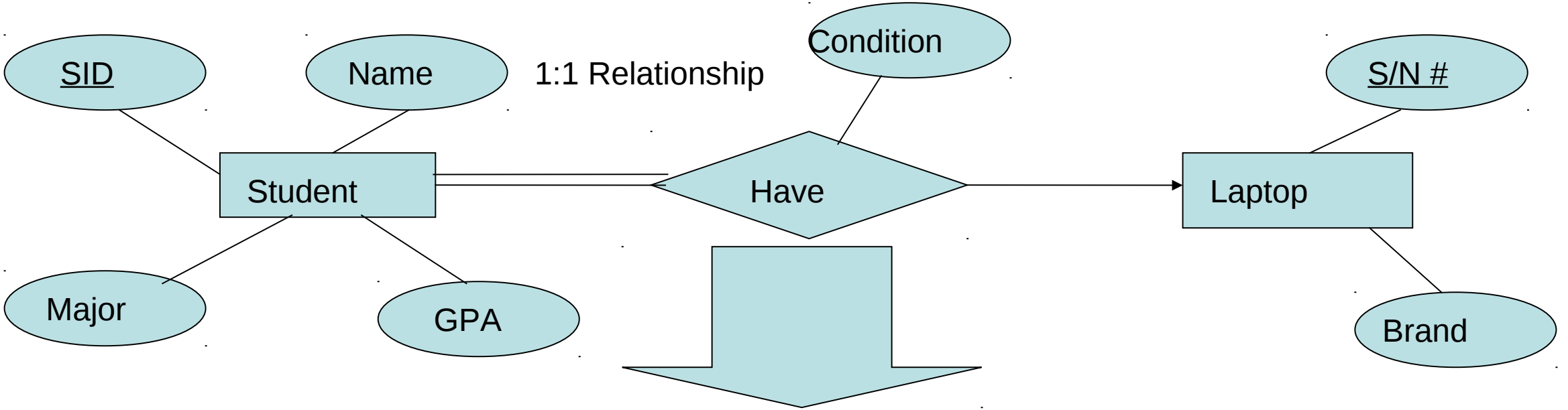
Example – One-to-One Relationship Set



SID	Maj_ID Co	S_Degree
9999	07	1234
8888	05	5678

* Primary key can be either *SID* or Maj_*ID_Co*

Example – One-to-One Relationship Set



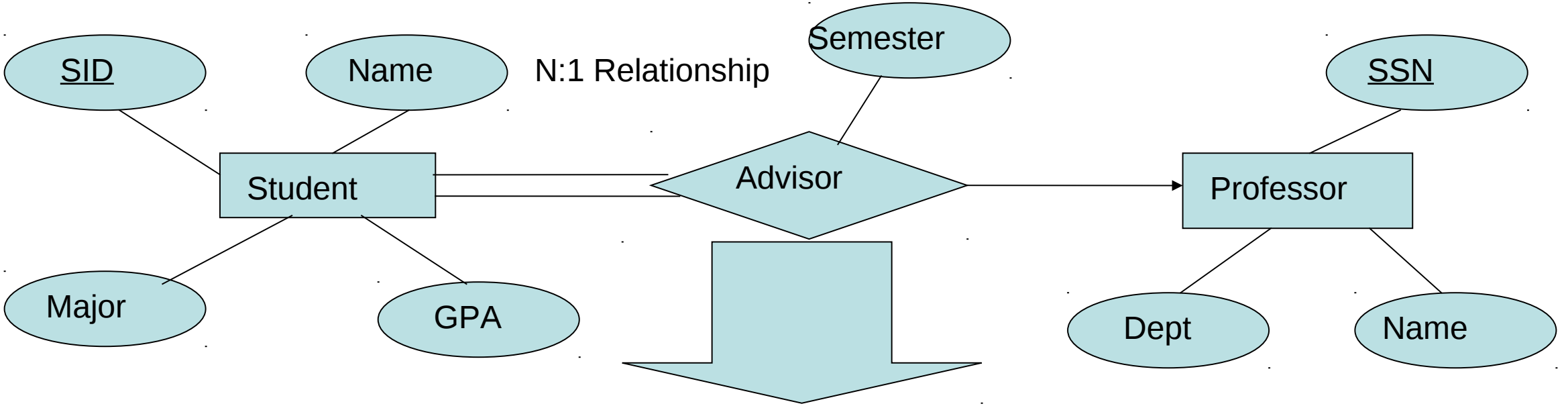
SID	Name	Major	GPA	LP_S/N	Hav_Cond
9999	Bart	Economy	-4.0	123-456	Own
8888	Lisa	Physics	4.0	567-890	Loan

* Primary key can be either *SID* or *LP_S/N*

Representing Relationship Set
Unary/Binary Relationship

- ✓ For one-to-many relationship w/out total participation
  - Same thing as one-to-one
- ✓ For one-to-many/many-to-one relationship with one entity set having total participation on “many” side
  - Augment one extra column on the right side of the table of the entity set on the “many” side, put in there the primary key of the entity set on the “one” side as per to the relationship.

Example – Many-to-One Relationship Set



SID	Name	Major	GPA	Pro_SSN	Ad_Sem
9999	Bart	Economy	-4.0	123-456	Fall 2006
8888	Lisa	Physics	4.0	567-890	Fall 2005

* Primary key of this table is *SID*

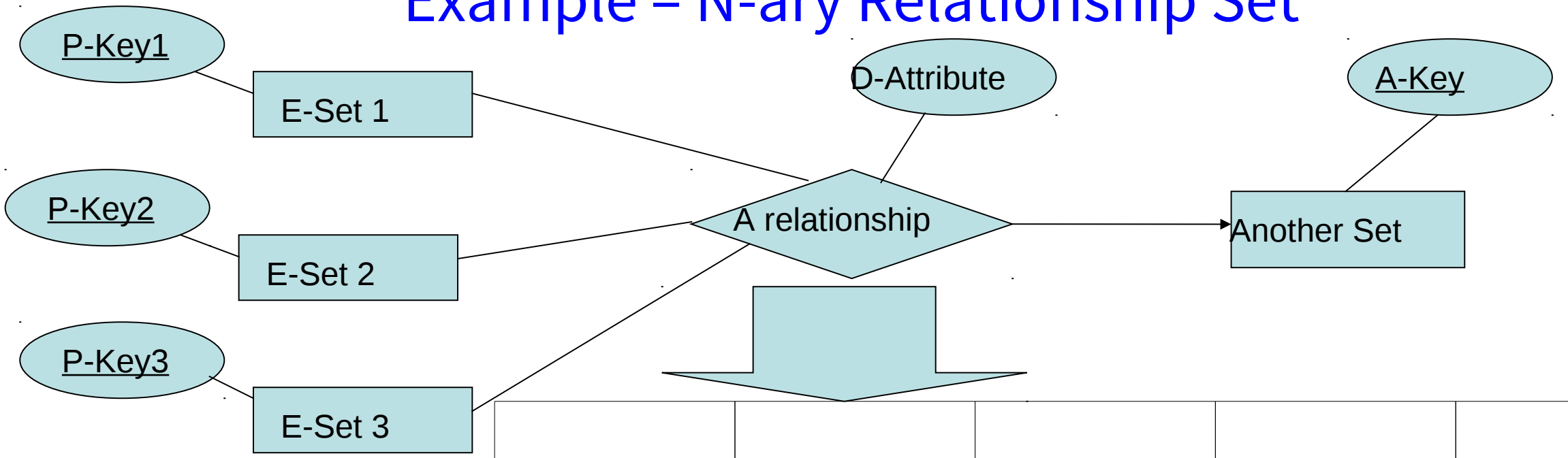
Representing Relationship Set
Unary/Binary Relationship

- ✓ For many-to-many relationship
  - Same thing as one-to-one relationship without total participation.
  - Primary key of this new schema is the union of the foreign keys of both entity sets.
  - No augmentation approach possible…

Reduction of an E-R Diagram to Relational Schemas

- **Tabular Representation of Relationship Sets**
  - ✓ The **primary key** chosen as follows:
    - For **n-ary** relationship sets without any arrow on its edge, the union of the primary key-attributes from the participating entity set become the primary key.
    - For **n-ary** relationship sets with any an arrow on one of its edge, the primary keys of an entity sets not on the arrow side of the relationship set serves as the primary key for the schema.

Example – N-ary Relationship Set



P-Key1	P-Key2	P-Key3	A-Key	D-Attribute
9999	8888	7777	6666	Yes
1234	5678	9012	3456	No

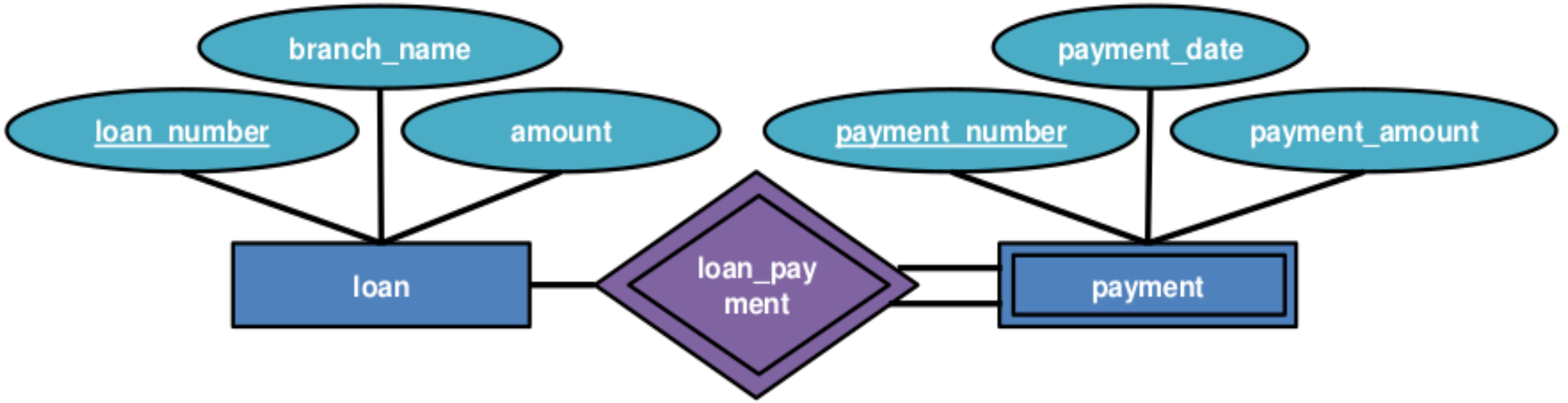
* Primary key of this table is *P-Key1 + P-Key2 + P-Key3*

Reduction of an E-R Diagram to Relational Schemas

- **Tabular Representation of Relationship Sets**
  - ✓ **Redundancy of Tables**
    - A relationship set linking a **weak entity set** to the corresponding **strong entity** is **many-to-one** and have no **descriptive attributes**.
    - The primary key of a **weak entity set** includes the primary key of the **strong entity set**.
    - The table for the relationship set linking a **weak entity set** to its corresponding **strong entity set** is redundant and does not need to be present in a tabular representation of an E-R diagram.

Reduction of an E-R Diagram to Relational Schemas

- **Tabular Representation of Relationship Sets**
  - ✓ **Redundancy of Tables**
    - **Example –** No need to represent the relation for identifying relationship *loan_payment*

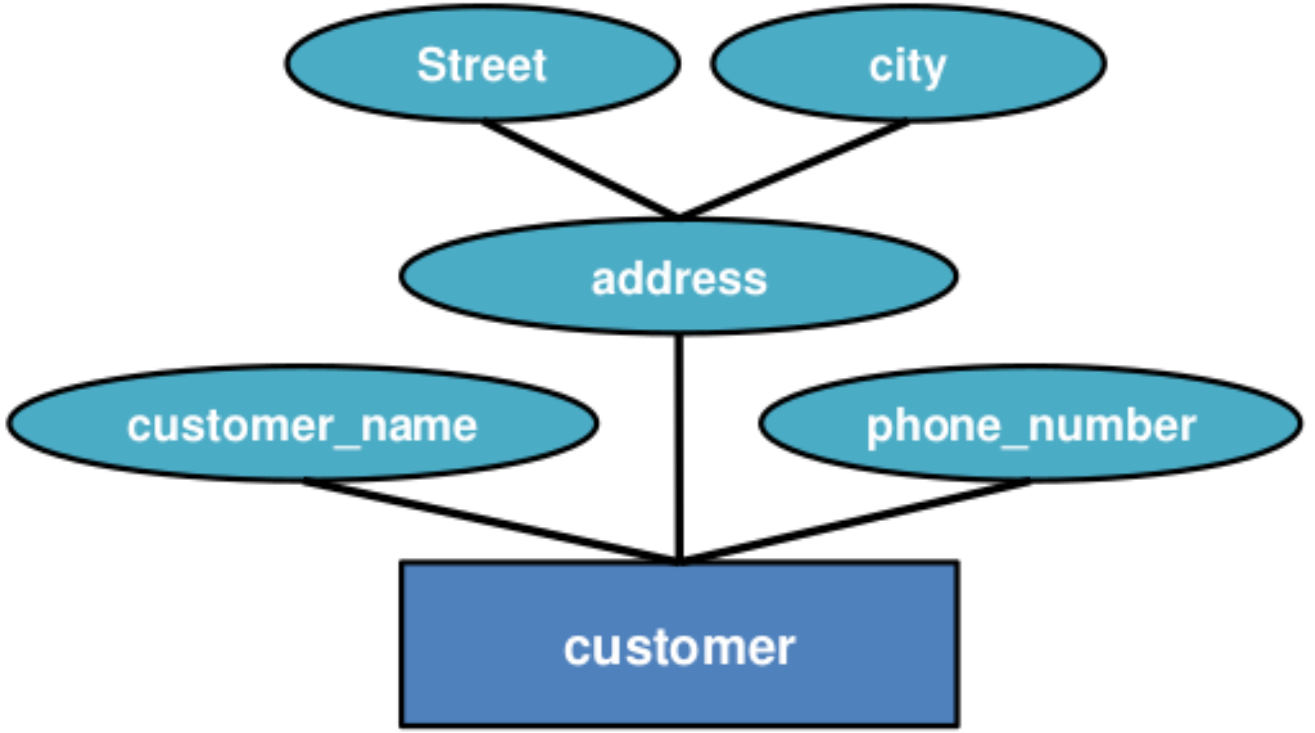


Reduction of an E-R Diagram to Relational Schemas

- **Composite Attributes**
  - ✓ We handle **composite attributes** by creating a separate attribute for each of the component attributes; we do not create a separate column for the composite attribute itself.
    - Suppose *address* is a composite attribute of entity set *customer*, and the components of *address* are *street* and *city*. The table generated from *customer* would then contain columns *address-street* and *address-city*; there is no separate column for *address*

Reduction of an E-R Diagram to Relational Schemas

- **Composite Attributes**
  - **Example**



customer_name	customer_street	customer_city	phone_number

The relation *customer*

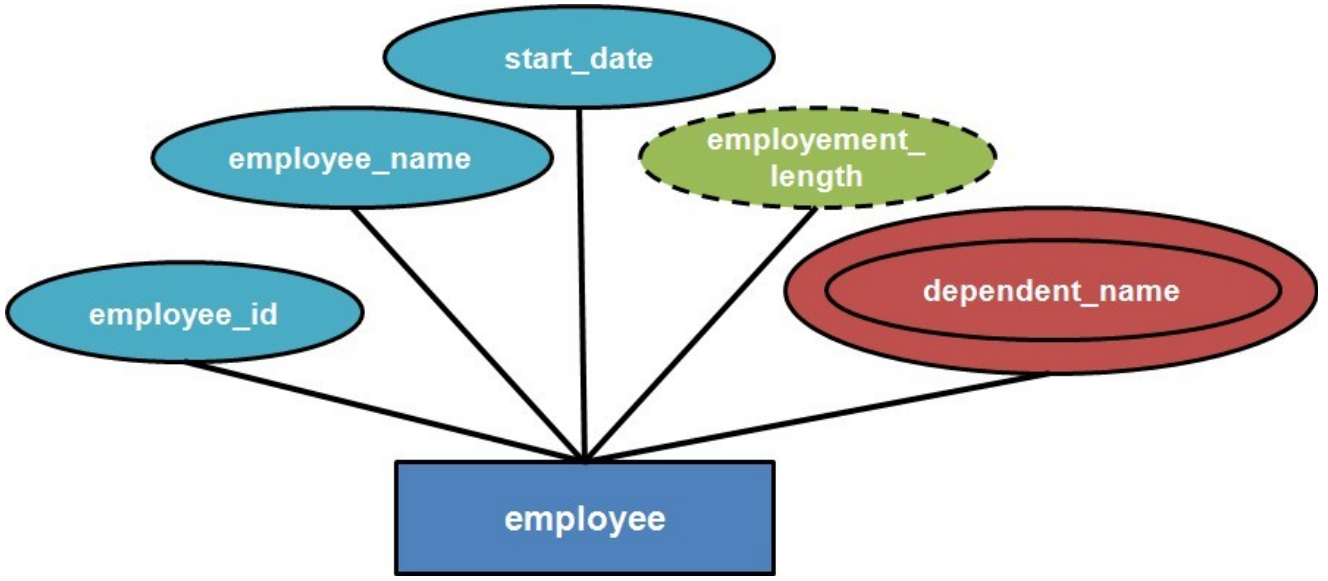
Reduction of an E-R Diagram to Relational Schemas

- **Multivalued Attributes**
  - ✓ For a **multivalued attribute** *M*, we create a table *T* with a column *C* that corresponds to *M* and columns corresponding to the **primary key** of the entity set or relationship set of which *M* is an attribute.

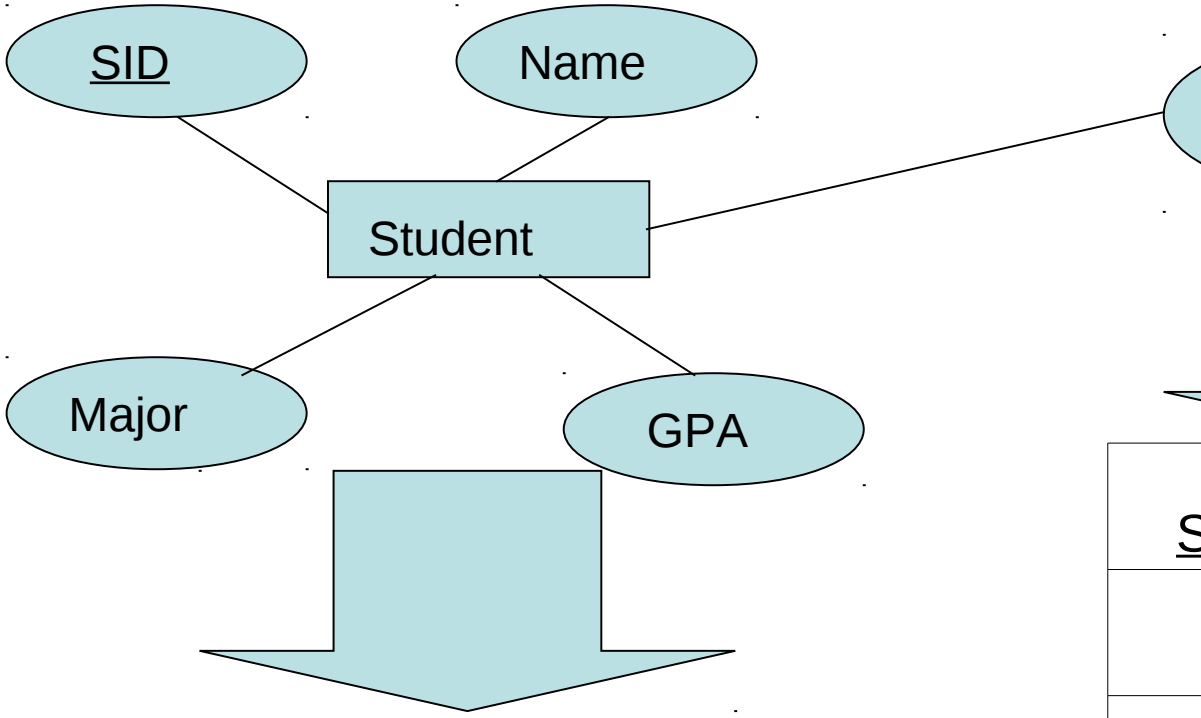
Reduction of an E-R Diagram to Relational Schemas

- **Multivalued Attributes**
  - ✓ **Example**: For the multivalued attribute *dependent-name*, we create a table *dependent-name*, with columns *dname*, referring to the *dependent-name* attribute of *employee*, and *employee-id*, representing the primary key of the entity set *employee*. Each dependent of an employee is represented as a unique row in the table.

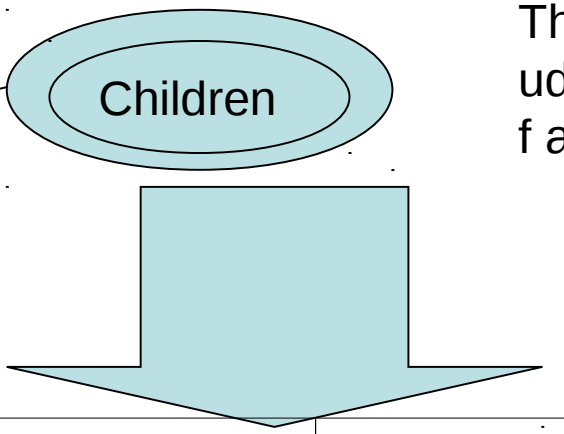
dname	employee_id
The relation *dependent_name*	



Example – Multivalue attribute



SID	Name	Major	GPA
1234	John	CS	2.8
5678	Homer	EE	3.6



The primary key for this table is Student_SID + Children, the union of all attributes

Stud_SID	Children
1234	Johnson
1234	Mary
5678	Bart
5678	Lisa
5678	Maggie

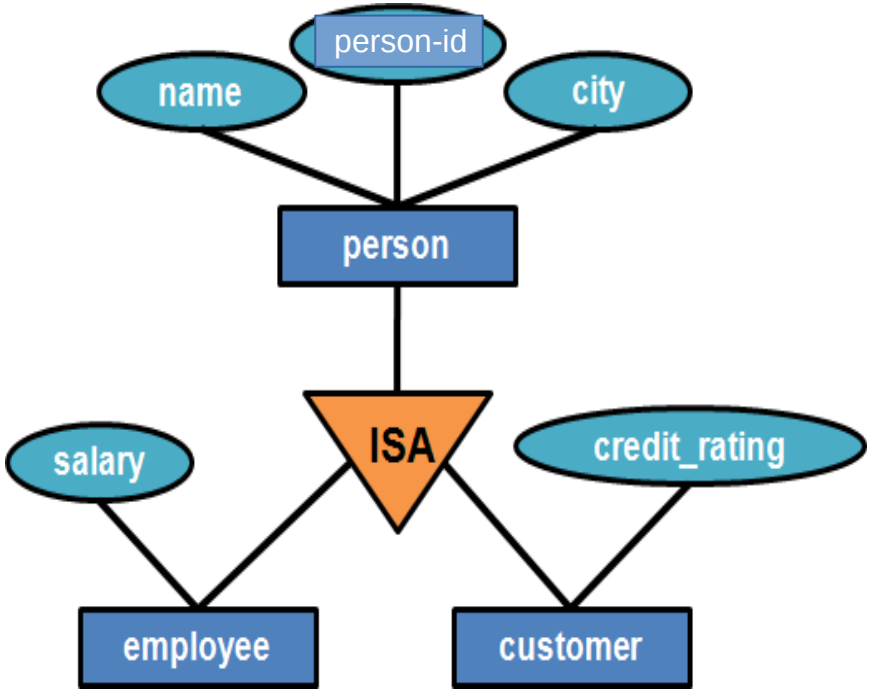
Reduction of an E-R Diagram to Relational Schemas

- **Representation of Generalization**
  - ✓ **Method 1**- Create a schema for the higher-level entity set. For each lower-level entity set, create a schema that includes a column for each of the attributes of that entity set plus a column for each attribute of the primary key of the higher-level entity set. Thus we have three tables:

person = (person-id, name, city)

employee = (person-id, salary)

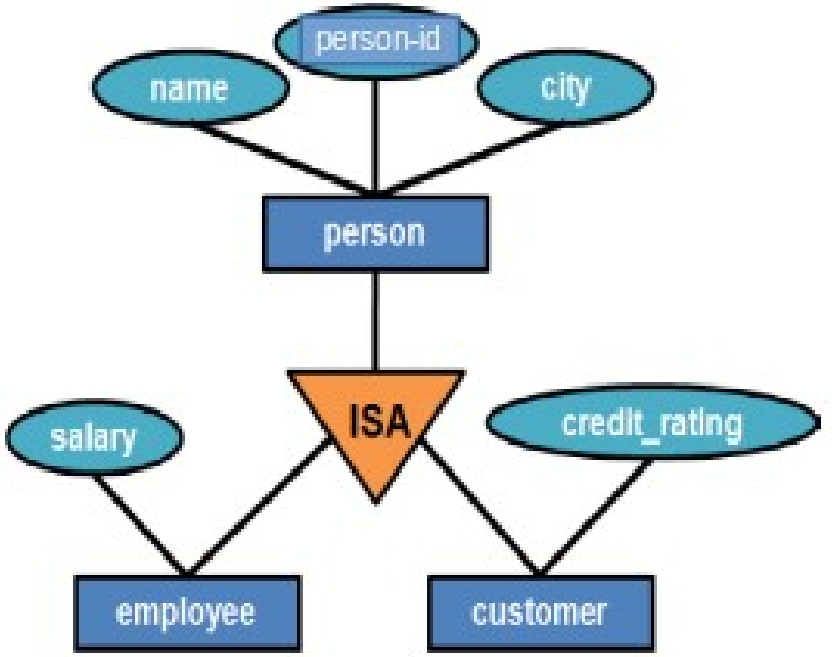
customer = (person-id, credit-ratings)



Reduction of an E-R Diagram to Relational Schemas

- **Representation of Generalization**
  - ✓ **Method 1:**

    Drawback: 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

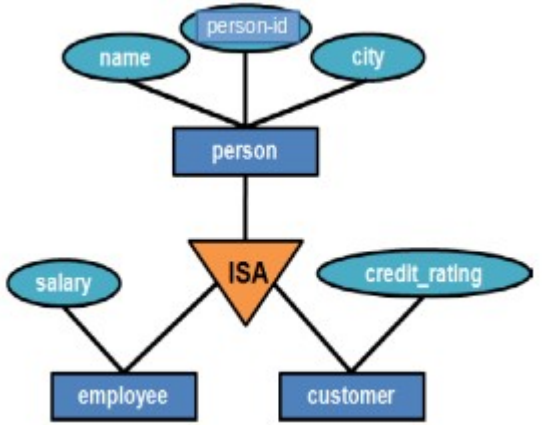


Reduction of an E-R Diagram to Relational Schemas

- **Representation of Generalization**
  - ✓ **Method 2:** If the generalization is disjoint and complete—that is, if no entity is a member of two lower-level entity sets directly below a higher-level entity set, and if every entity in the higher level entity set is also a member of one of the lower-level entity sets. Here, for each lower-level entity set, create a table that includes a column for each of the attributes of that entity set plus a column for *each* attribute of the higher-level entity set.

    employee = (person-id, name, city, salary)

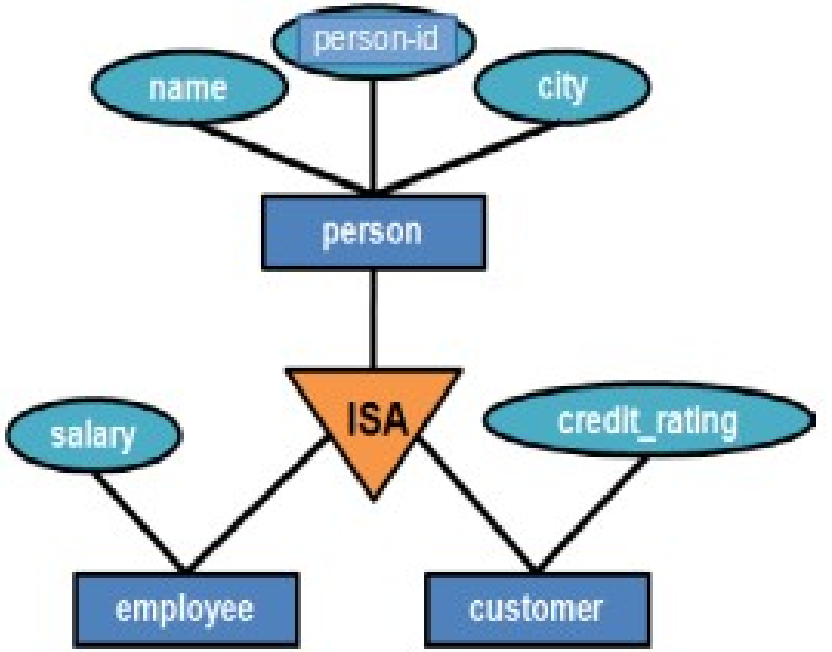
    customer = (person-id, name, city, credit-ratings)



Reduction of an E-R Diagram to Relational Schemas

- **Representation of Generalization**
  - ✓ **Method 2:**

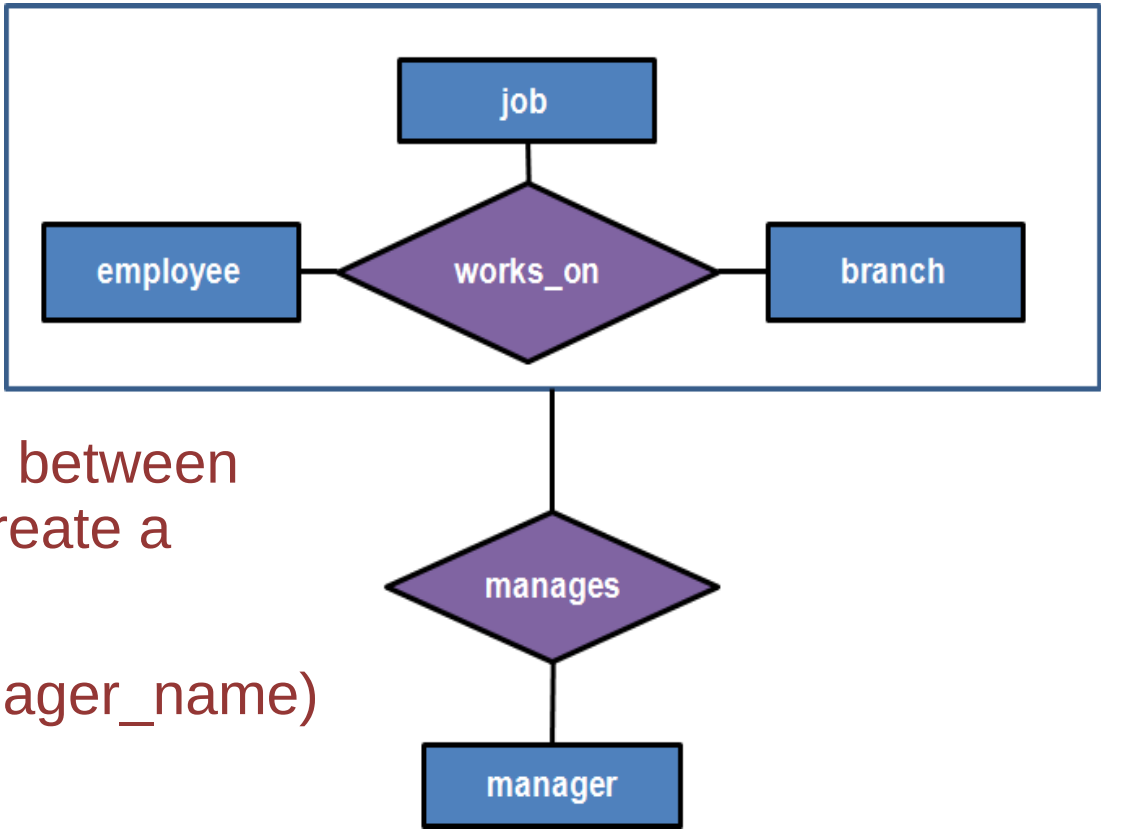
    Drawback: *street* and *city* may be stored redundantly for people who are both customers and employees



Reduction of an E-R Diagram to Relational Schemas

- **Representation of Aggregation**
  - ✓ To represent aggregation, create a schema containing
    - primary key of the aggregated relationship,
    - the primary key of the associated entity set
    - any descriptive attributes
  - ✓ For example, to represent aggregation manages between relationship works_on and entity set manager, create a schema

    manages (employee_id, branch_name, title, manager_name)



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3) Introduction to MongoDB

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References

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- http://codex.cs.yale.edu/avi/db-book/db4/slide-dir/
- http://codex.cs.yale.edu/avi/db-book/db5/slide-dir/
- http://codex.cs.yale.edu/avi/db-book/db6/slide-dir/