

RELATIONAL MODEL

Introduction to relational model

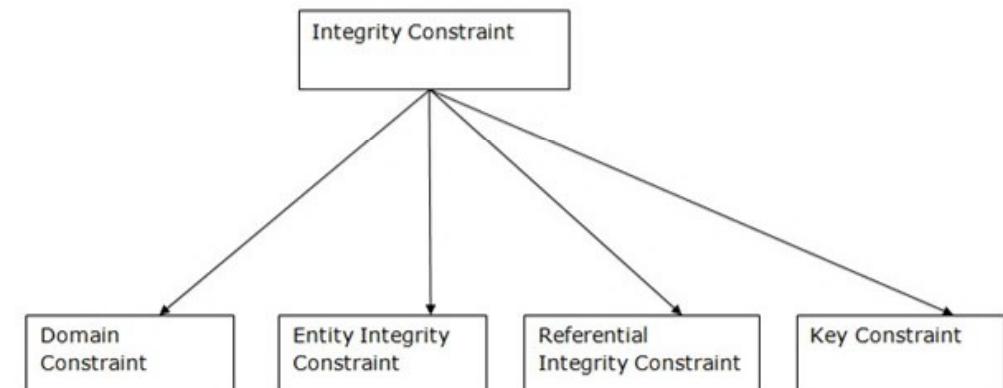
Integrity Constraints over relation

Logical database design: ER to relational

Integrity Constraints over relation

▪ Various types of integrity constraints are-

- Domain Integrity
- Entity Integrity Constraint
- Referential Integrity Constraint
- Key Constraints



Key Constraints



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A Key Constraint is a statement that a certain minimal subset of the fields of a relation is a unique identifier for a tuple.

- Candidate key
- Primary key
- Foreign key

The diagram illustrates the concepts of Primary Key, Alternate Key, Composite Key, and Foreign Key across two tables.

Table 1: Employee Data

EMPID	PAN ID	FIRST NAME	LASTNAME	ADDRESS	DID
1101	SDFGW2564G	Nikita	Patil	Sea view apts, Vashi	2
1102	ERTER5456R	Rahul	Singh	Avern, Ghatkopar	1
1103	DASDA3495L	Anu	Nair	Sicily, Panvel	2

Table 2: Department Data

DID	DEPT NAME	Location
1	HR	1 st Floor
2	Finance	2 nd Floor

Annotations:

- Primary Key:** Points to the **EMPID** column of Table 1.
- Alternate Key:** Points to the **PAN ID** column of Table 1.
- Composite Key:** Points to the **FIRST NAME** and **LASTNAME** columns of Table 1.
- Relationship:** Points to the **DID** column of Table 1, indicating its role as a foreign key in Table 2.
- Foreign Key:** Points to the **K J Somaiya Institute of Management** logo, which is the name of the institution where the data is stored.



CUSTOMER (Cust_ID INTEGER,
Cust_Name VARCHAR2(15),
Address VARCHAR2(25),
Contact VARCHAR2(10))

PRODUCT(Prod_ID VARCHAR(5),
Prod_Name varchar(10),
Category Varchar(10),
Price Float);

ORDER (Ord_id integer,
Cust_id integer,
Prod_id Varchar2(10),
Price float,
discount integer,
disc_price float)

Transaction (tras_id integer,
ord_id integer,
payment_method varchar(5),
amount float)

Referential Integrity Constraint



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If a foreign key exists in a relation then either the foreign key value must match a primary key value of some tuple in its home relation or the foreign key value must be null.

The rules are:

- can't delete a record from a primary table if matching records exist in a related table.
- can't change a primary key value in the primary table if that record has related records.
- can't enter a value in the foreign key field of the related table that doesn't exist in the primary key of the primary table.

Referential Integrity Constraint

(Table 1)

EMP_NAME	NAME	AGE	D_No
1	Jack	20	11
2	Harry	40	24
3	John	27	18
4	Devil	38	13

Foreign key

Not allowed as D_No 18 is not defined as a Primary key of table 2 and In table 1, D_No is a foreign key defined

Relationships

Primary Key

D_No	D_Location
11	Mumbai
24	Delhi
13	Noida

(Table 2)



Domain Integrity

- The definition of a valid set of values for an attribute.
- Define data type, length or size, is null value allowed , is the value unique or not for an attribute ,the default value, the range (values in between) and/or specific values for the attribute.

ID	NAME	SEMESTER	AGE
1000	Tom	1 st	17
1001	Johnson	2 nd	24
1002	Leonardo	5 th	21
1003	Kate	3 rd	19
1004	Morgan	8 th	A

Not allowed. Because AGE is an integer attribute



Entity Integrity Constraint

- This rule states that in any database relation value of attribute of a primary key can't be null.

EMPLOYEE

EMP_ID	EMP_NAME	SALARY
123	Jack	30000
142	Harry	60000
164	John	20000
	Jackson	27000

Not allowed as primary key can't contain a NULL value



So... how do we convert an ER diagram into a table?? Simple!!

Basic Ideas:

- Build a table for each entity set.
- Build a table for each relationship set if necessary.
- Make a column in the table for each attribute in the entity set.
- Indivisibility Rule and Ordering Rule.
- Primary Key



▪ER-to-Relational Mapping Algorithm

Step 1: Mapping of Regular Entity Types

Step 2: Mapping of Weak Entity Types

Step 3: Mapping of Binary 1:1 Relation Types

Step 4: Mapping of Binary 1:N Relationship Types.

Step 5: Mapping of Binary M:N Relationship Types.

Step 6: Mapping of Multivalued attributes.

Step 7: Mapping of N-ary Relationship Types.

▪Mapping EER Model Constructs to Relations

Step 8: Options for Mapping Specialization or Generalization.

Step 9: Mapping of Union Types (Categories).

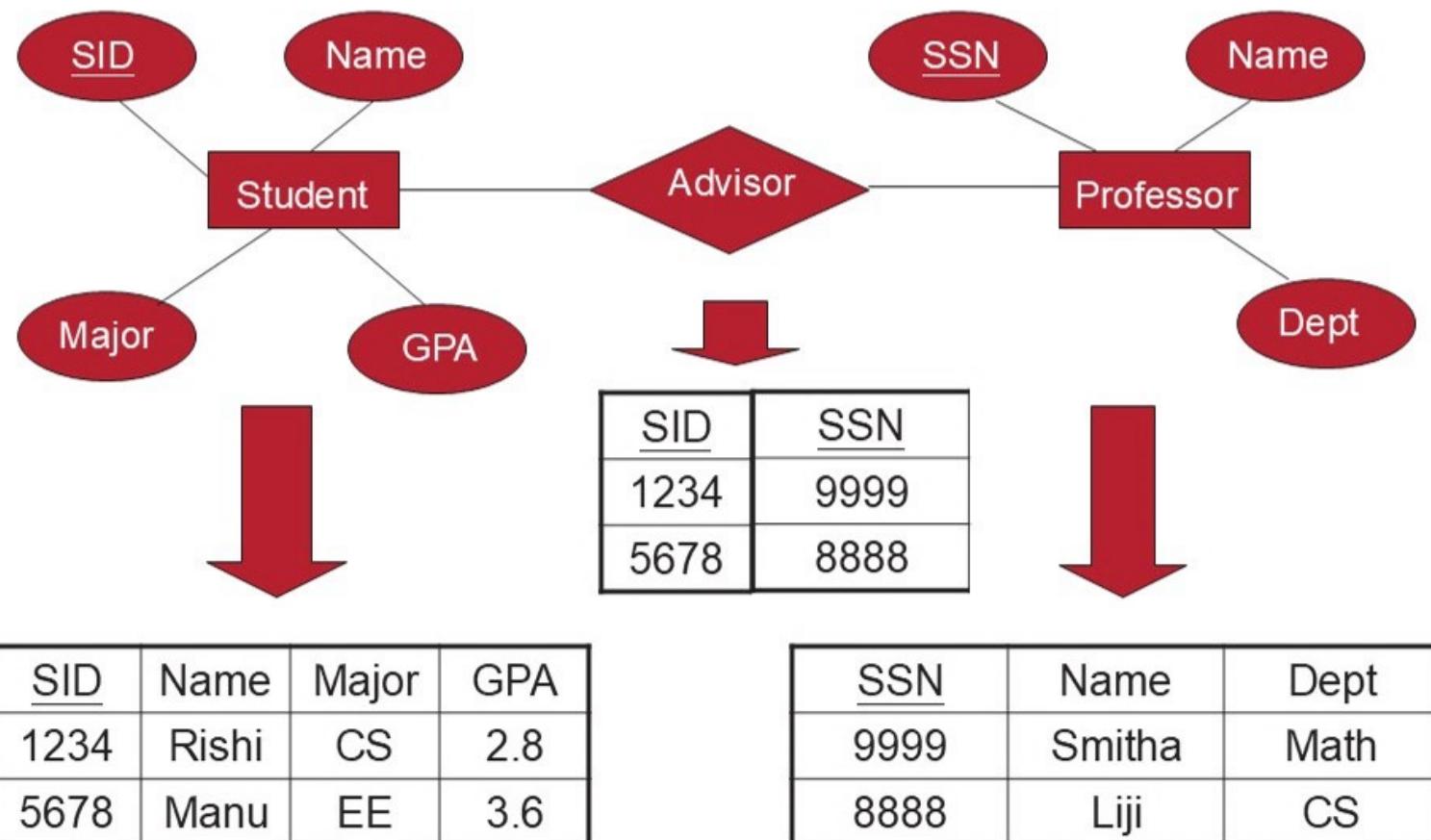
ER-to-Relational Mapping Algorithm

Step 1: Mapping of Regular Entity Types.

- For each regular (strong) entity type E in the ER schema, create a relation R that includes all the simple attributes of E.
- Choose one of the key attributes of E as the primary key for R. If the chosen key of E is composite, the set of simple attributes that form it will together form the primary key of R.

Example: We create the relations **EMPLOYEE**, **DEPARTMENT**, and **PROJECT** in the relational schema corresponding to the regular entities in the ER diagram. SSN, DNUMBER, and PNUMBER are the primary keys for the relations EMPLOYEE, DEPARTMENT, and PROJECT.

Example – Strong Entity Set



Representation of Weak Entity Set

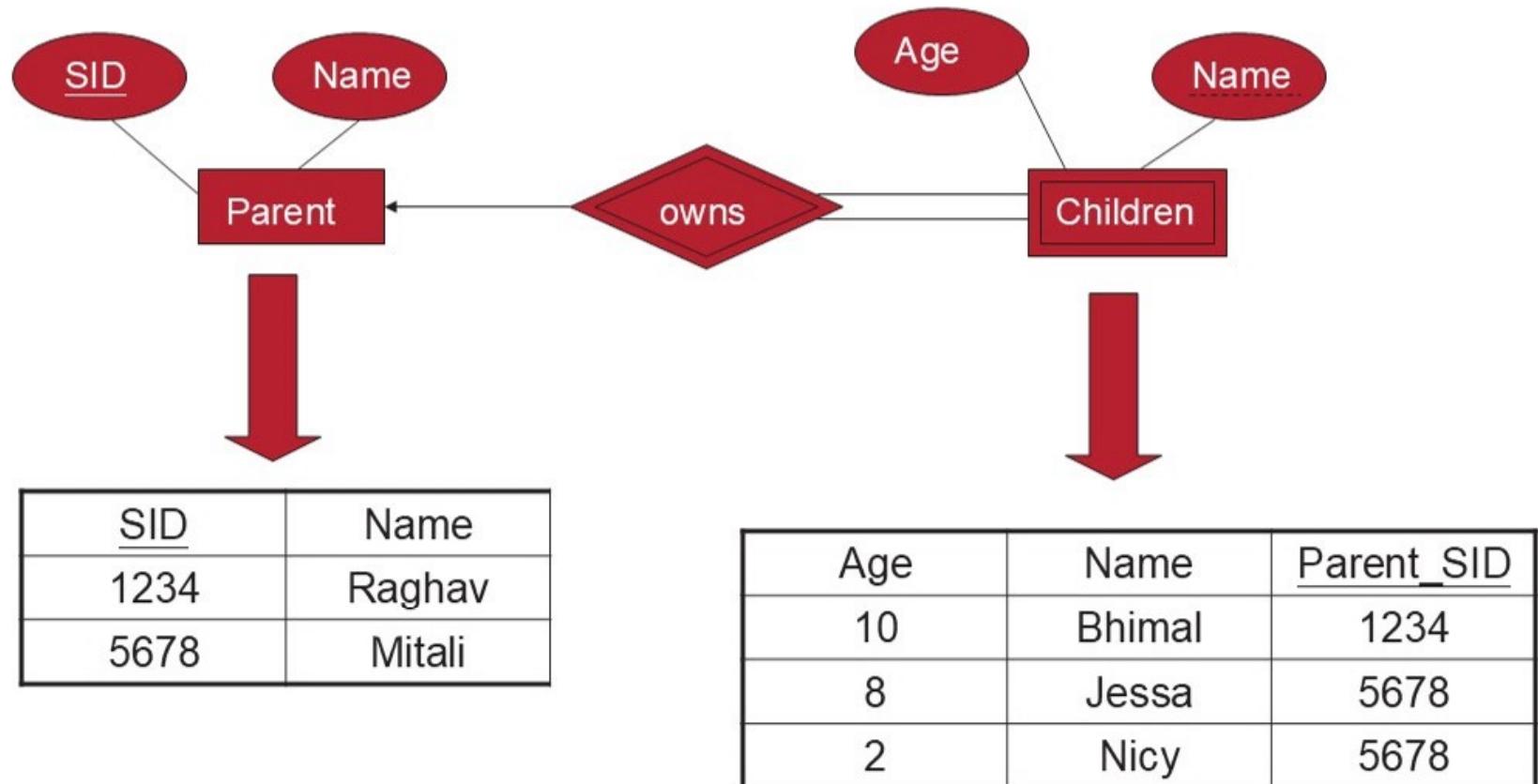


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- Weak Entity Set Cannot exists alone
- To build a table/schema for weak entity set
 - Construct a table with one column for each attribute in the weak entity set
 - include discriminator
 - Augment one extra column on the right side of the table, put in there the primary key of the Strong Entity Set (the entity set that the weak entity set is depending on)
 - Primary Key of the weak entity set = Discriminator + foreign key

Example – Weak Entity Set



* Primary key of *Children* is *Parent_SID + Name*

Representation of Relationship Set



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✓ Unary/Binary Relationship set

- Depends on the cardinality and participation of the relationship
- Two possible approaches

✓ N-ary (multiple) Relationship set

- Primary Key Issue

✓ Identifying Relationship

- No relational model representation necessary

Representing Relationship Set Unary/Binary Relationship

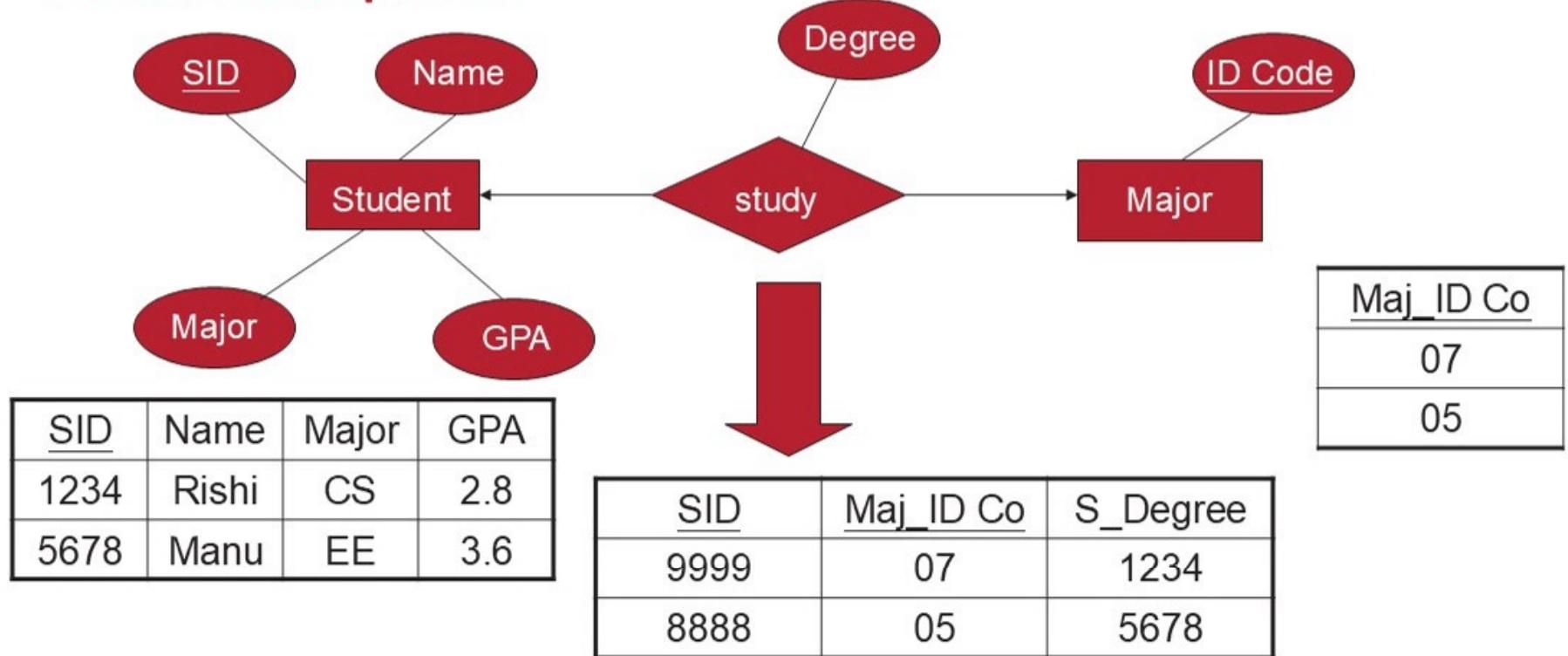


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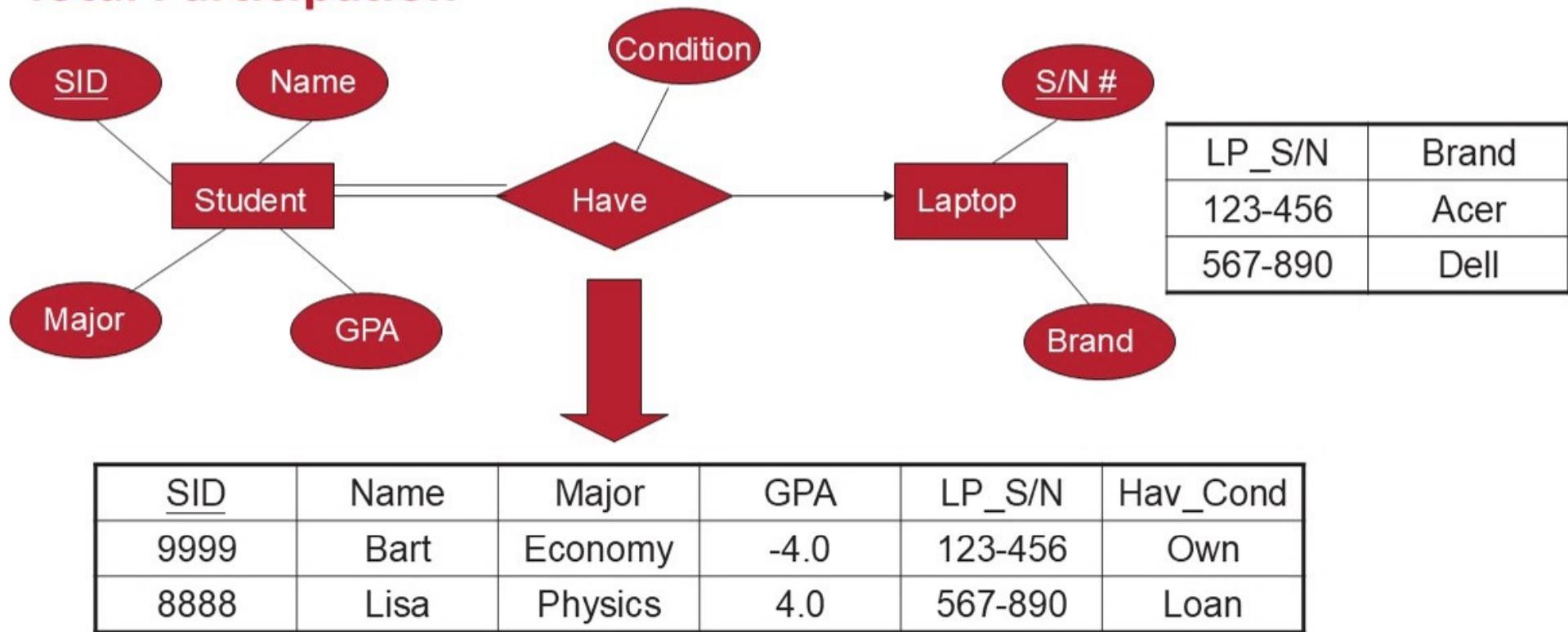
- For one-to-one relationship w/out total participation
 - Build a table with two columns, one column for each participating entity set's primary key. Add successive columns, one for each descriptive attributes of the relationship set (if any).
- For one-to-one relationship with one entity set having 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 Partial Participation



* Primary key can be either *SID* or *Maj_ID_Co*

Example – One-to-One Relationship Set Total Participation



Representing Relationship Set Unary/Binary Relationship



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■ 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...

Representing Relationship Set N-ary Relationship



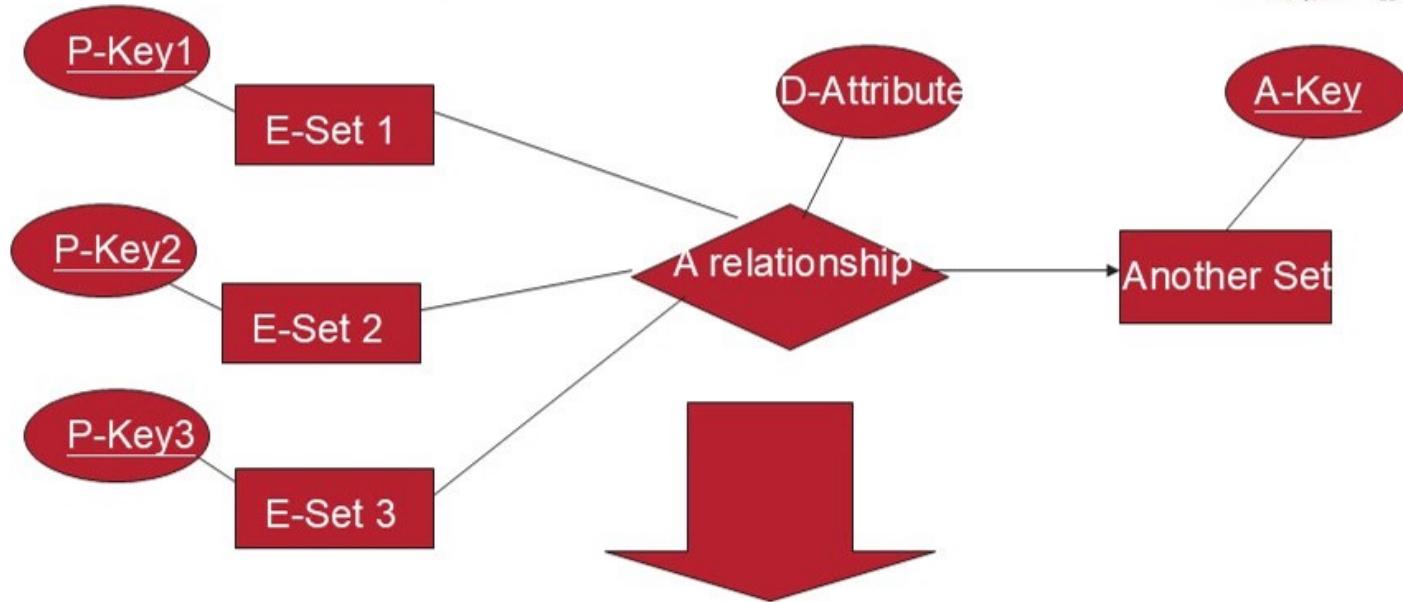
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- Intuitively Simple

- Build a new table with as many columns as there are attributes for the union of the primary keys of all participating entity sets.
- Augment additional columns for descriptive attributes of the relationship set (if necessary)
- The primary key of this table is the union of all primary keys of entity sets that are on “many” side

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 $P\text{-Key1} + P\text{-Key2} + P\text{-Key3}$

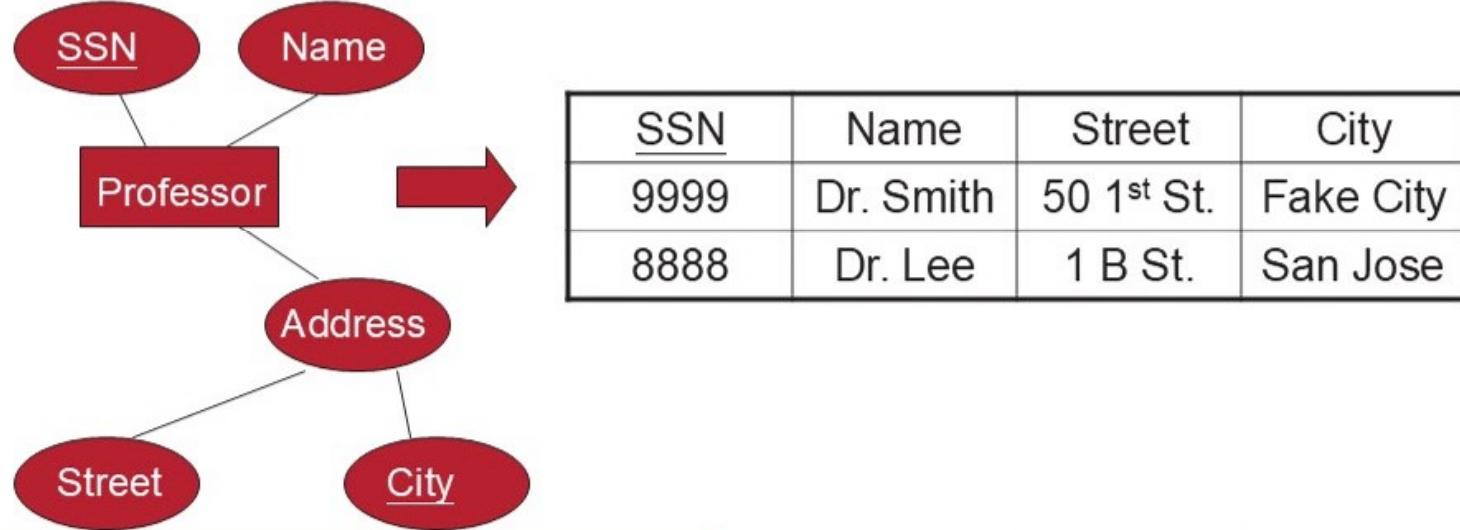
Representing Composite Attribute



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- Relational Model Indivisibility Rule Applies
- One column for each component attribute
- NO column for the composite attribute itself



Representing Multivalued Attribute



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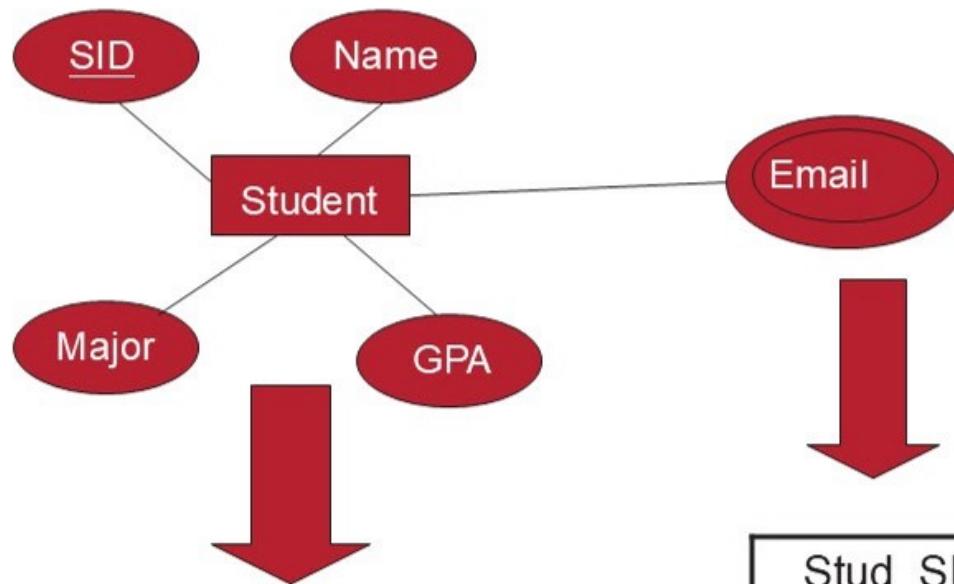
- For each multivalue attribute in an entity set/relationship set
 - Build a new relation schema with two columns
 - One column for the primary keys of the entity set/relationship set that has the multivalue attribute
 - Another column for the multivalue attributes. Each cell of this column holds only one value. So each value is represented as an unique tuple
 - Primary key for this schema is the union of all attributes

Example – Multivalue attribute



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

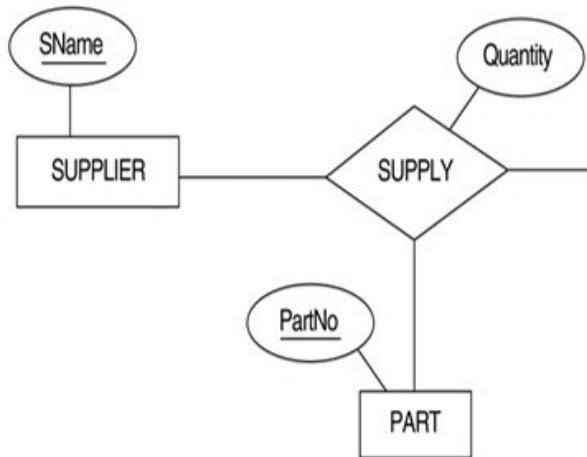
SID	Name	Major	GPA
1234	John	CS	2.8
5678	Homer	EE	3.6

Stud_SID	Email
1234	j@gmail
1234	j@somaiya
5678	h@gmail
5678	h@rediff
5678	h@somaiya

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Example – N-ary Relationship Set

(a)



SUPPLIER	
<u>SNAME</u>	...

PROJECT	
<u>PROJNAME</u>	...

PART	
<u>PARTNO</u>	...

SUPPLY			
<u>SNAME</u>	<u>PROJNAME</u>	<u>PARTNO</u>	<u>QUANTITY</u>

Representing Class Hierarchy

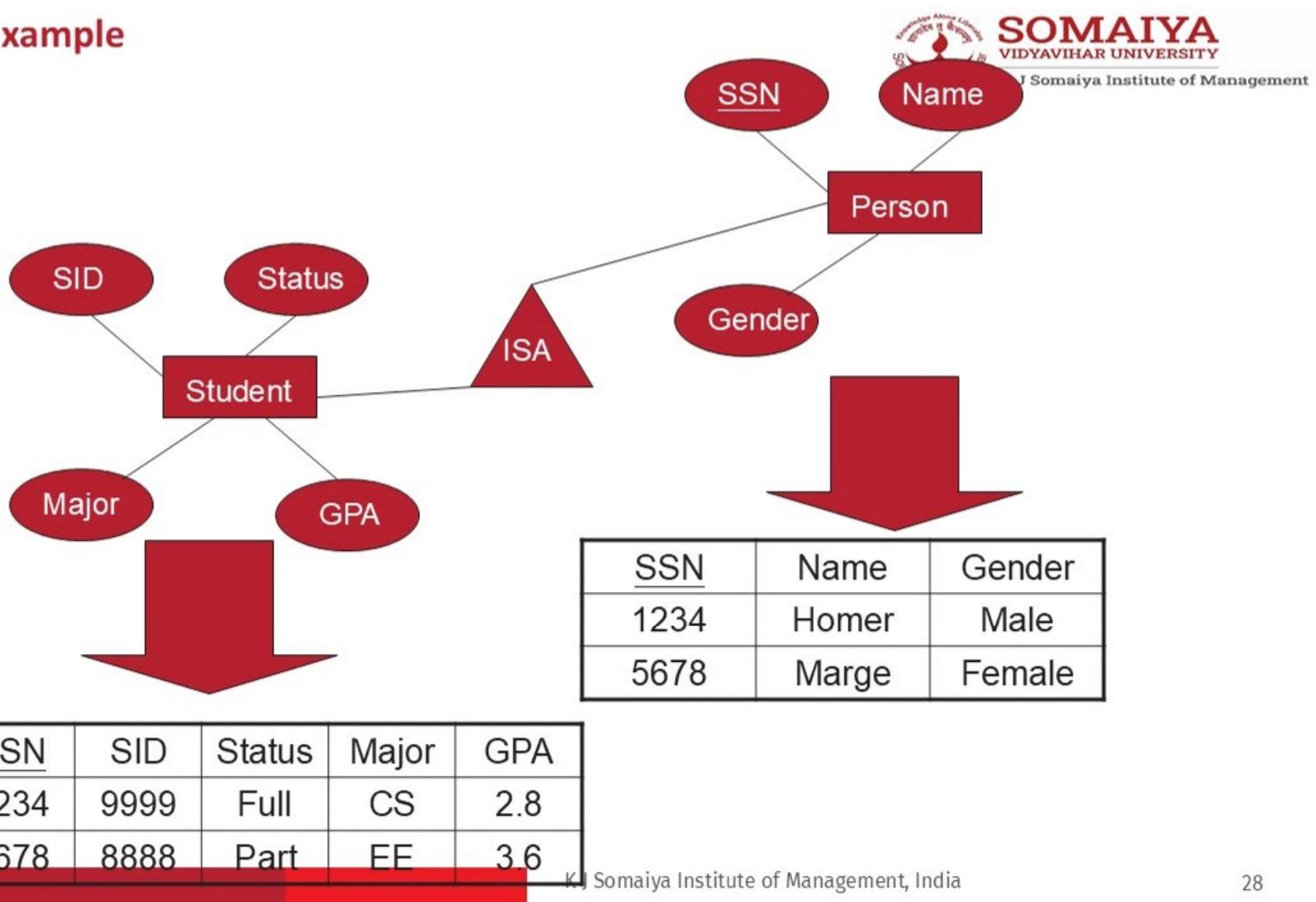


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- Two general approaches depending on disjointness and completeness
 - For non-disjoint and/or non-complete class hierarchy:
 - create a table for each super class entity set according to normal entity set translation method.
 - Create a table for each subclass entity set with a column for each of the attributes of that entity set plus one for each attributes of the primary key of the super class entity set
 - This primary key from super class entity set is also used as the primary key for this new table

Example



Representing Class Hierarchy



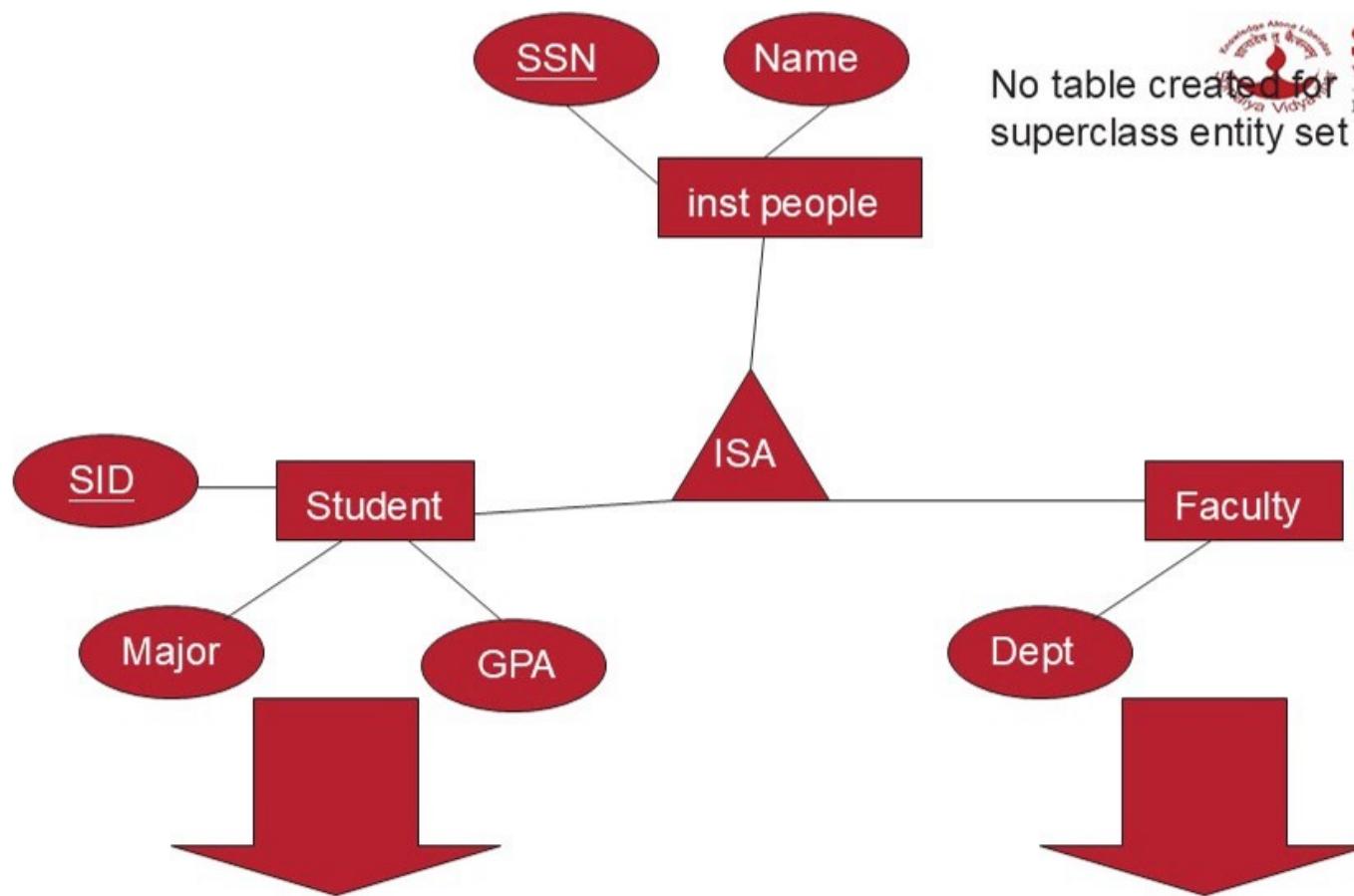
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- Two general approaches depending on disjointness and completeness
 - For disjoint **AND** complete mapping class hierarchy:
 - DO NOT create a table for the super class entity set
 - Create a table for each subclass entity set include all attributes of that subclass entity set and attributes of the superclass entity set



No table created for
superclass entity set



SSN	Name	SID	Major	GPA
1234	John	9999	CS	2.8
5678	Mary	8888	EE	3.6

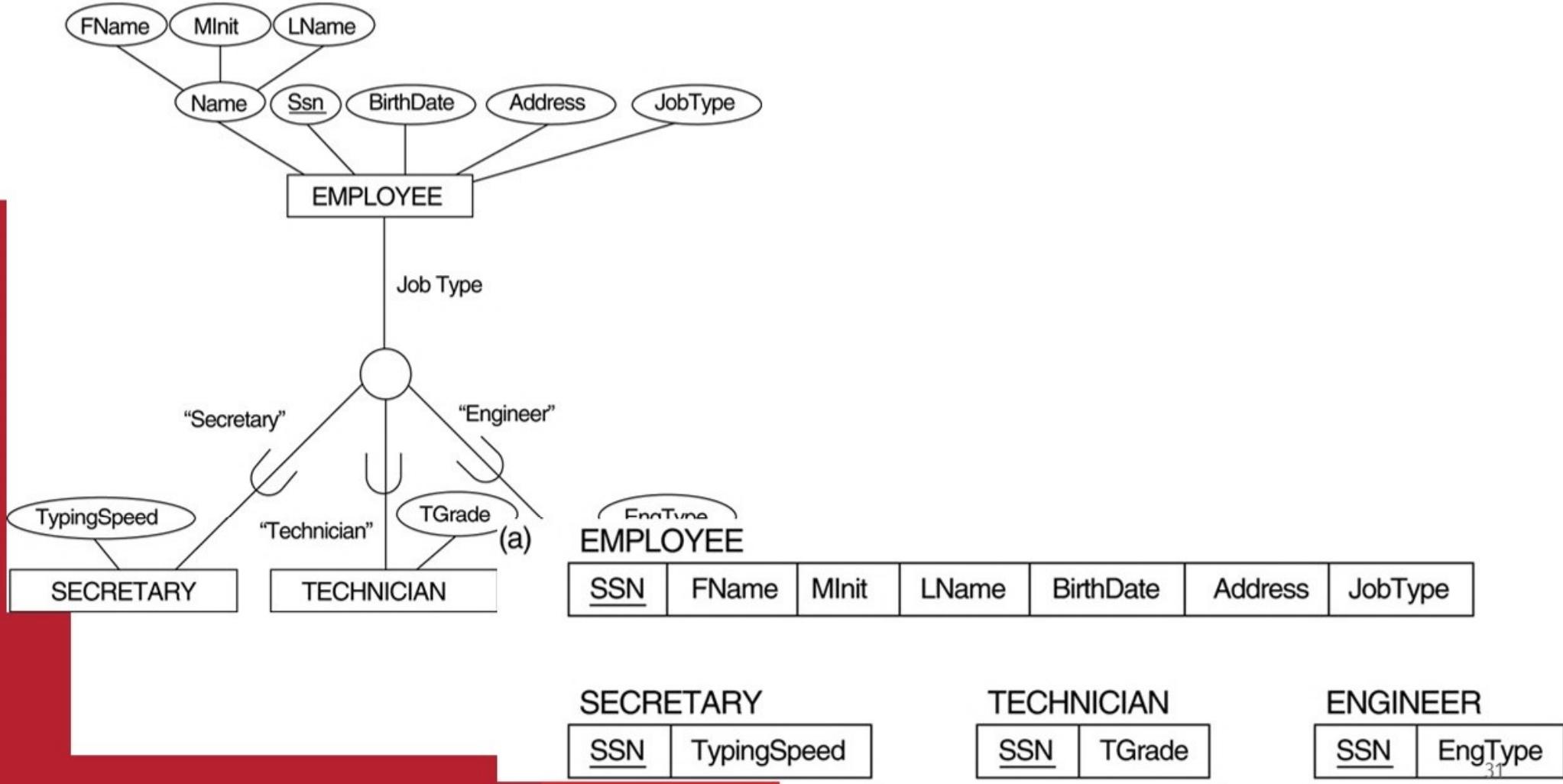
SSN	Name	Dept
1234	Homer	C.S.
5678	Marge	Math

Specialization

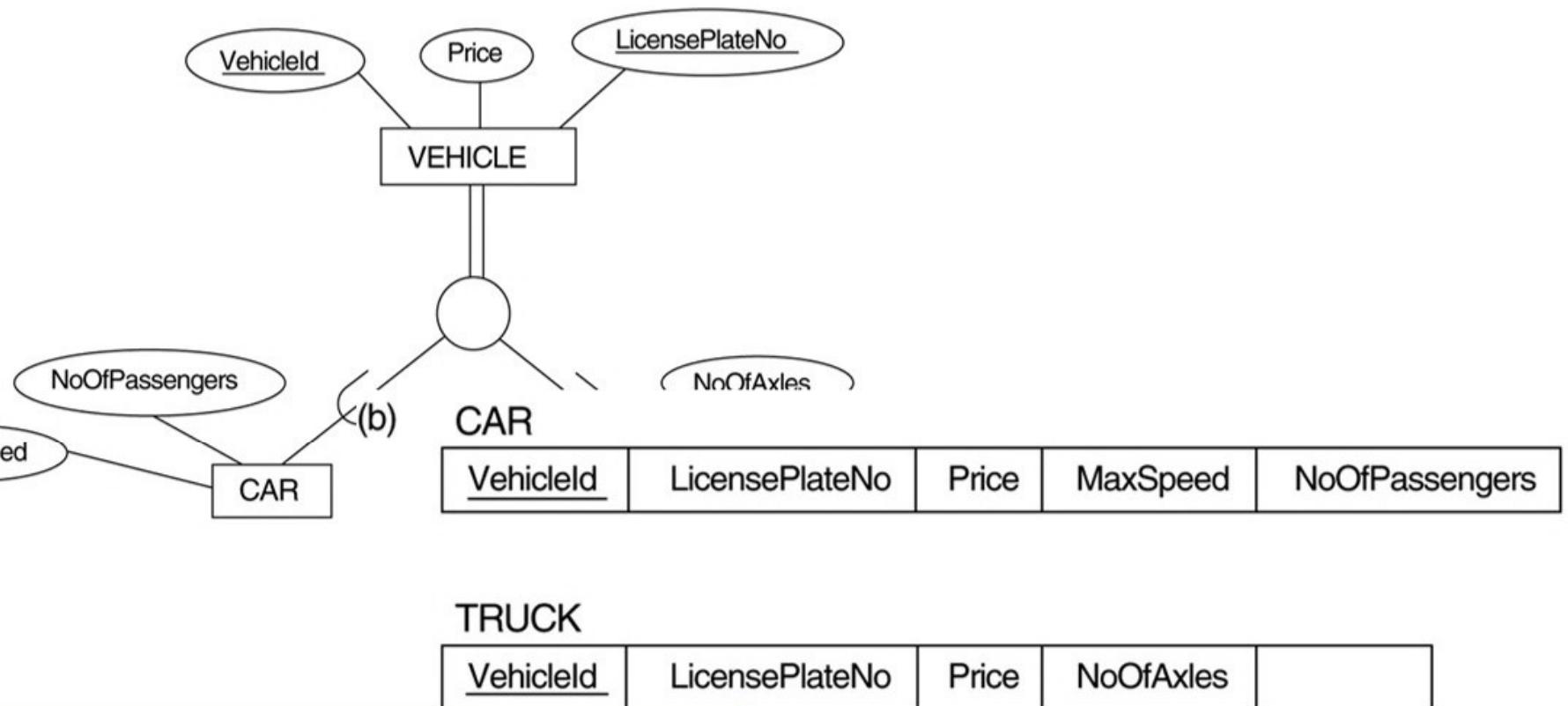


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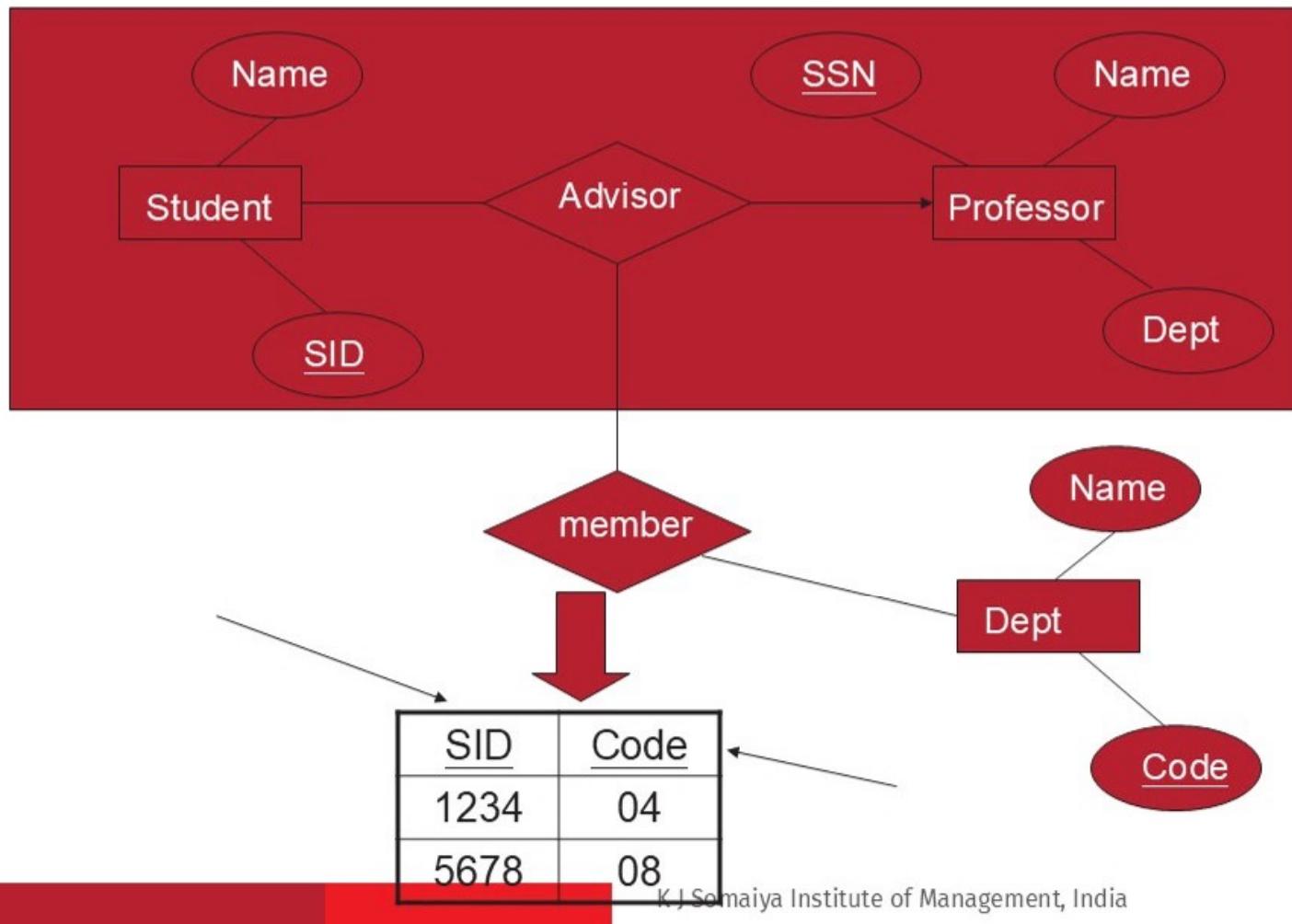
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(b)



Representing Aggregation

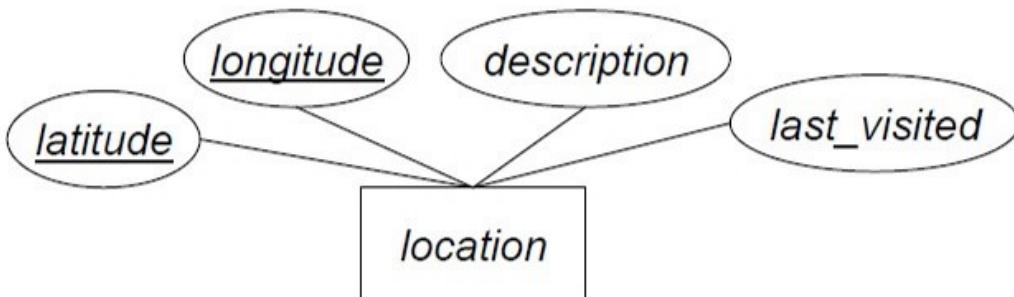


ER to R

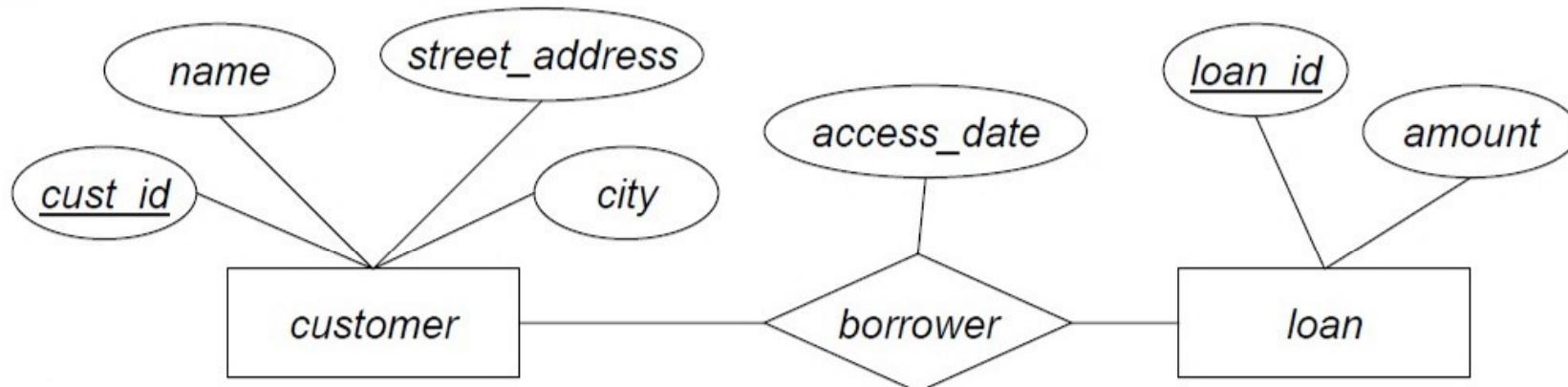


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location(latitude, longitude, description, last_visited)

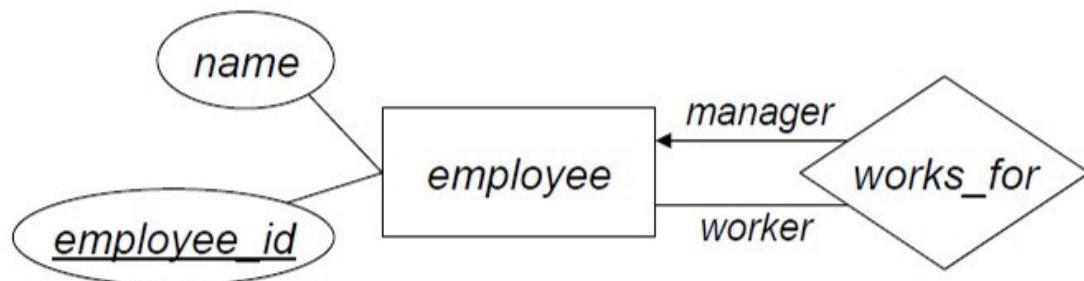


customer(cust_id, name, street_address, city)

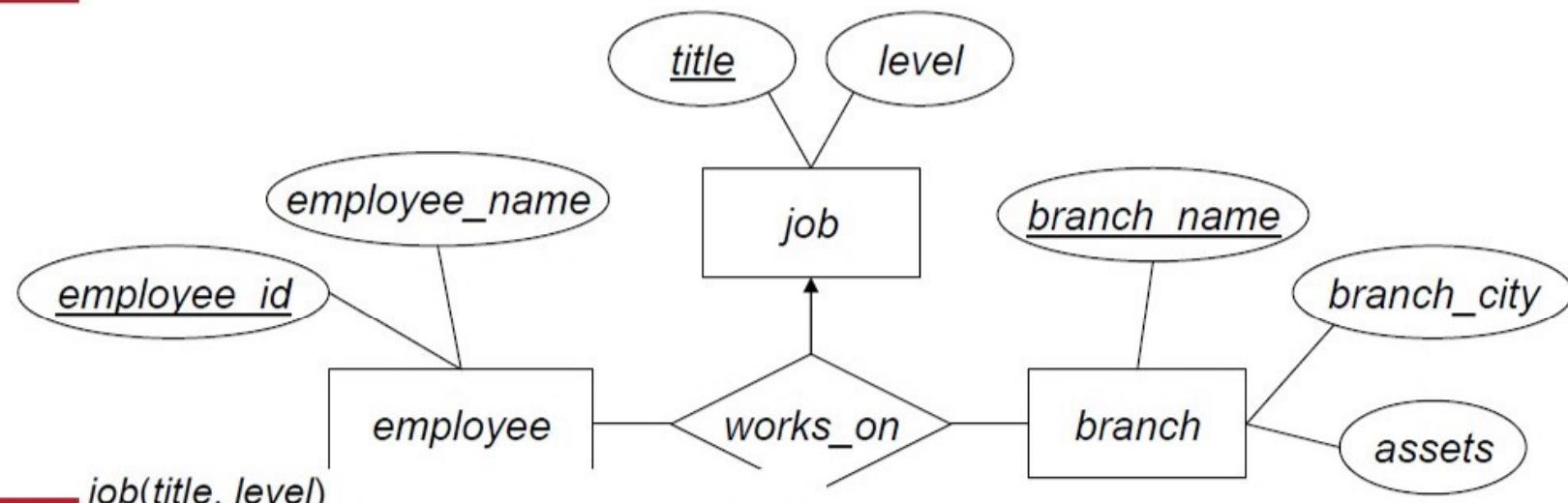
loan(loan_id, amount)

borrower(cust_id, loan_id, access_date)

ER to R



employee(employee_id, name,
manager_id)



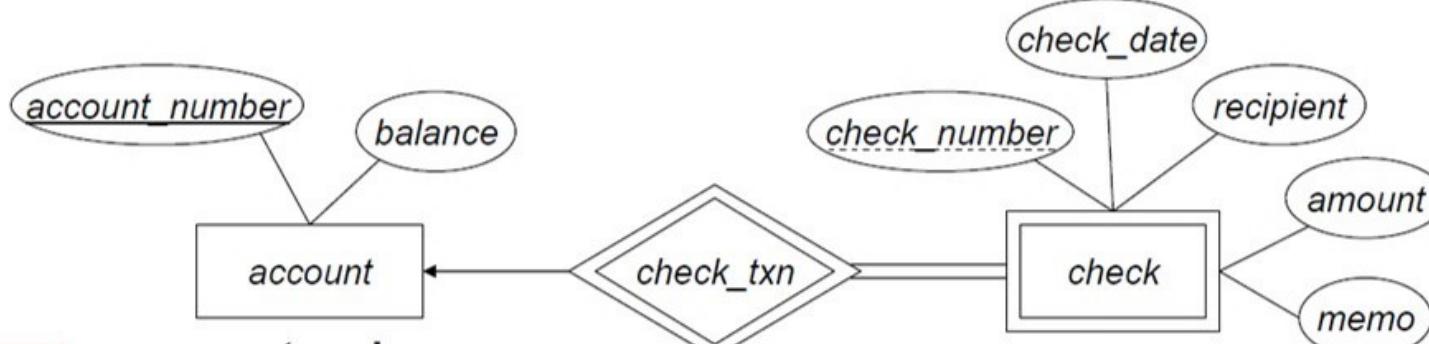
job(title, level)

employee(employee_id, employee_name)

branch(branch_name, branch_city, assets)

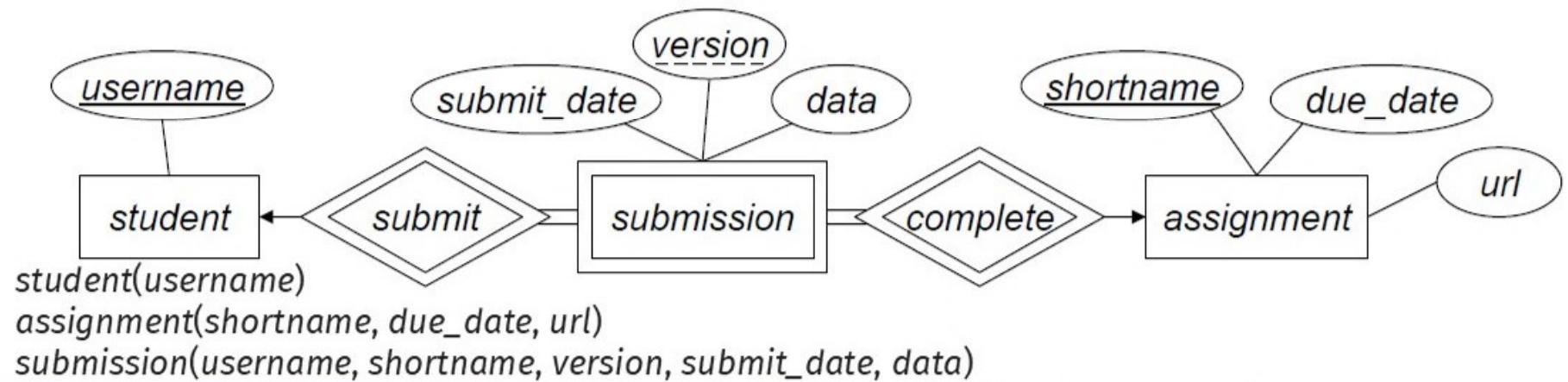
works_on(employee_id, branch_name, title)

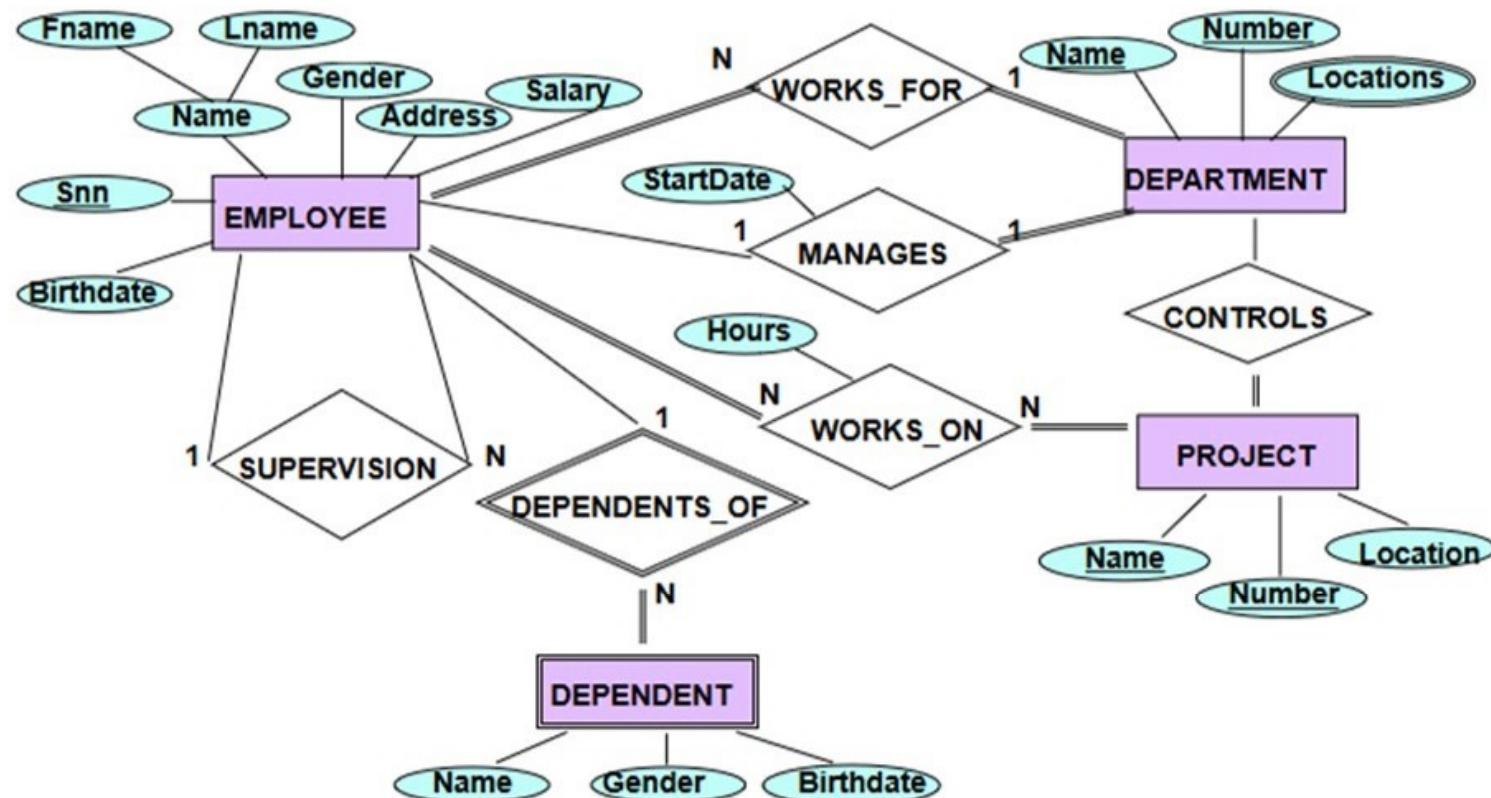
ER to R



account(account_number, balance)

check(account_number, check_number, check_date, recipient, amount, memo)





Each Entity becomes a table



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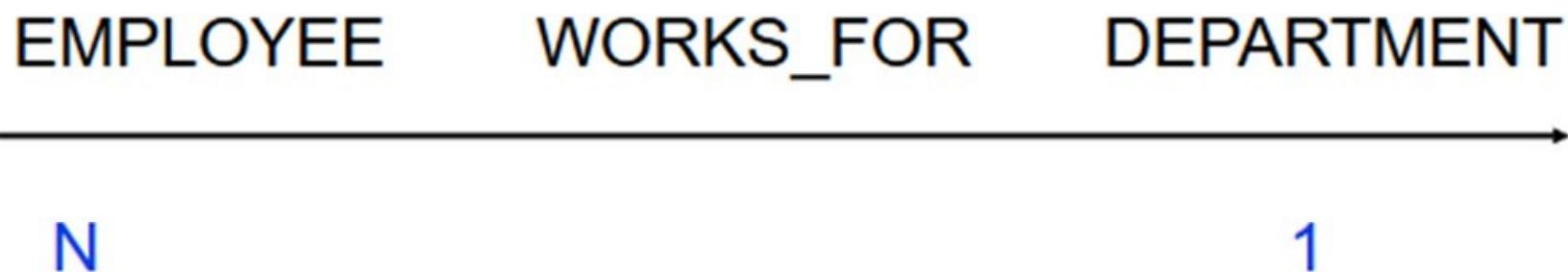
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ENTITY	TABLE	PRIMARY KEY
Employee	Employee	Employee_SSN
Department	Department	Department_Number
Project	Project	Project Number



1:N relationships create a primary key

For each 1:N relationship – create the Primary Key from the entity on the 1 side to the entity on the N side where it will become a foreign key.



Department Number is moved into the Employee entity

Examine the weak entities



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The **DEPENDENT** entity cannot exist on its own and must have a parent entity (**EMPLOYEE**).

They are identified in a M:N relation as the ‘intersect entity’ with the primary key the composite of the primary keys of the two (or more) other ‘strong entities’

Create Table for weak entity



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For each weak entity create a table

- include the Primary Key of the owner tables

The Primary Key becomes the:

owner key plus the weak entity key

Entity	Table	Primary Key
Dependent	Dependent	Employee_SSN + Dependent_No

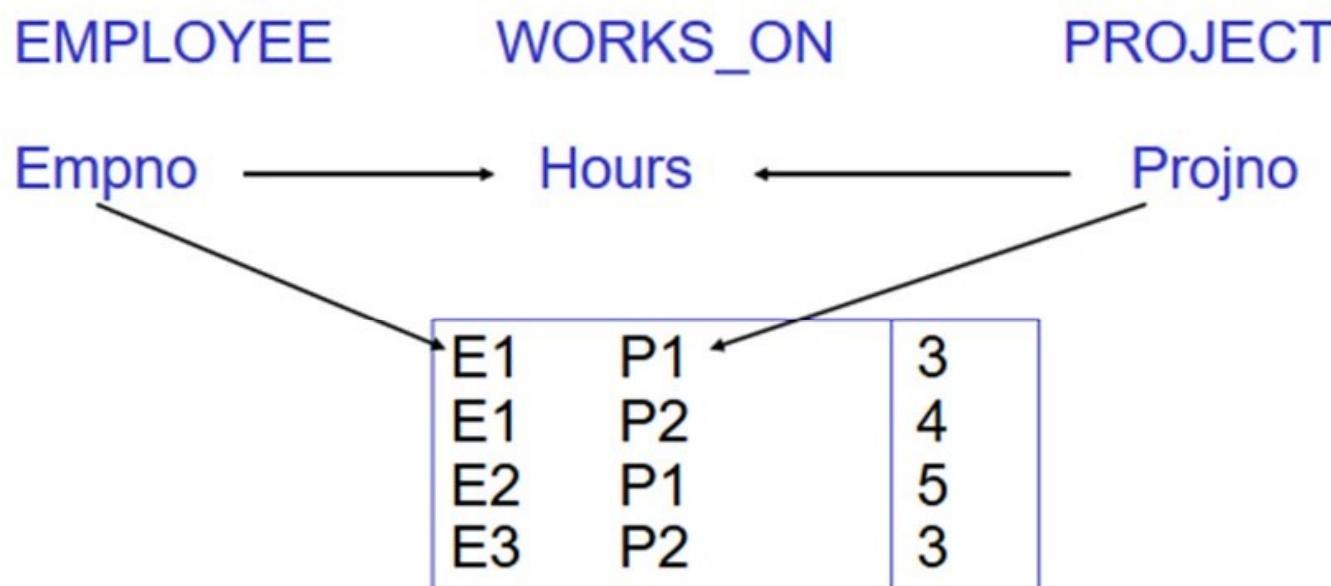
M:N Relationships



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For each M:N relationship create a new table with the Primary Key being the the Primary Key of both entities involved in the relationship



Multivalued attributes

For each multi-valued attribute create a new relation.
The Primary Key is the Primary Key of the entity plus the
Multi-valued attribute.

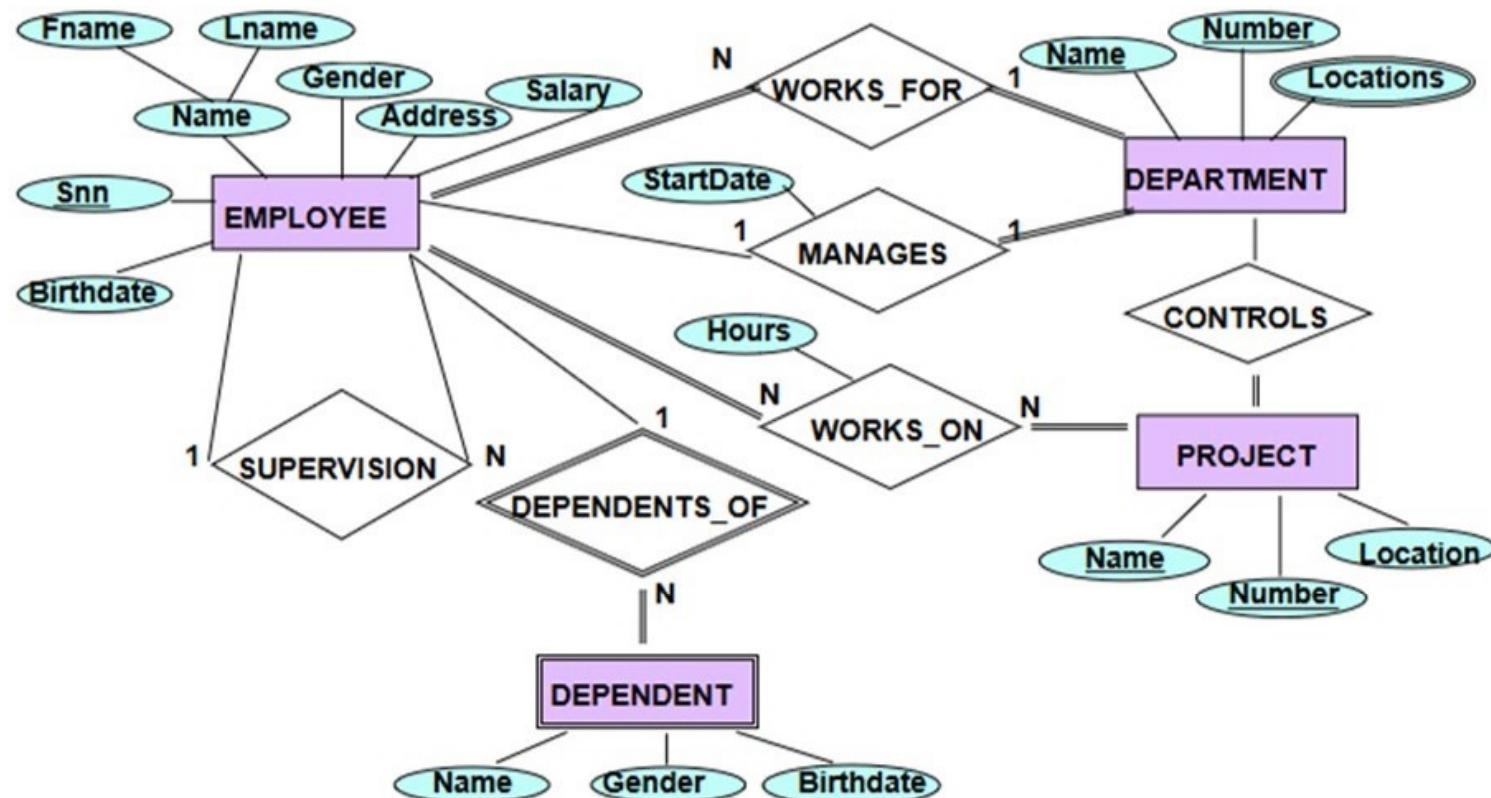
DEPARTMENT → LOCATION

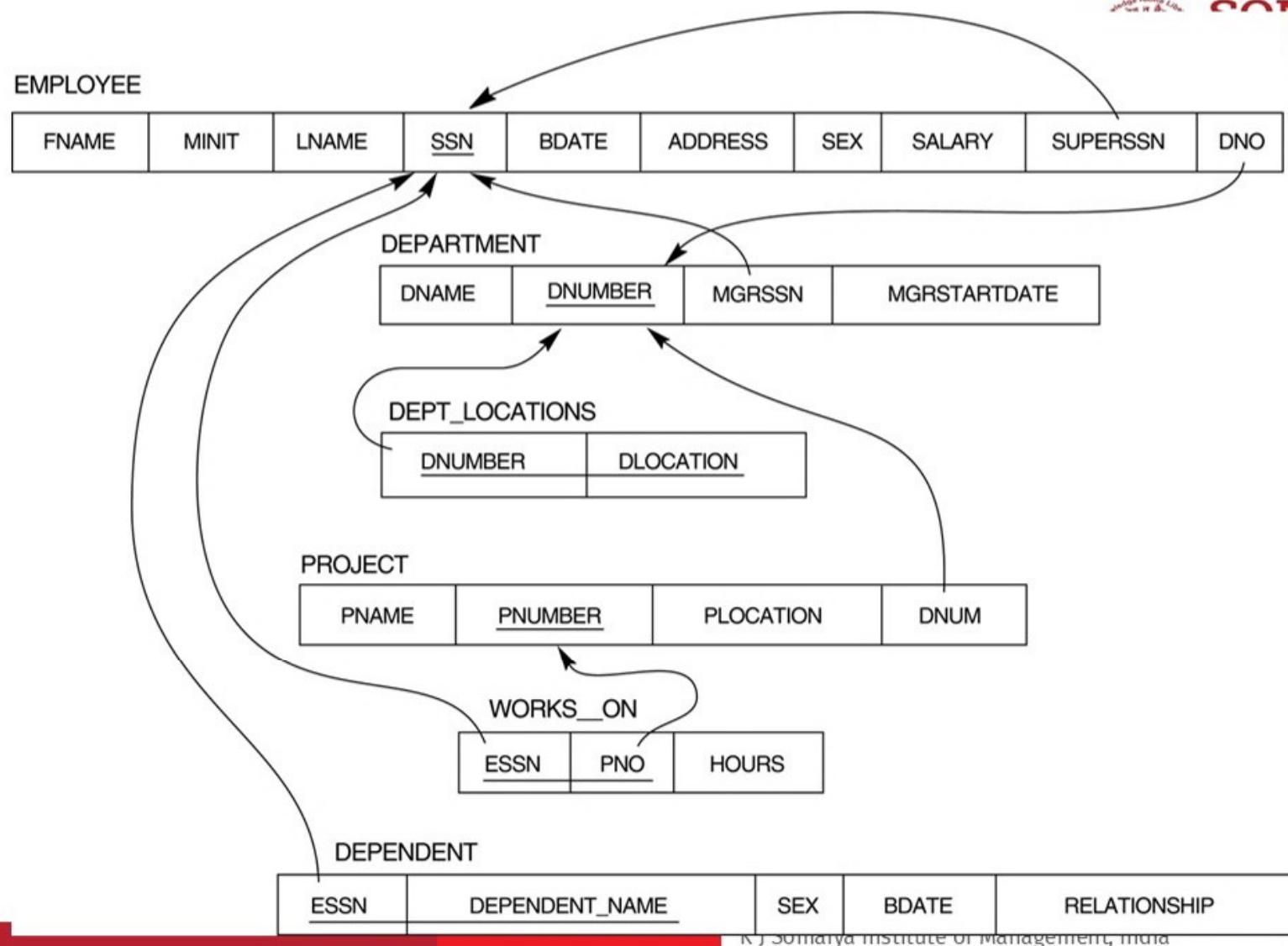
TABLE

PRIMARY KEY

DEPARTMENT_LOCATIONS DEPARTMENT LOCATION

D1	MELB
D1	SYD
D2	MELB



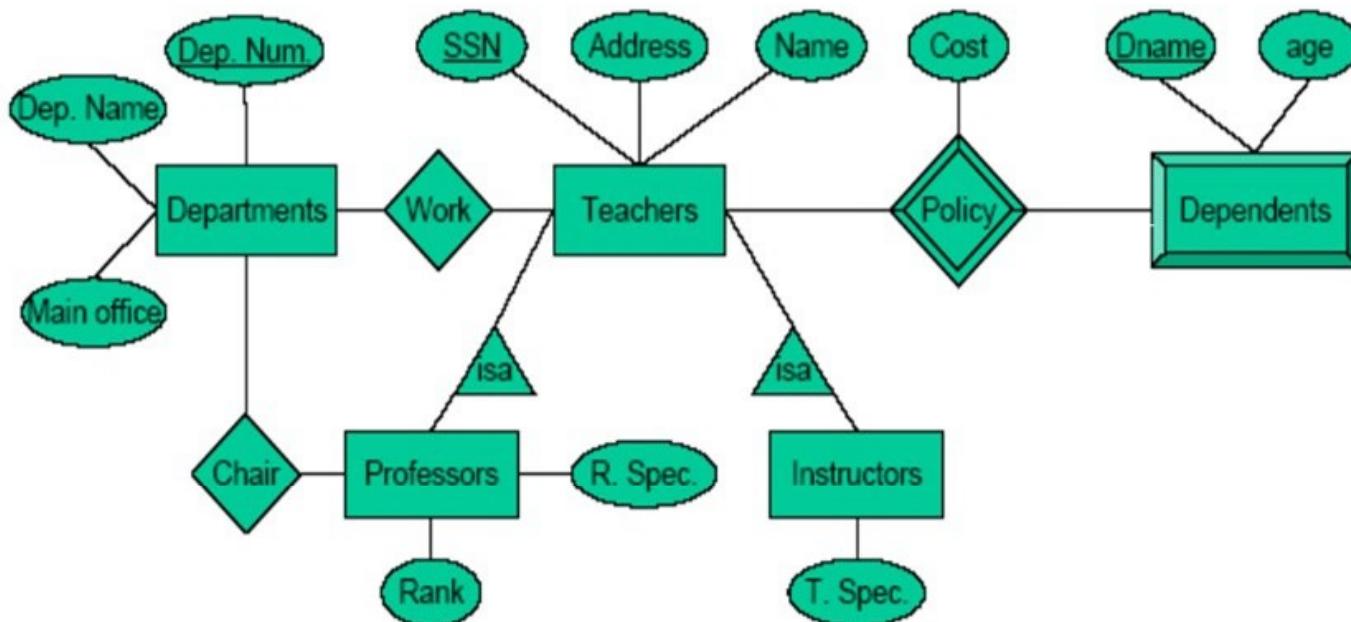


ER to R



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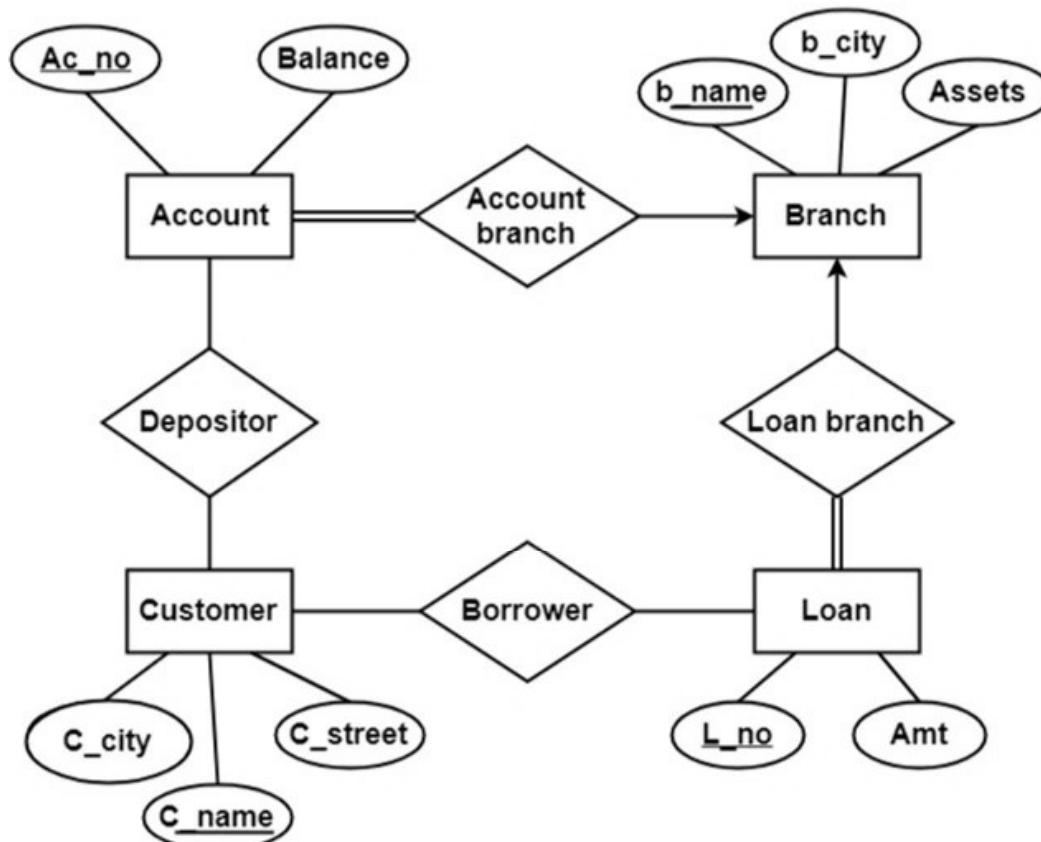


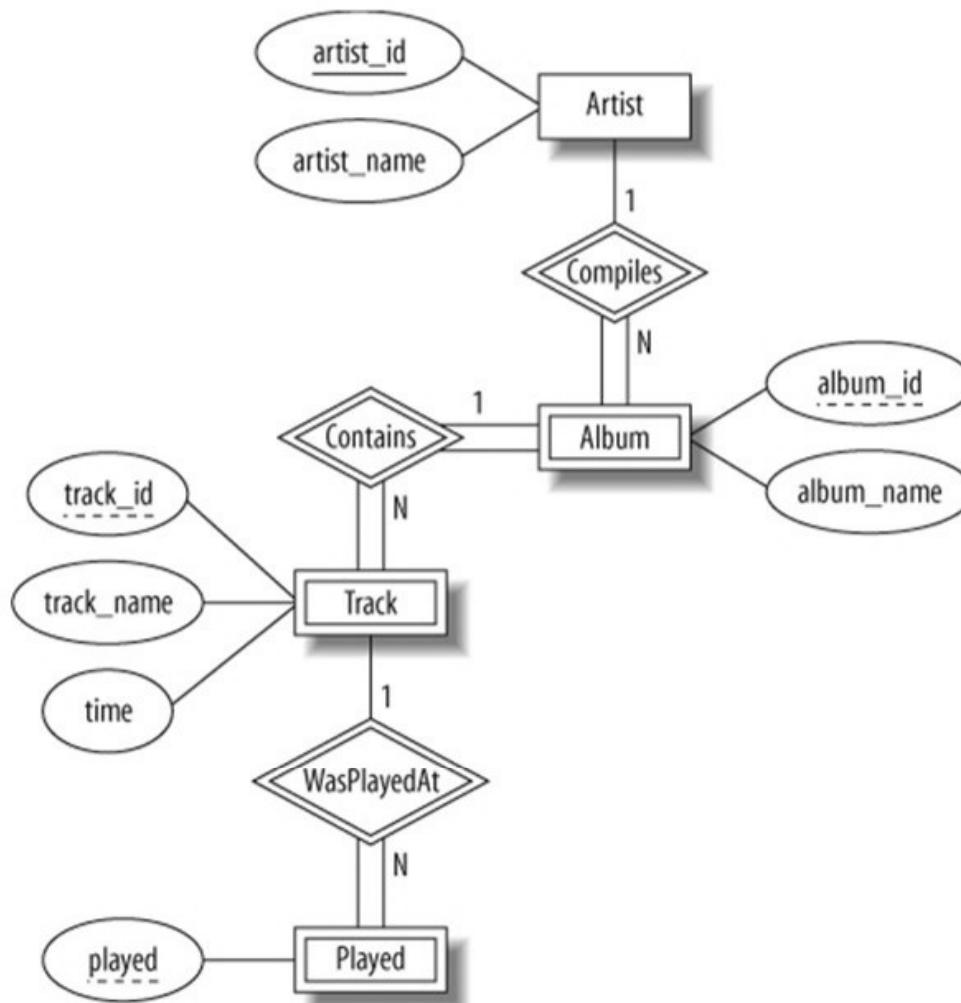
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