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Relational Algebra: Part I

Complete Course on Database Management System

Vishvadeep Gothi • Lesson 17 • July 10, 2023

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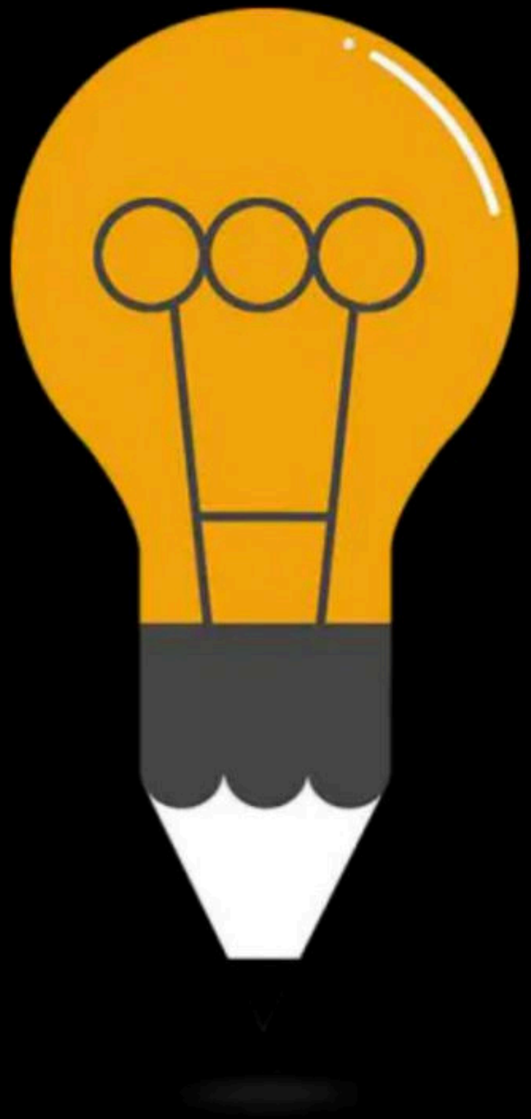

DBMS

ER to Relational Model & RA

By: Vishvadeep Gothi

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ER Diagram to Relational Model

1 Entity set ⇒ 1 Table

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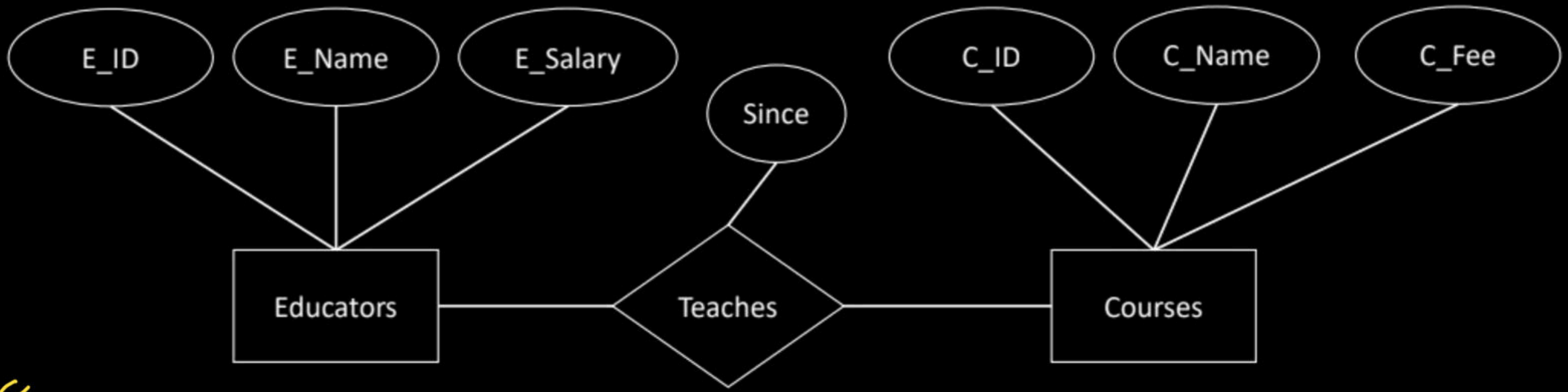
Many to Many Relationship



option 1:-

3 tables → ① Educators
② Courses
③ Teaches

Best option

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Educators

Eid	Ename	Esalary

Courses

Cid	Cname	Cfee

Teaches

Eid	Cid	since
1	C1	2010
1	C2	2015
1	C3	2012
2	C2	2015
3	C3	2020

Teaches.Eid ⇒ fk refering to Educators.Eid

Teaches.cid ⇒ fk refering to Courses.Cid

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Educators	Courses	Teaches
Eid → ename esalary	Cid → cname cfee	cid Eid → since

all 3 relations are in BCNF

Option 2:- keep relationship info along with an entity set.

→ relationship towards Educators ⇒ 2 Tables

Educators

Eid	Ename	esalary	cid	Since
1	—	—	C1	2010
1	—	—	C2	2015
1	—	—	C3	2012
2	—	—	C2	2015
3	—	—	C3	2020

Courses

cid	cname	Cfee

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Primary key ⇒ Eid cid

but partial dependency ⇒ Eid → ename Esalary

after removing partial dependency ⇒ 3 tables same as option 1

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Option 2:-

take relationship info^n towards courses entity set => 2 tables

Educators

Eid	Ename	Esalary

Courses

Cid	Cname	Cfee	Eid	since

Problem in Courses => partial dep.

Cid → Cname Cfee

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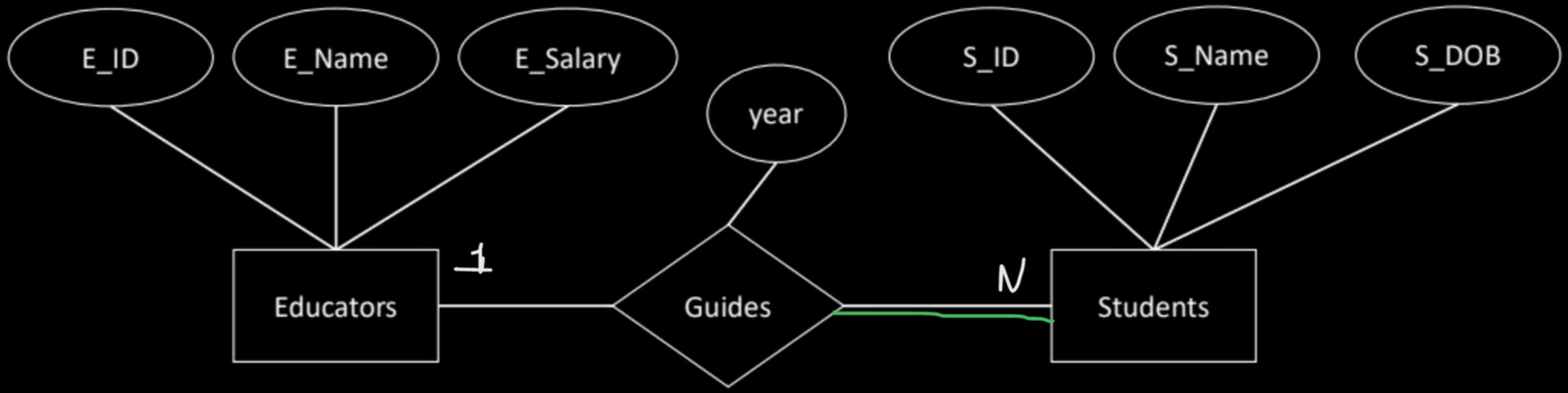
One to Many Relationship



Best soln :-

2 tables ⇒ Take relationship info^n towards many side entity set

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Educators

Eid	Ename	Esalary

students

Sid	sname	sdob	guide eid	year
S1	Rohit	27 Jan	E1	2022
S2	Govinda	1 Feb	E1	2022
S3	Vijay	23 Mar	E2	2023

not null

FD =>

Eid → Ename Esalary

FD => Sid → name, dob, guide, year

---

options:-

✗

Educators

Eid	Ename	Esalary	Sid	year
E1	—	1	S1	2022
E1	—	1	S2	2022

} Eid not p.k. & redundancy.

Option 3:-

3 tables

Eductors

Eid	Ename	Esalary

Student

sid	sname	sdob

Guides

sid	Eid	year
S1	E1	
S2	E1	

sid is pk so better to keep it in same table

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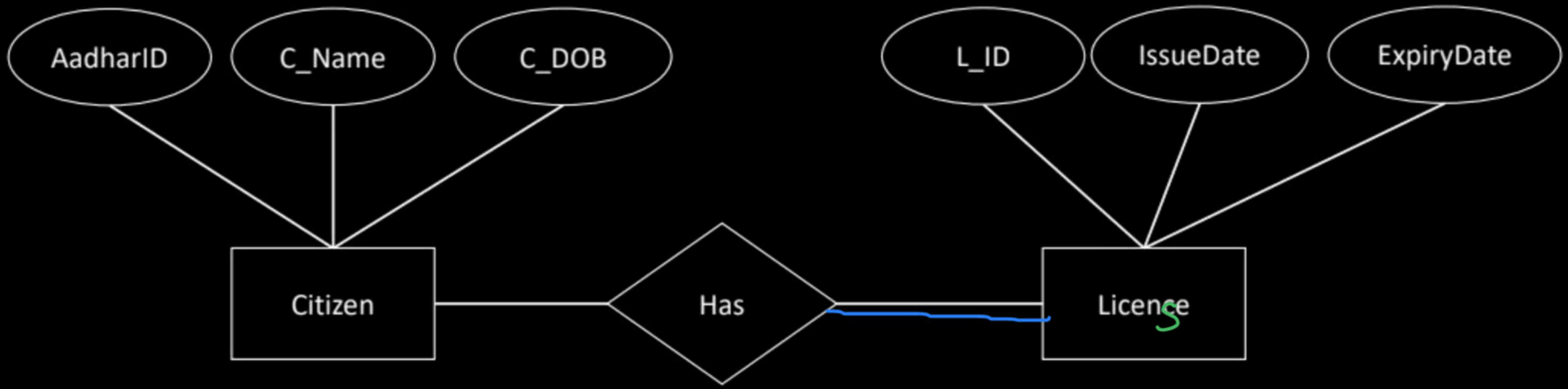
One to One Relationship



option 1 :- key relationship info^n towards citizen

Citizen

Aadharid	c_name	c_dob	L_id

License

lid	issuedate	Edate

Option 2:- keep relationship info towards license side.

citizen

Aadharid	c_name	c_dob

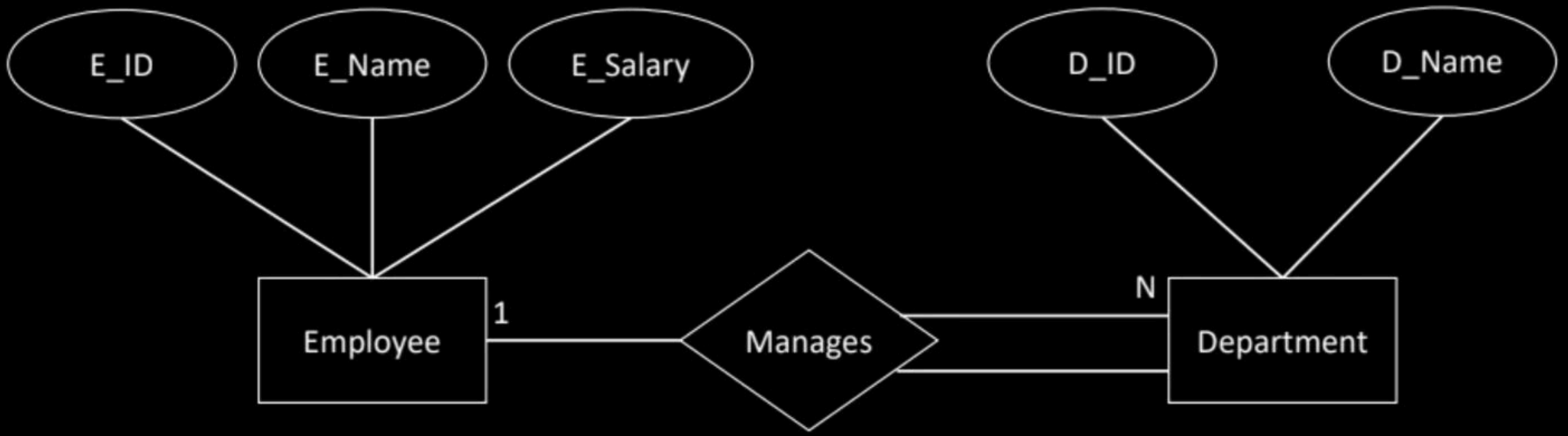
license

lid	issuedate	expiry date	Aadharid

not NULL

option 2 is better because license has total participation in relationship.

Participation Constraint



Employee

Eid Ename Esalary

Department

Did Dname Eid of manager

Not NULL

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How to control participation in many-to-many ⇒ ?

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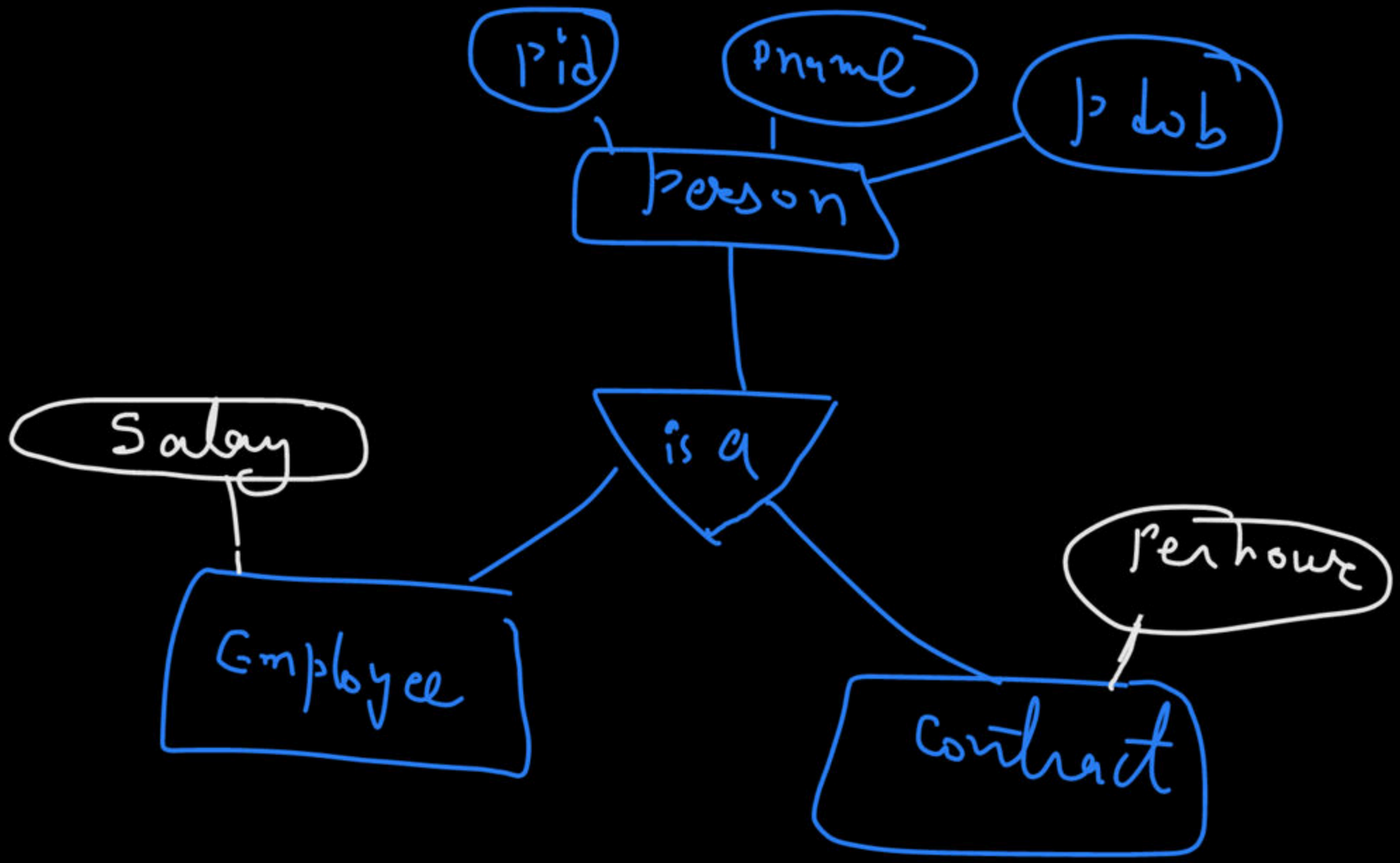
Generalization & Specialization



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option 1 :- 3 Tables

Person (Pid , pname , pdob)

Employee (pid , salary)

contract (Pid , per hour)

⇑

overlapping

option 2 :- 2 tables

Employee (pid , pname , pdob , salary

contract (pid , pname , pdob , perhour

⇑

disjoint

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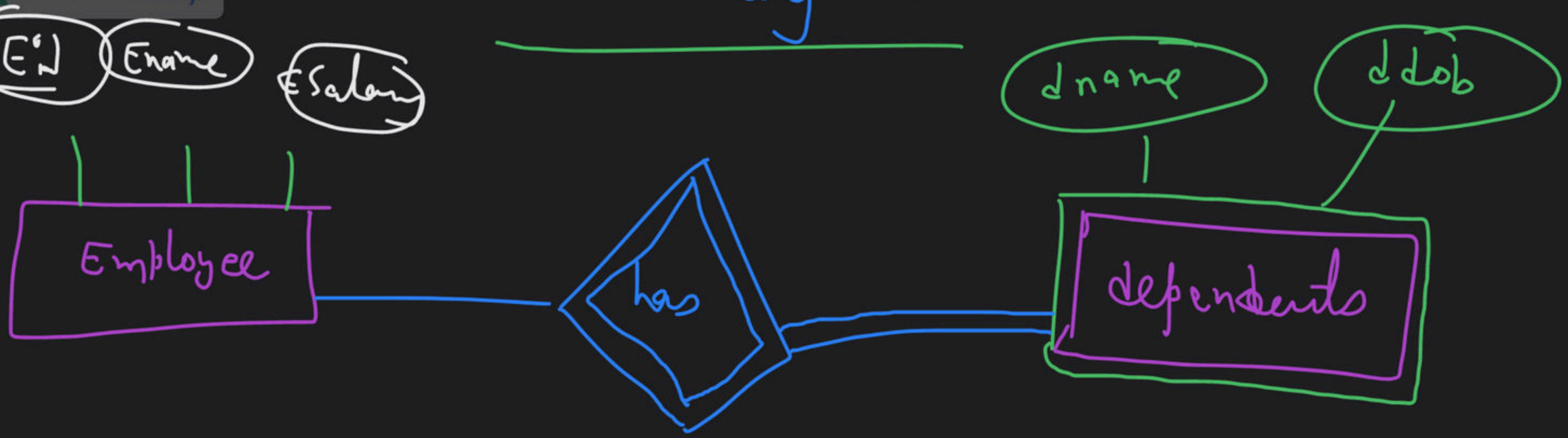
weak entity set



2 tables :-

Employee

Eid Ename Esalary

dependents

Eid dname dbod

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Relational Algebra

Relational algebra is a procedural query language, which takes instances of relations as input and yields instances of relations as output

The main application of relational algebra is to provide a theoretical foundation for relational databases, particularly for query languages.

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Relational Algebra

Basics Operators:

1. Select (σ)
2. Project (∏)
3. Union (∪)
4. Set Difference (−)
5. Intersection (∩)
6. Cartesian Product (X)
7. Rename (ρ)
8. Division (÷)

5. natural join (inner) ⋈

10. left outer join ⟕

11. Right - " ⟖

12. full outer join ⟗

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select * from table ⟸ SQL

R.A. ⇒ Π (table)

$\Downarrow\Downarrow$

(table)

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Select

The SELECT operator chooses those tuples in the output that satisfy the specified condition.

$\sigma_{\text{<selection-condition>}}$ (Relation name)

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Select

sailors

Eid	Ename	Rating	Age
101	Richa	7	24
105	Rohan	9	20
120	Mahesh	8	26
145	Abhishek	10	29

```
select * from sailors
where rating > 8
```

To select those tuples of sailors relation where rating is greater than 8

$\sigma_{Rating > 8}(sailors)$

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Find all sailors who have rating greater than 8 but age less than 25.

$$\sigma_{rating > 8 \wedge age < 20}(sailors)$$

$\wedge \Rightarrow$ And

$\vee \Rightarrow$ OR

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Select

Comparison operators that can be used in selection conditions are:

<, <=, =, ≠, >=, >

The select operation is commutative i.e.

$$\sigma_{<\text{cond 1}>}(\sigma_{<\text{cond 2}>}(R)) = \sigma_{<\text{cond 2}>}(\sigma_{<\text{cond 1}>}(R)) = \sigma_{\text{cond1} \wedge \text{cond2}}(R)$$

$$\sigma_{\text{rating}>8}(\sigma_{\text{age}<25}(R)) = \sigma_{\text{age}<25}(\sigma_{\text{rating}>8}(R))$$

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Project

The project operation is used to choose certain columns from the table and trashes out the other attribute fields

A projection is a unary operation written as $\prod_{A1, A2, \ldots, An} (r)$

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Project

Fetch only Ename and salary of all employees from employee relation

Eid	Ename	Salary	Dno	Sex
101	Raman	30,000	1	M
102	Sneha	20,000	1	F
103	Maya	20,000	2	F
104	Ranjith	20,000	2	M
105	Mahesh	15,000	3	M

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Project

The project operation results in a set of a distinct tuple as the Project operation removes duplicate tuples

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Project

Write a relation algebra statement to find name of all such employees from department no 2 whose salary is greater than 17000

Eid	Ename	Salary	Dno	Sex
101	Raman	30,000	1	M
102	Sneha	20,000	1	F
103	Maya	20,000	2	F
104	Ranjith	20,000	2	M
105	Mahesh	15,000	3	M

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Set Operations

1) Union
2) Intersection
3) Set-difference

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Set Operations

The two relations on which set operations are implemented upon must necessarily have similar data types of tuples. This condition is called type or union compatibility.

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Example

Eid	Ename	Age	Rating
20	Somya	24.0	7
30	Rahul	25.0	8
40	Ranjith	24.0	9
50	Yashvi	23.0	10
60	Sonam	27.0	8

Eid	Ename	Age	Rating
30	Rahul	25.0	8
35	Satyam	24.0	9
50	Yashvi	23.0	10
60	Sonam	27.0	8

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Question

Consider 2 relations Students(rno, sname, dob) and Employess(eId, ename, salary)

Write a relational algebra statement for corresponding SQL Query:

Select distinct sname from Students where dob='27-10-1988' Union Select distinct ename where salary>15000

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Set Operations

Union and intersection are commutative and associative

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Question

Consider 2 relations R1(x,y) and R2(x,y). R1 and R2 contains all Not NULL values.

Will the following 2 statements be equivalent or not?

$$\pi_x(R1 \cup R2)$$

$$\pi_x(R1) \cup \pi_x(R2)$$

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Question

Consider 2 relations R1(x,y) and R2(x,y). R1 and R2 contains all Not NULL values.

Will the following 2 statements be equivalent or not?

$$\pi_x(R1 \cap R2)$$

$$\pi_x(R1) \cap \pi_x(R2)$$

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Happy Learning.!

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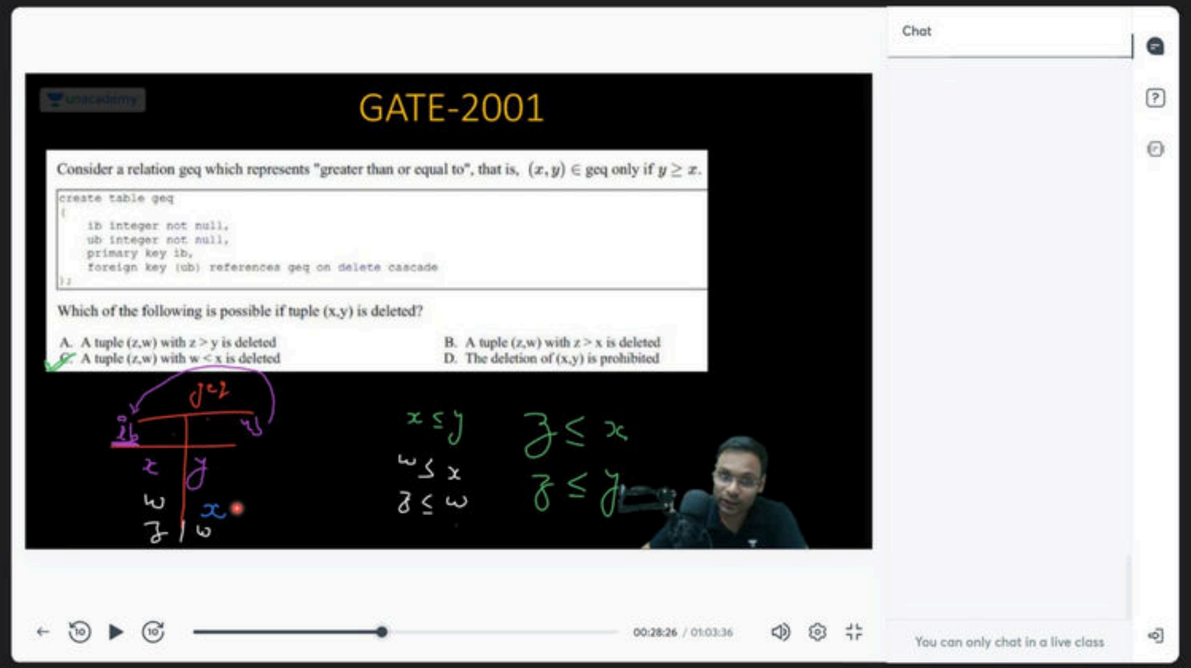
▲ 1 • Asked by Saloni

yeh ques nhi samaj aaya sir



▲ 1 • Asked by Rishabh

If the relation is not in BCNF then all the attributes of every Dependency not having a superkey in LHS is kept in a separate relation.