DBMS

ER diagram

Conversion of E-R Diagram to Tables
Handling of Entity Sets

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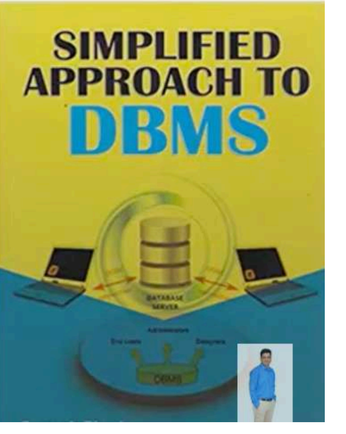
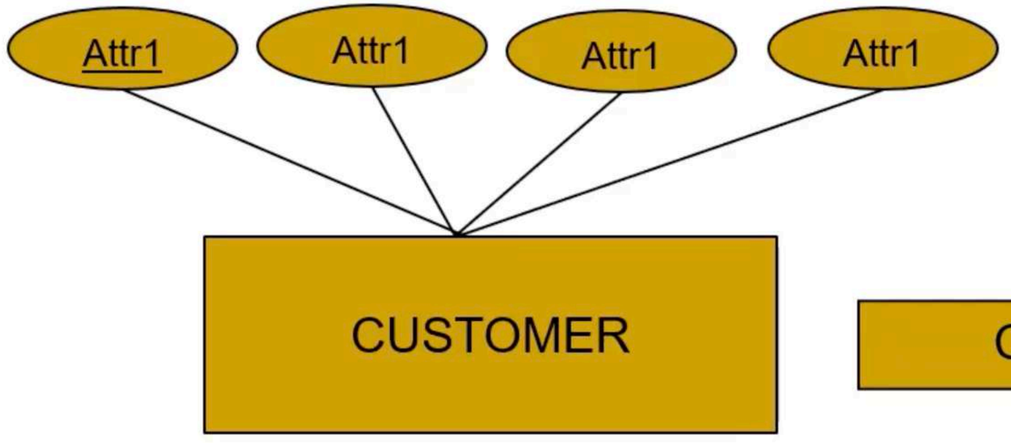


Handling of Entity Sets

- For each entity set create a unique table.
- As entity set refers to class in OOP and table in relational model.
- Assign the name of table as name of the corresponding entity set.

Conversion of Entity Set to Relational Table



Entity Set

Convert to

Primary Key

CUSTOMER

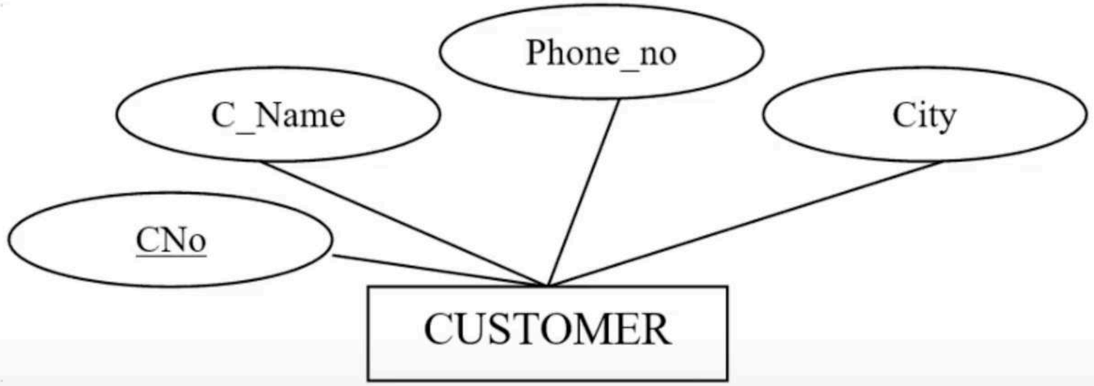
Attr1	Attr2	Attr3	Attr4

Relational Table

Handling of Attributes

- For every simple attribute create a column of the table.
- The key attribute will become primary key of the table.
- However, composite attribute, multi-value attribute and derived attribute need special treatment.

Example:



CNo	C_Name	Phone_No	City
100	Rahat Bhatia	2444566	Patiala
101	Ruhani Sharma	4547235	Jalandhar
102	Raj Singh	3445432	Amritsar

Conversion of E-R Diagram to Tables
Handling of Composite Attributes

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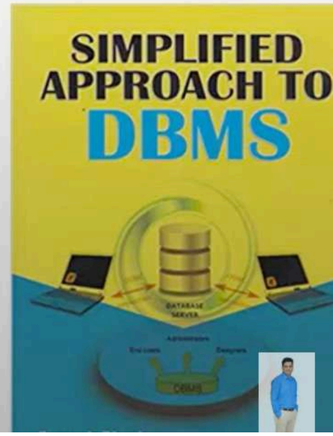
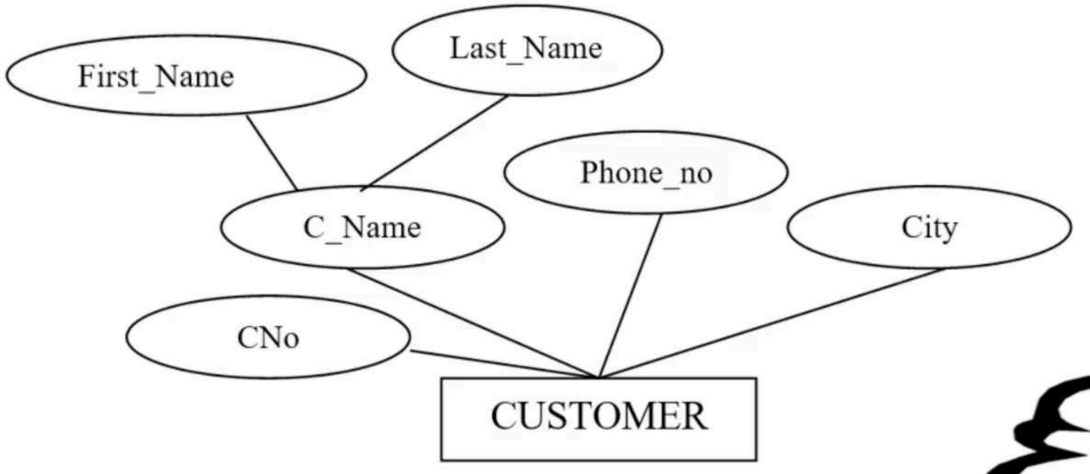


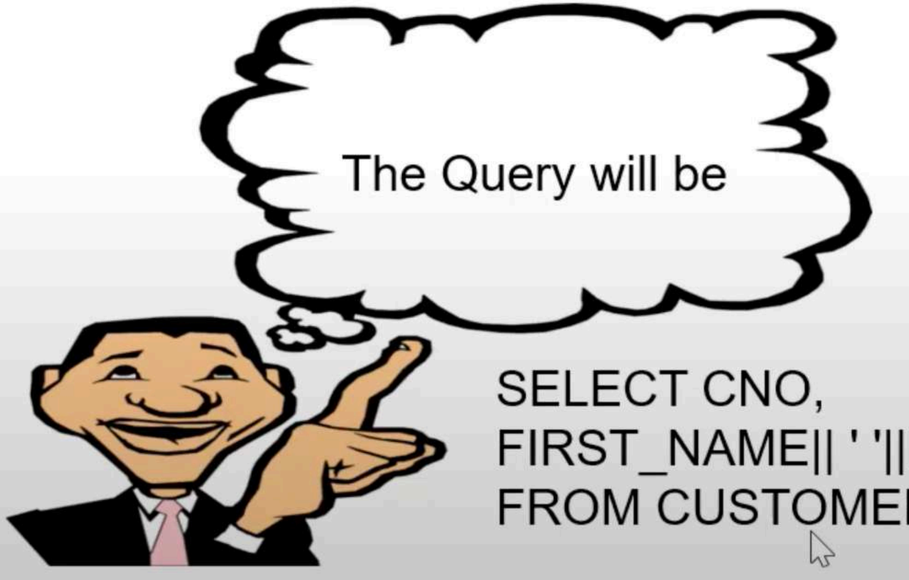
Handling of Composite Attribute

- Composite attributes are those which can split into components.
- For example: Name as First_Name and Last_Name
- In order to convert an entity set to table the composite attributes are flattened out by creating a separate attribute for each component of composite attribute.
- Create the columns for branches and ignore the root.

Handling of Composite Attribute



CNo	First_Name	Last_Name	Phone_No	City
100	Rahat	Bhatia	2444566	Patiala
101	Ruhani	Sharma	4547235	Jalandhar
102	Raj	Singh	3445432	Amritsar




```
SELECT CNO,
FIRST_NAME|| ' '||LAST_NAME AS FULL_NAME
FROM CUSTOMER;
```

Exercise

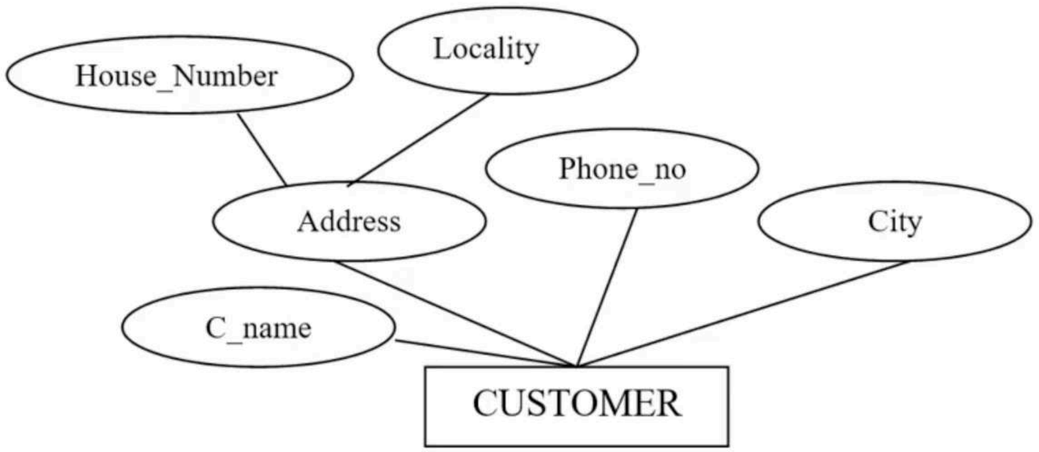


Table Customer

- Columns
- C_name, House_Number, Locality, Phone_no, City
- Query to retrieve full Address

Select C_Name,

House_Number||' '||Locality Address from Customer;

Conversion of E-R Diagram to Tables
Handling of Multi-Value Attributes

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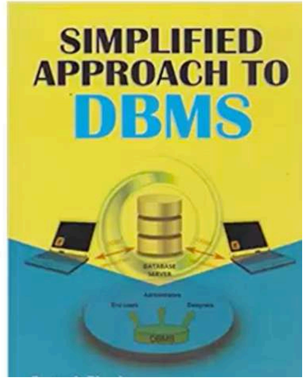
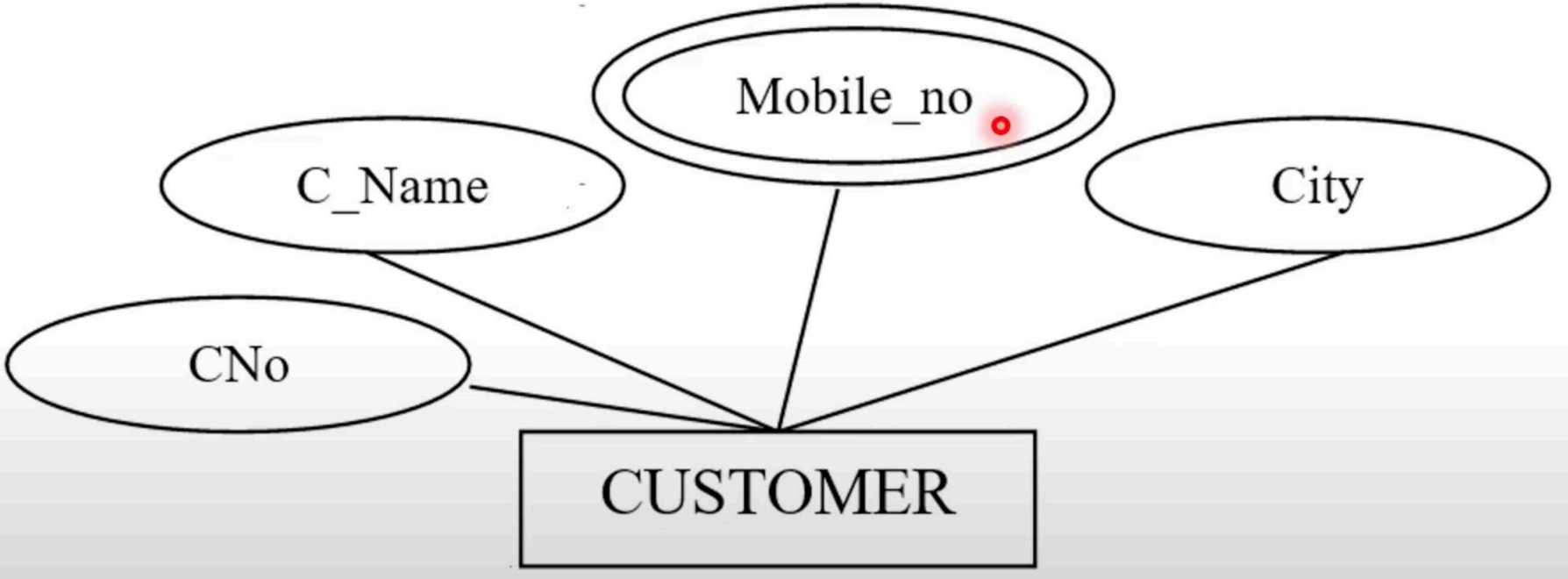


Multi-Value Attributes

- Multi-value attributes are those which can take many values.
- For example: Mobile_Number, Hobbies, Skills etc.

Example



Possible Solution: Create a column for each possible value of attribute for a record

Cno	C_Name	City	Mobile_No1	Mobile_No2	Mobile_No3
100	Rahat Bhatia	Patiala	1876115046	8739593711	8739593715
101	Ruhani Sharma	Jalandhar	3475784928		
102	Rishan	New Delhi	7457483929	8734648483	

First we have to fins that in which column 8739593711 is stored and then we have to update it.
Will be very tough and tricky.
Simplicity of RDBMS is lost…

Second Solution

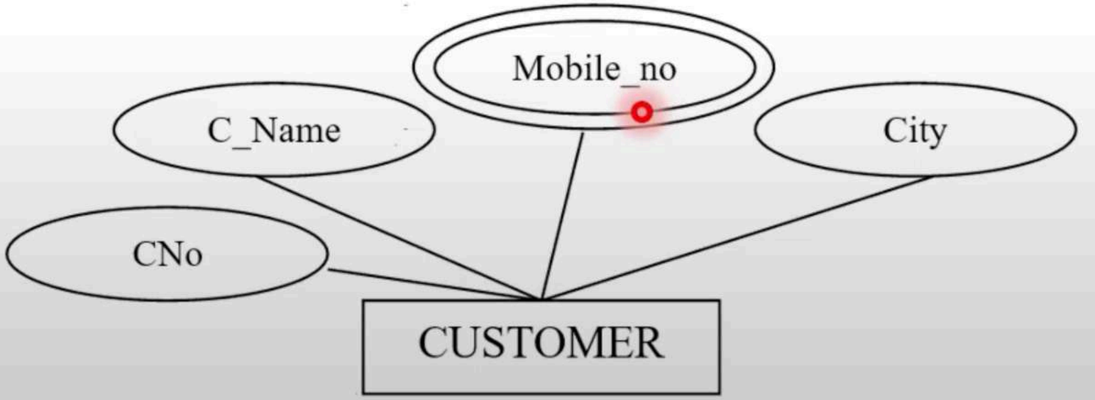
Store the multiple values of the column by comma separation.

Cno	C_Name	City	Mobile_Nos
100	Rahat Bhatia	Patiala	1876115046, 8739593711, 8739593715
101	Ruhani Sharma	Jalandhar	3475784928
102	Rishan	New Delhi	7457483929, 8734648483

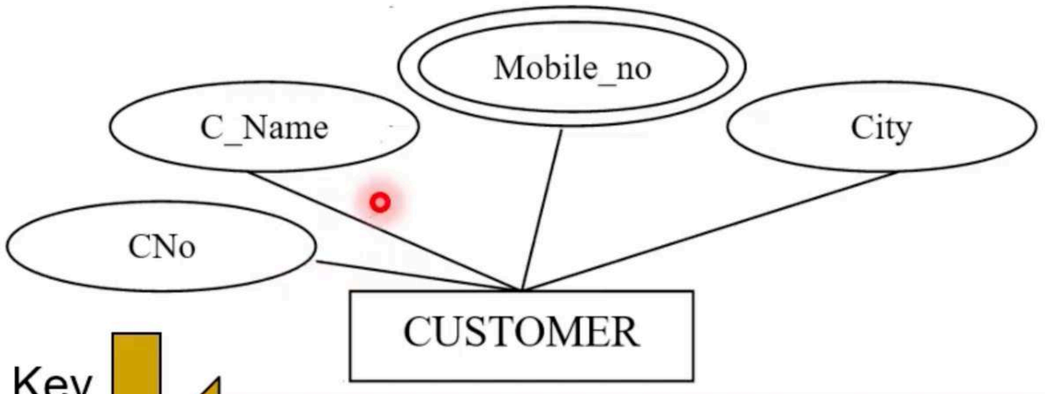
Integrity of data is lost.
Still Retrieve and Updation and Deletion operations are tricky
Will be very tough and tricky.
Simplicity of RDBMS is lost…

Solution for Handling of Multi-value Attribute

- A multivalued attribute M of an entity E is represented by a separate table EM.
- A table EM has attributes corresponding to the primary key of E and an attribute corresponding to multivalued attribute M.



Handling of Multi-value Attribute



- Solution: Two Tables

Primary Key

Foreign Key

Cno	C_Name	City
100	Rahat Bhatia	Patiala
101	Ruhani Sharma	Jalandhar
102	Rishan	New Delhi

Table: Customer

Primary Key

Cno	Mobile_No
100	1876115046
100	8739593711
100	8739593715
101	3475784928
102	7457483929
102	8734648483

Table: Cust_Mobile

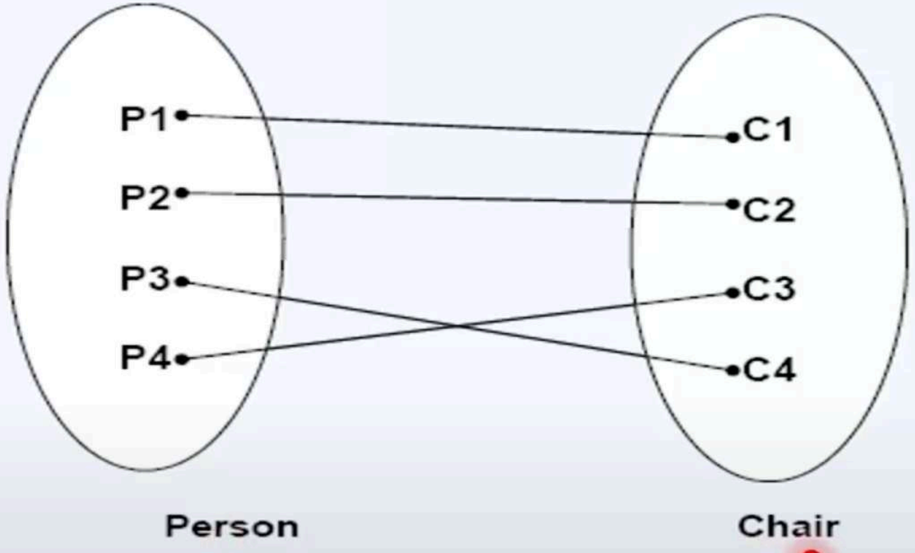
Connectivity of a Relationship

The connectivity of a relationship describes the mapping of associated entity instances in the relationship. The values of connectivity are "one" or "many".

- One to One (1:1)
- One to Many (1:M)
- Many to One (M:1)
- Many to Many (M:M)

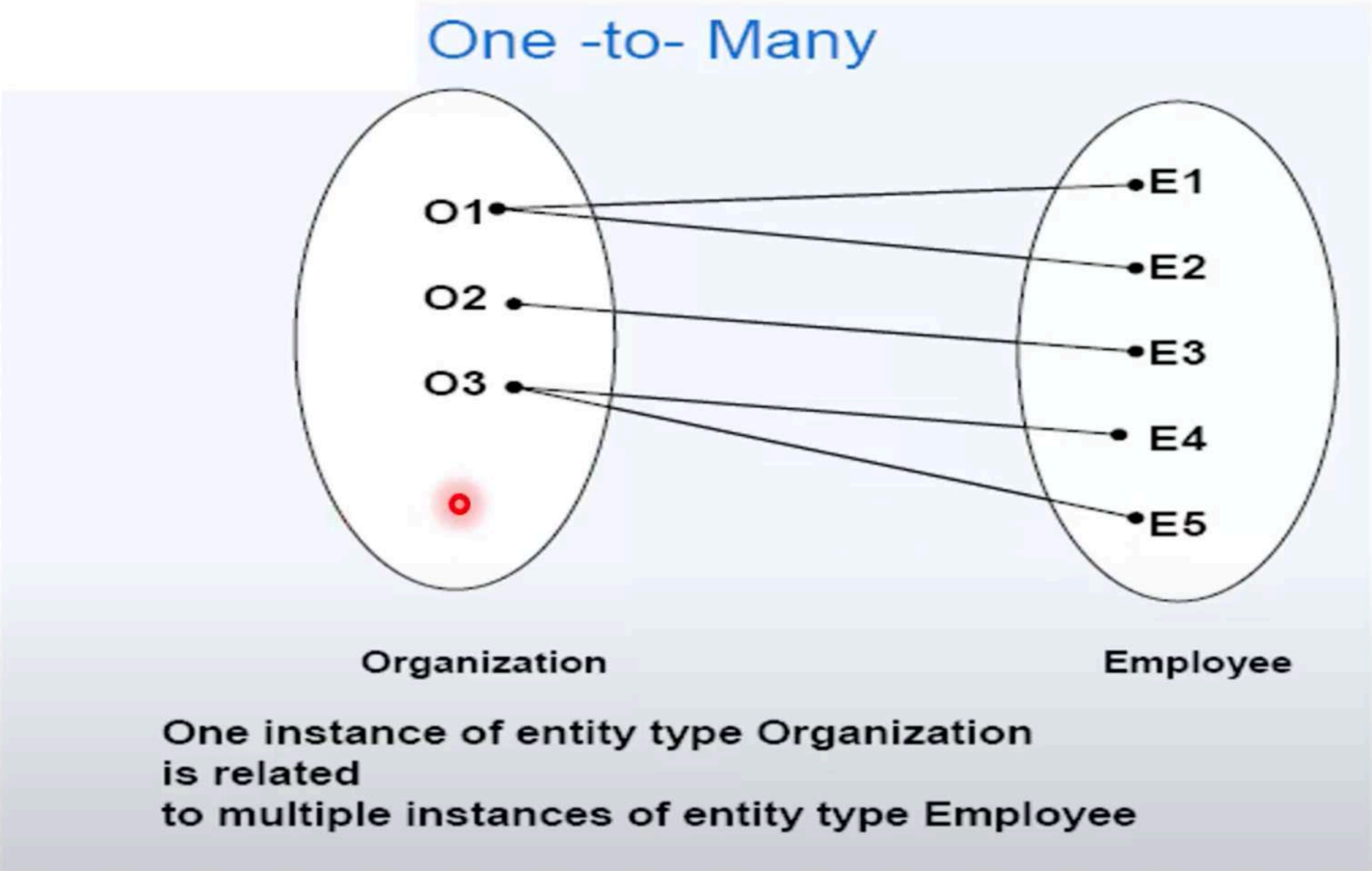
Connectivity of a Relationship

One - To - One

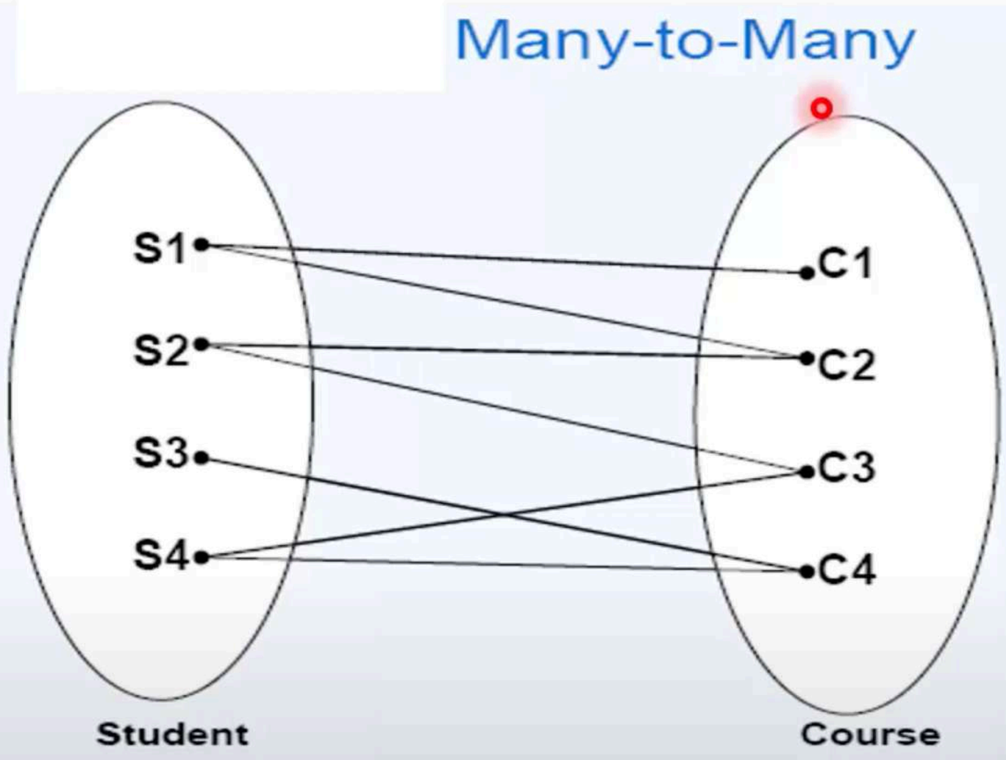


One instance of entity type Person
is related
to one instance of the entity type Chair.

Connectivity of a Relationship

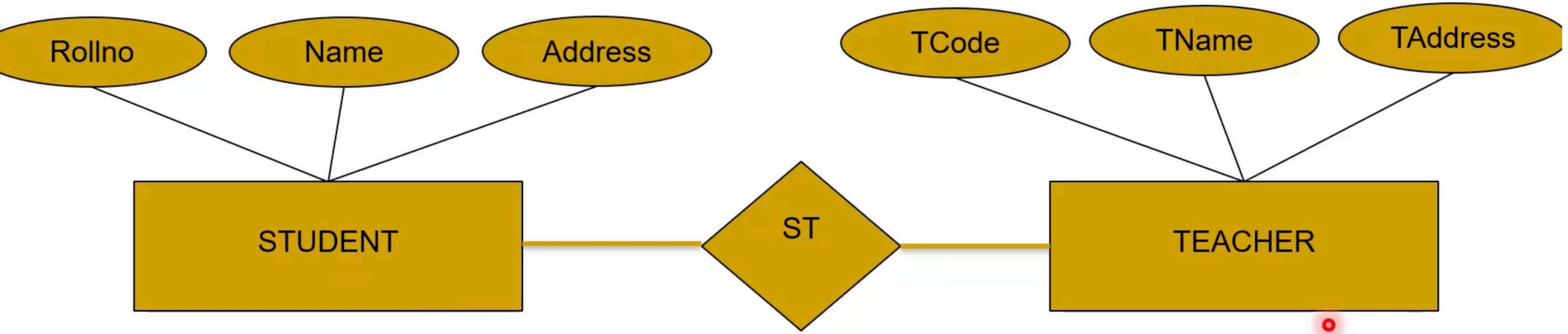


Connectivity of a Relationship

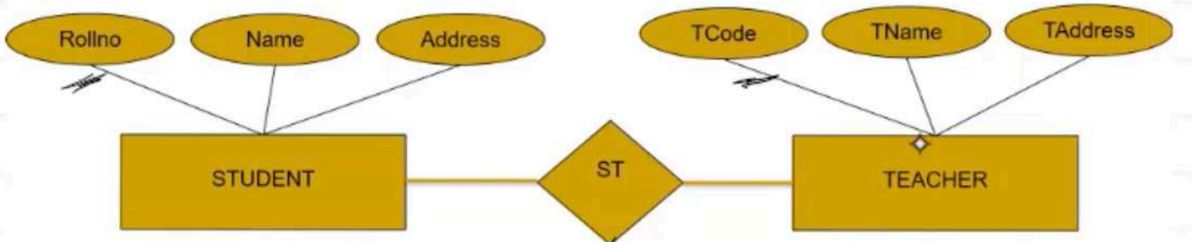


Multiple instances of one Entity are related to multiple instances of another Entity.

Handling of Many to Many Type of Relationship



Handling of Many to Many Type of Relationship



PK

STUDENT

Roll No	Name	Address

ST

FK

RollNo	TCode

PK

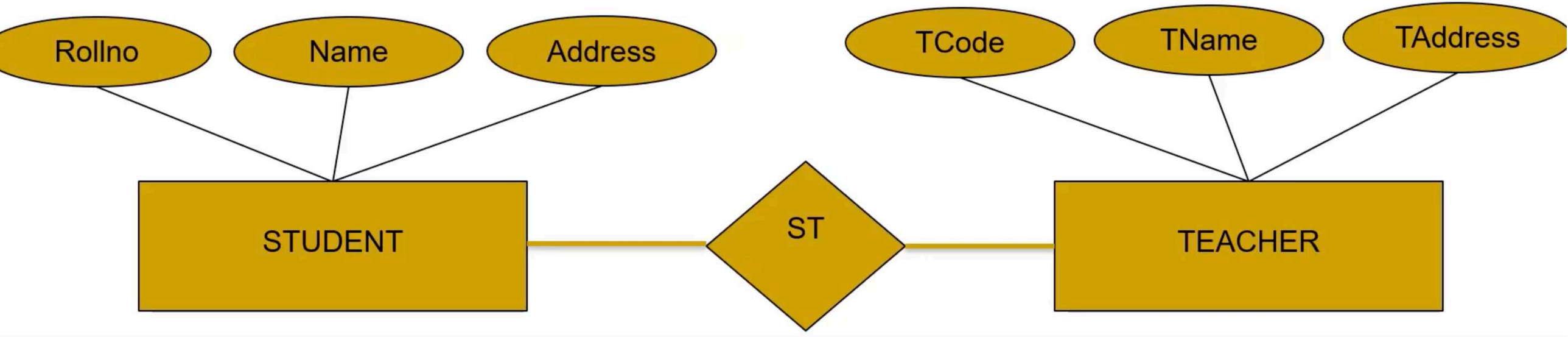
TEACHER

TCode	TName	TAddress

FK

PK

Handling of Many to Many Type of Relationship



Rule:
For every many to many type of relationship create a separate table for the relationship involving primary key of all participating entity sets.

Conversion of E-R Diagram to Tables
Handling of Many to One Type Relationships

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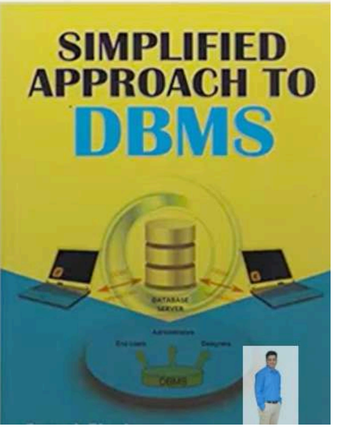
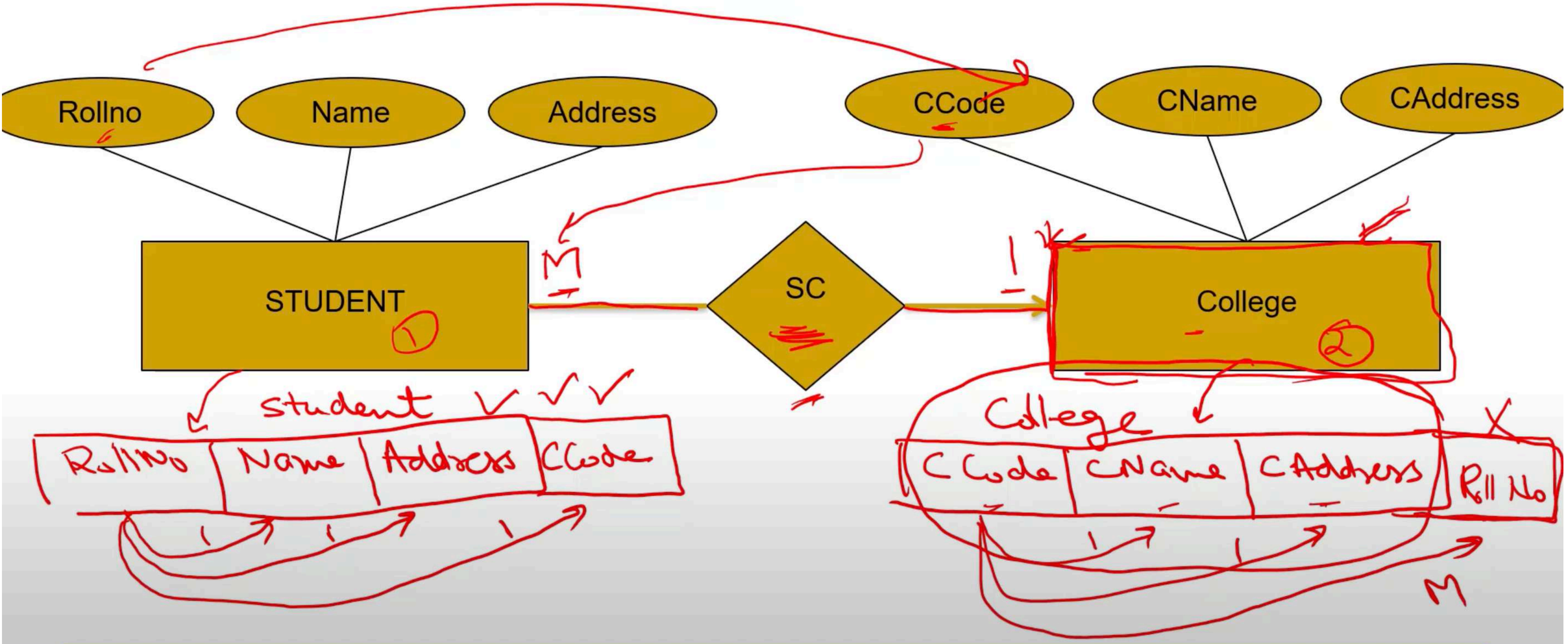


Handling of Many to One Type of Relationship



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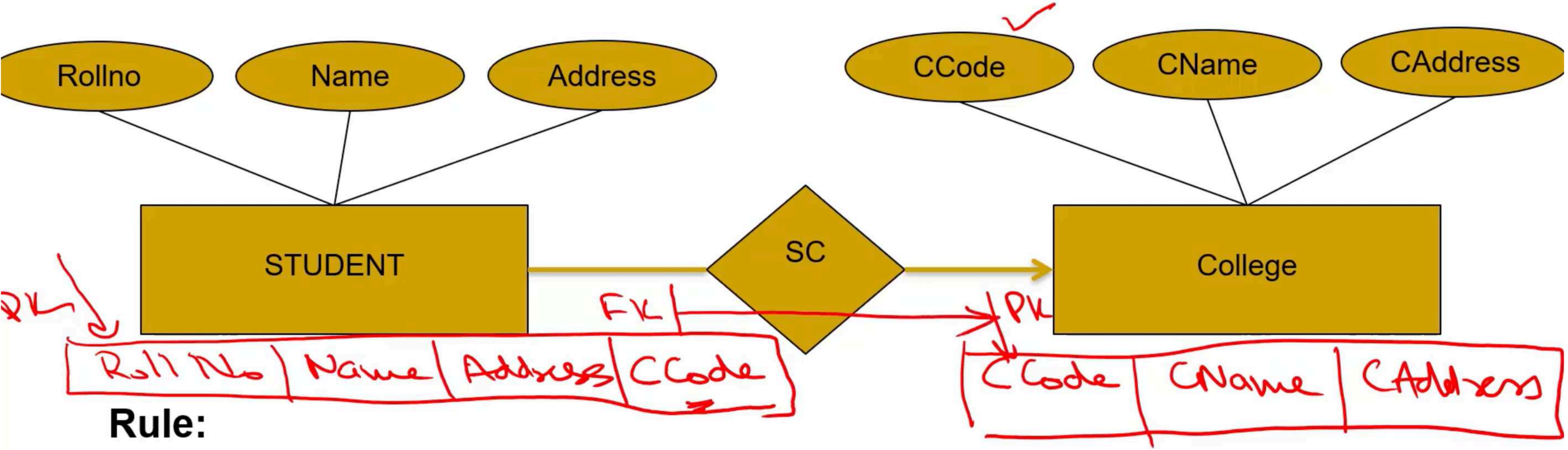

Rule:

For every many to one type of relationship, there is no need to create a separate table for the relationship.

Copy the primary key of one entity set towards many entity set.

Conversion of E-R Diagram to Tables
Handling of One to Many Type Relationships

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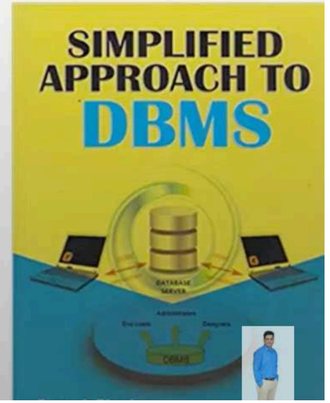
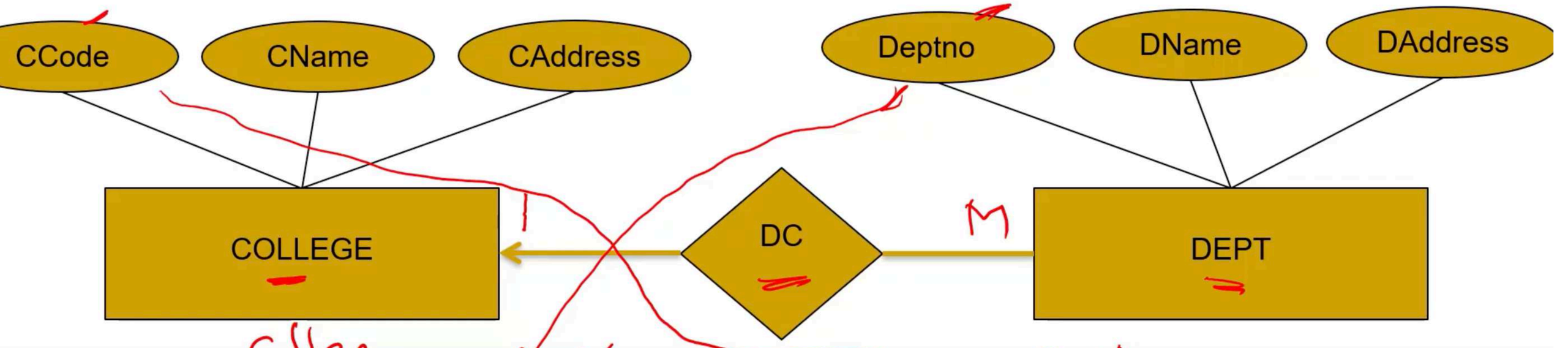


Handling of One to Many Type of Relationship



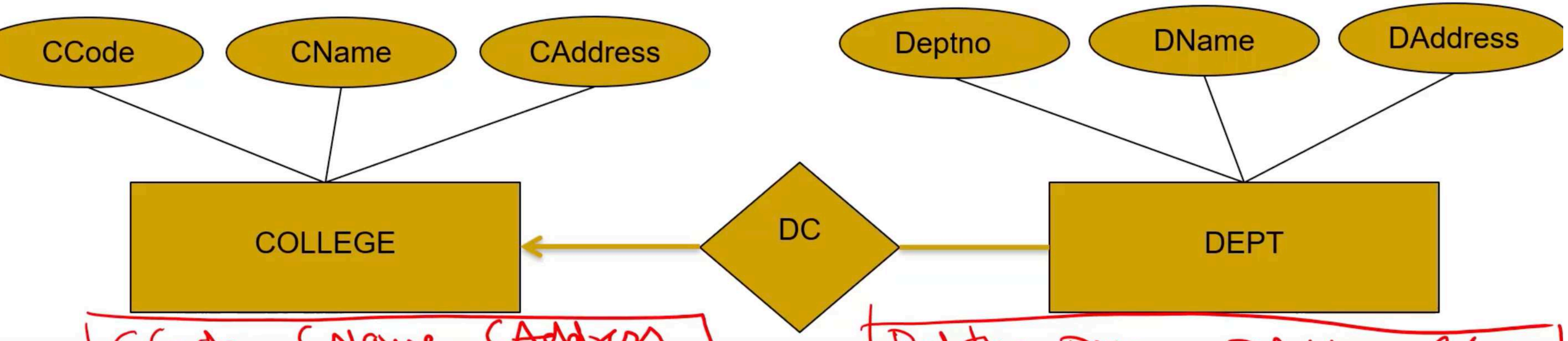
College

CCode	CName	CAddress	Deptno

Dept

Deptno	Dname	DAddress	CCode

Handling of One to Many Type of Relationship



CCode CName CAddress
College

Deptno DName DAddress CCode
Dept

Rule:

For One to Many type of relationship, there is no need to create a separate table for the relationship.

Copy the primary key of one entity set towards many entity set.

Conversion of E-R Diagram to Tables
Handling of One to One Type Relationships

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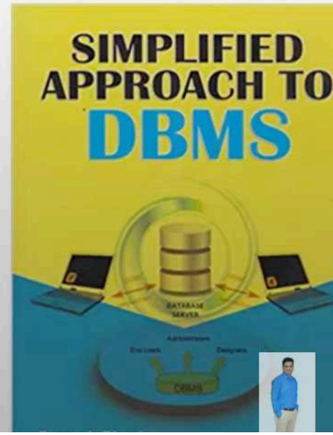
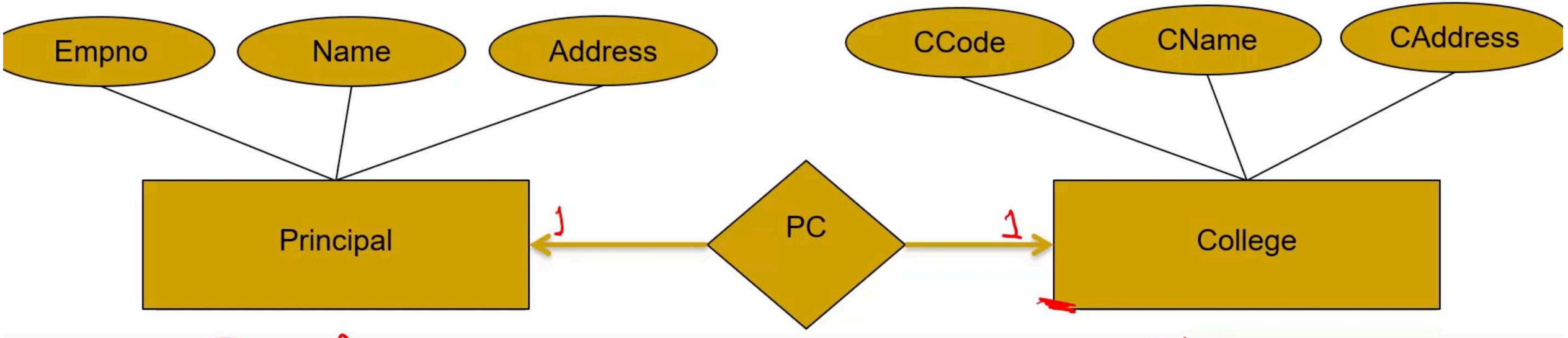


Handling of One to One Type of Relationship



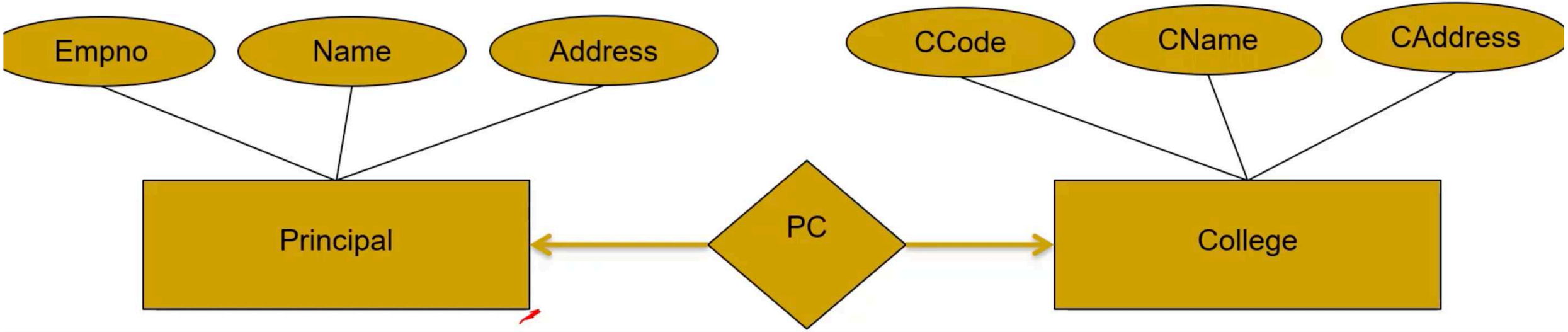
Principal

Empno	Name	Address	CCode

College

CCode	CName	CAddress

Handling of One to One Type of Relationship

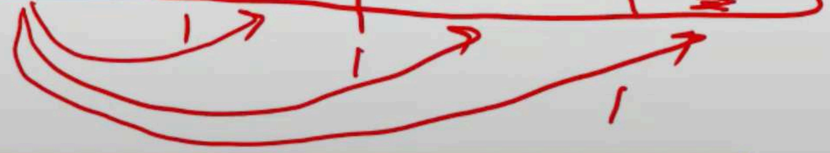


Principal

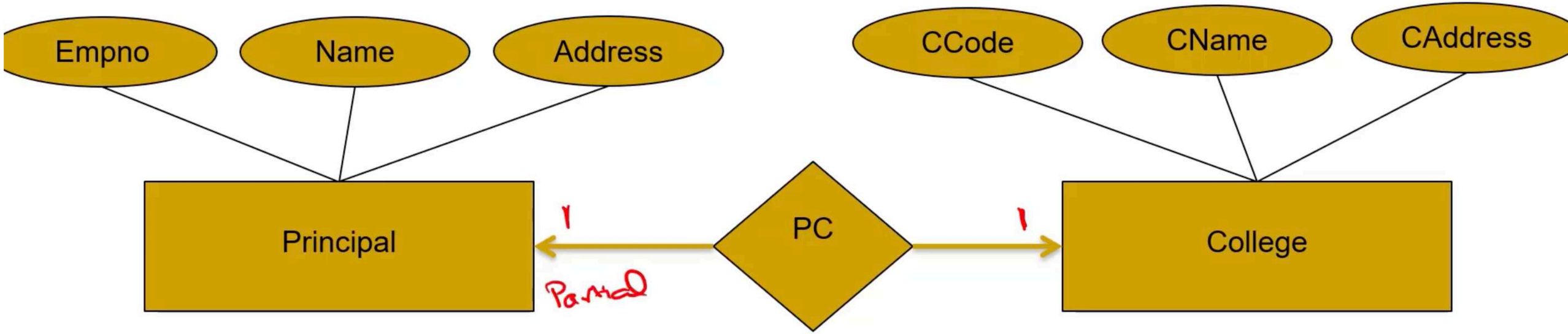
Empno	Name	Address

College

CCode	CName	CAddress	Empno



Handling of One to One Type of Relationship

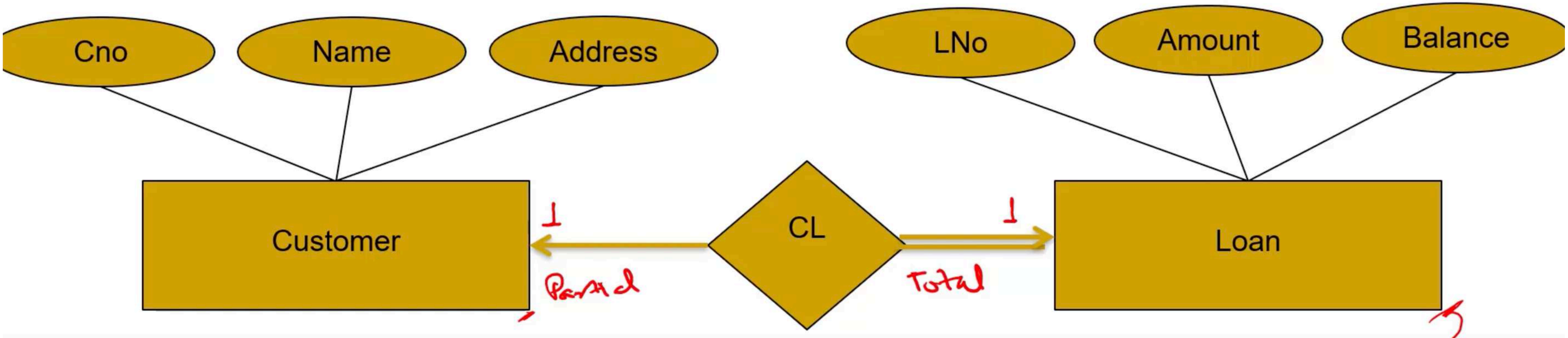


Rule:

For One to One type of relationship, there is no need to create a separate table for the relationship.

Copy the primary key of any of one entity set towards another entity set.

Handling of One to One Type of Relationship



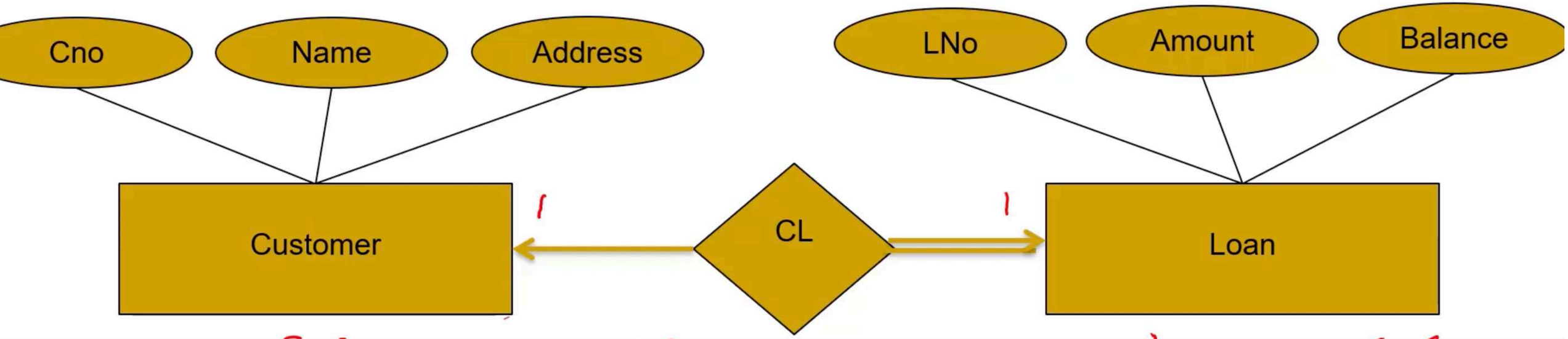
Customer

CNO	Name	Address

Loan

LNO	Amount	Balance	CNO

Handling of One to One Type of Relationship



Customer

90%

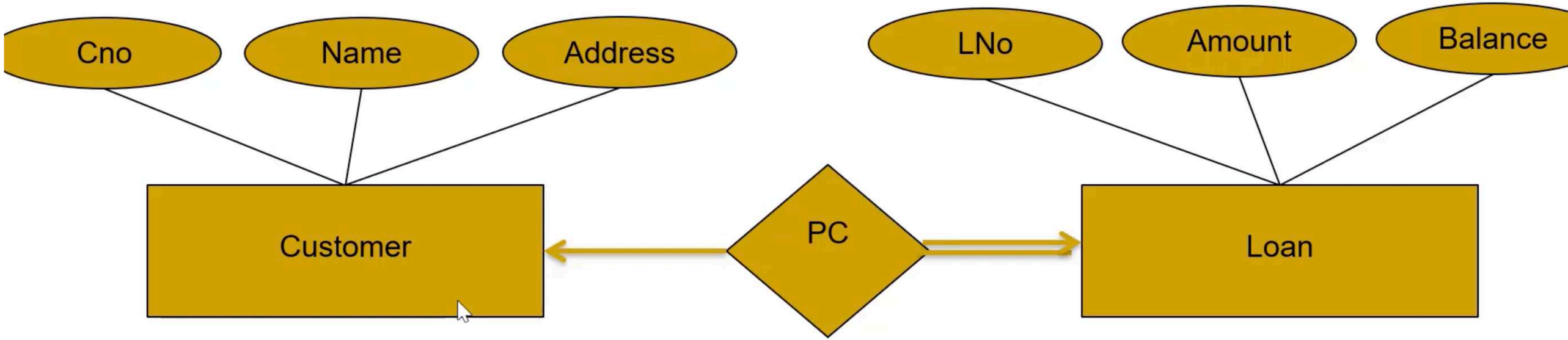
CNo	Name	Address	LNo
C1	A	ASR	Null
C2	B	JAL	L1
C3	C	PTA	Null
C4	D	PTA	Null

10%

Loan

LNo	Amount	Balance	CNo
L1	—	—	C1
L2	—	—	C2
L3	—	—	C3

Handling of One to One Type of Relationship



Rule:
If you have any of entity set with total participation, then always copy primary key of one entity set towards an entity set having total participation.

Conversion of E-R Diagram to Tables
Handling of Derived Attributes

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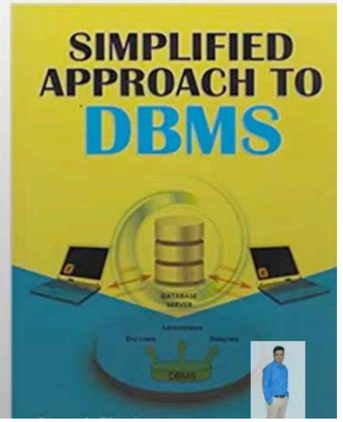
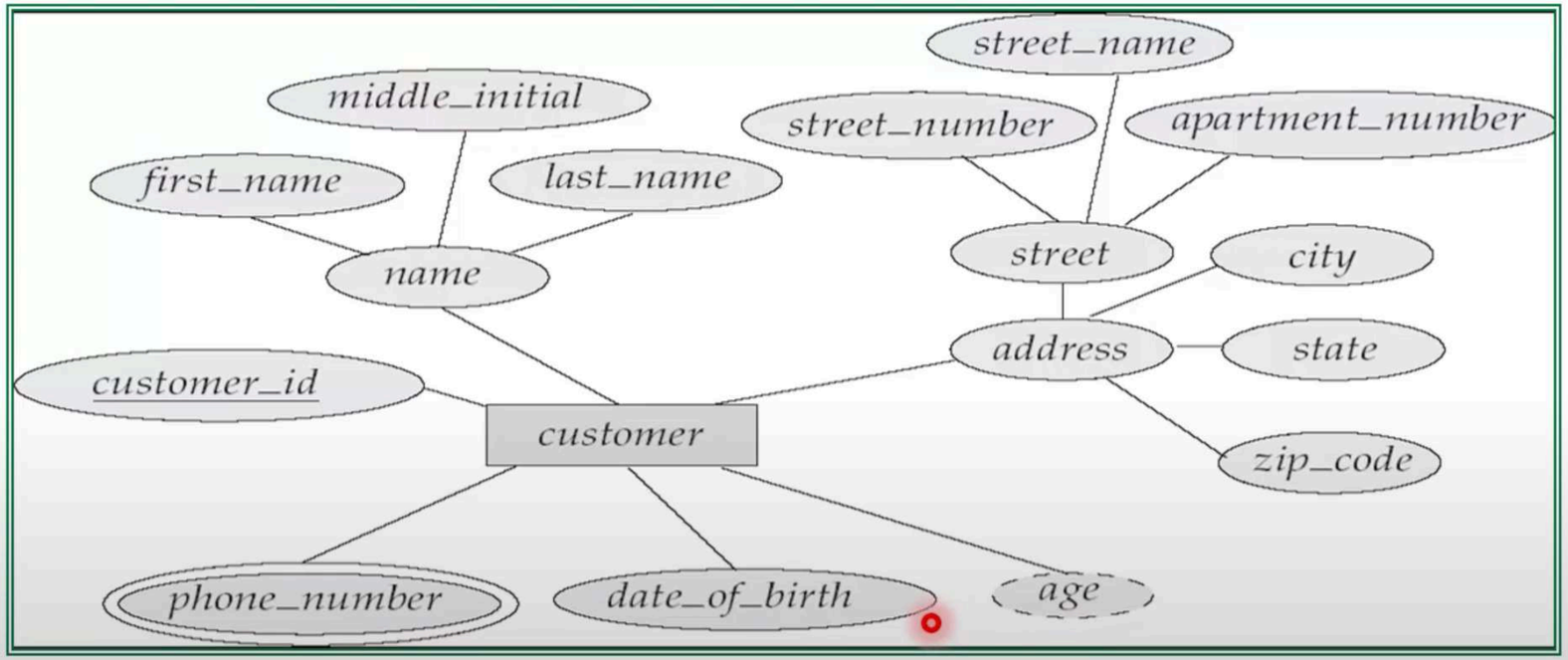


Derived Attribute

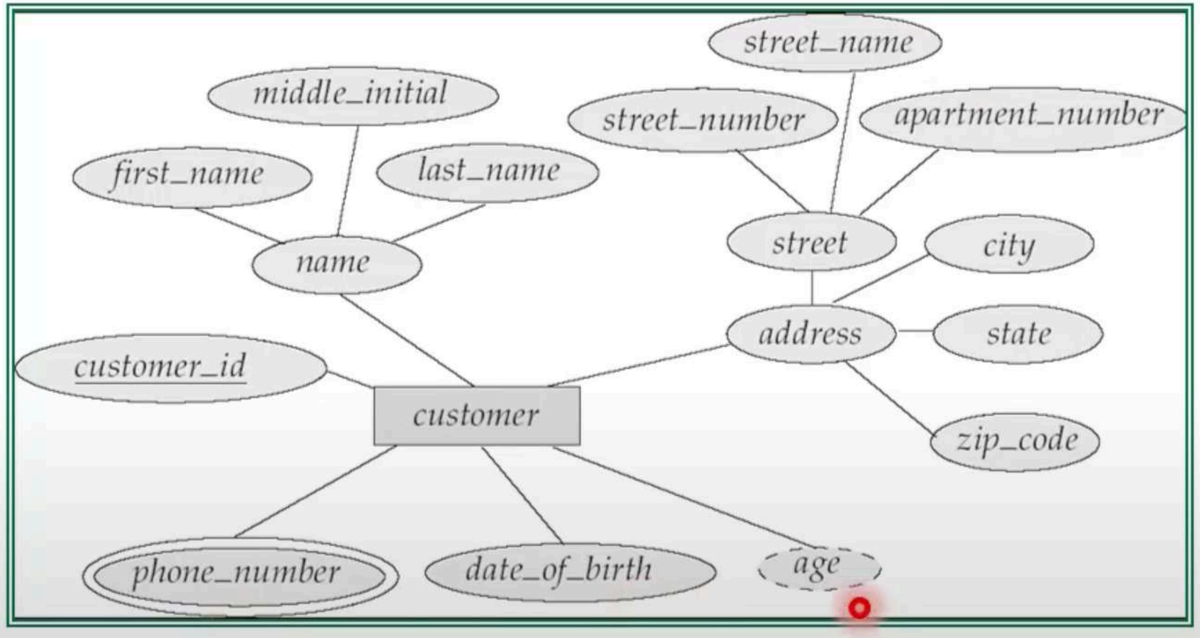
- The attribute whose value can be calculated based on other attributes is known as Derived Attribute.
- Examples: Age can be calculated based on Date of Birth, Experience of employee can be derived from his Date of Joining.

Example


street_name
middle_initial
street_number
apartment_number
first_name
last_name
street
city
name
address
state
customer_id
customer
zip_code
phone_number
date_of_birth
age

Derived Attribute

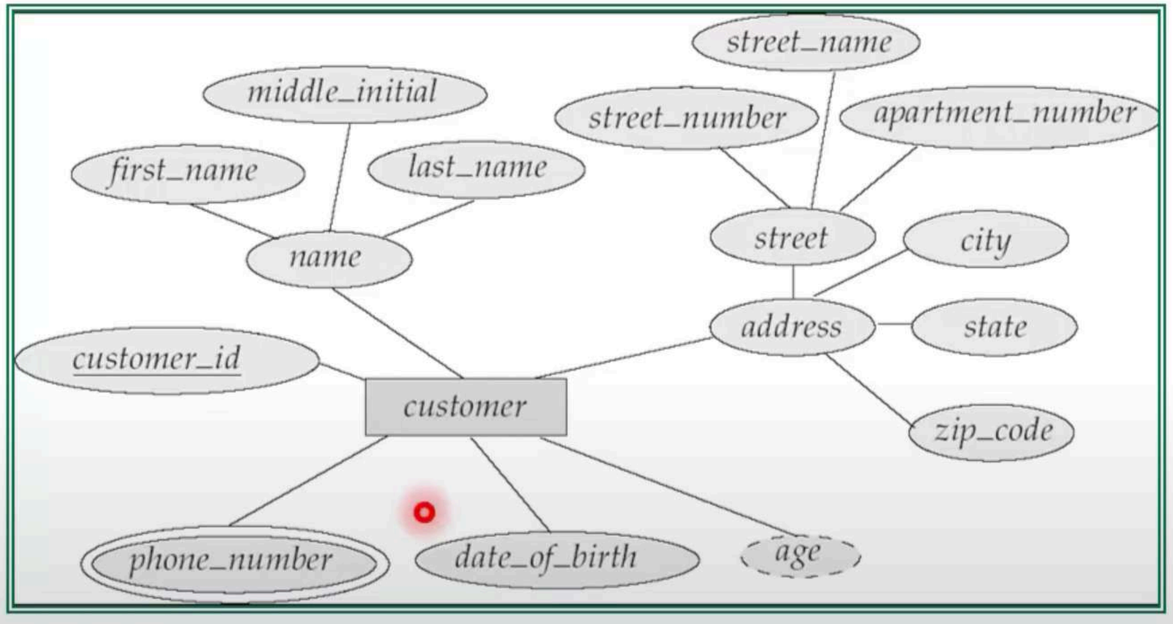
Example



- No need to create a column for age.
- Its value will be derived from date_of_birth column
- The query for this is:

```
SELECT
(SYSDATE- DATE_OF_BIRTH )/365 AGE
FROM CUSTOMER;
```

Conversion of Entity Set to Tables



- Table: CUSTOMER
- Columns:

customer_id, first_name, Middle_initial, last_name, stree_number, street_name, apartment_number, city, state, zip_code, date_of_birth

There will be 11 columns

- Table: Customer_phone
- Columns:

Customer_id, phone_number

Steps to Design ER Model

By

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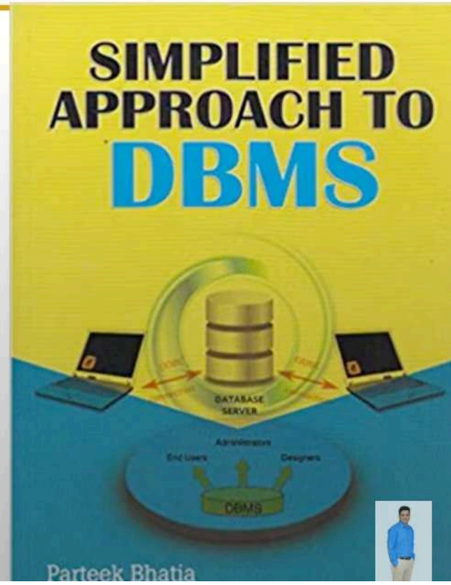
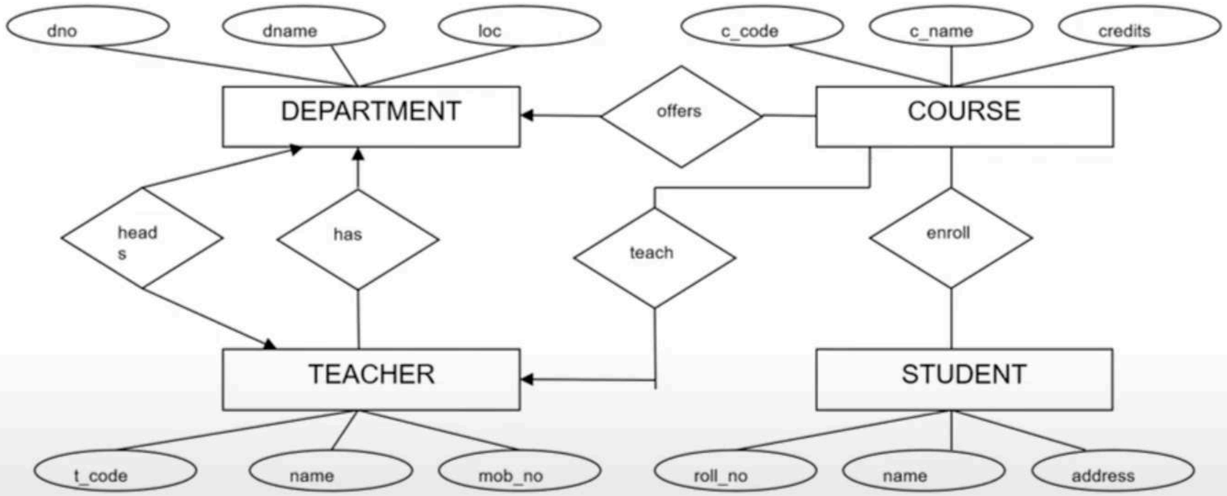
Patiala



Case Study of University Management System

- Consider, a university contains many departments. Each department can offer any number of courses. Many teachers can work in a department. A teacher can work only in one department. For each department there is a Head. A teacher can be head of only one department. Each teacher can take any number of courses. A course can be taken by only one instructor. A student can enroll for any number of courses. Each course can have any number of students.



Steps to design E-R diagram

- **Step 1 to Identify the Entities**
- **Step 2 to find relationships among these entities**
- **Step 3 to identify the key attributes**
- **Step 4 to identify other relevant attributes**
- **Step 5 to draw the complete e-r diagram**

Case Study of University Management System

- Consider, a university contains many departments.
- Each department can offer any number of courses.
- Many teachers can work in a department. A teacher can work only in one department.
- For each department there is a role of Head which is performed by the Teacher. A teacher can act as head of only one department.
- Each teacher can take any number of courses. A course can be taken by only one instructor.
- A student can enroll for any number of courses. Each course can have any number of students.

First Step:
To Identify the Entities

We can identify the following nouns:

- University, Department, Course, Teacher, Student.
- Here, the database is of only one university. If an entity has a single instance then that entity is ignored. Thus, the final entities are:
- DEPARTMENT
- COURSE
- TEACHER
- STUDENT

Steps to Design ER Model

Step-2: Identifying relationships among Entities

By

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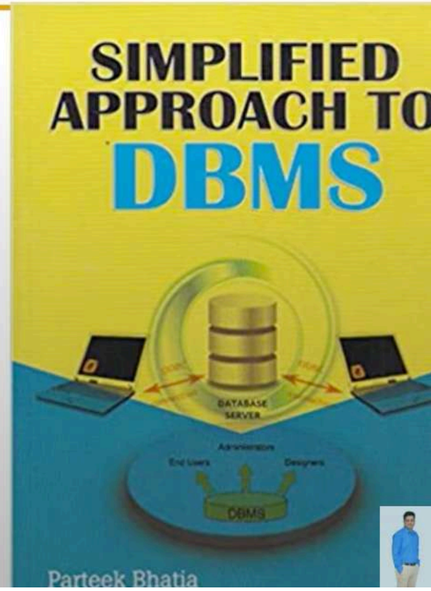
Patiala

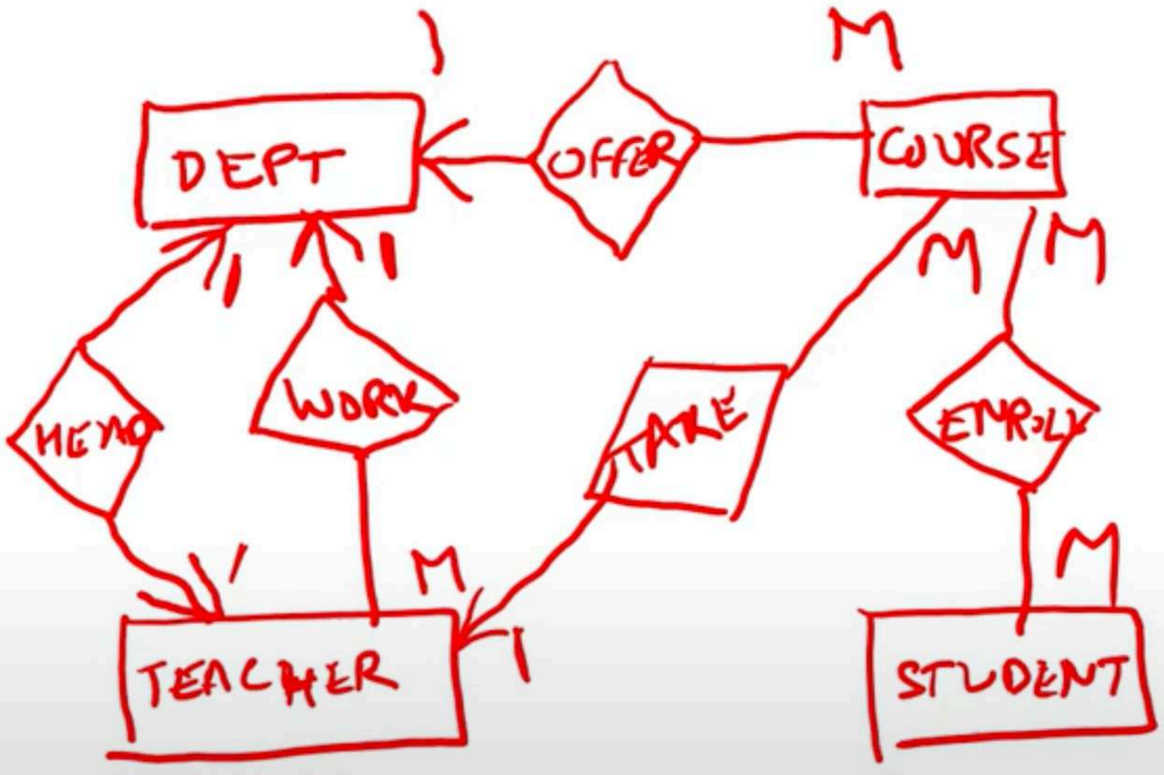


Second Step:
To find relationships among these entities

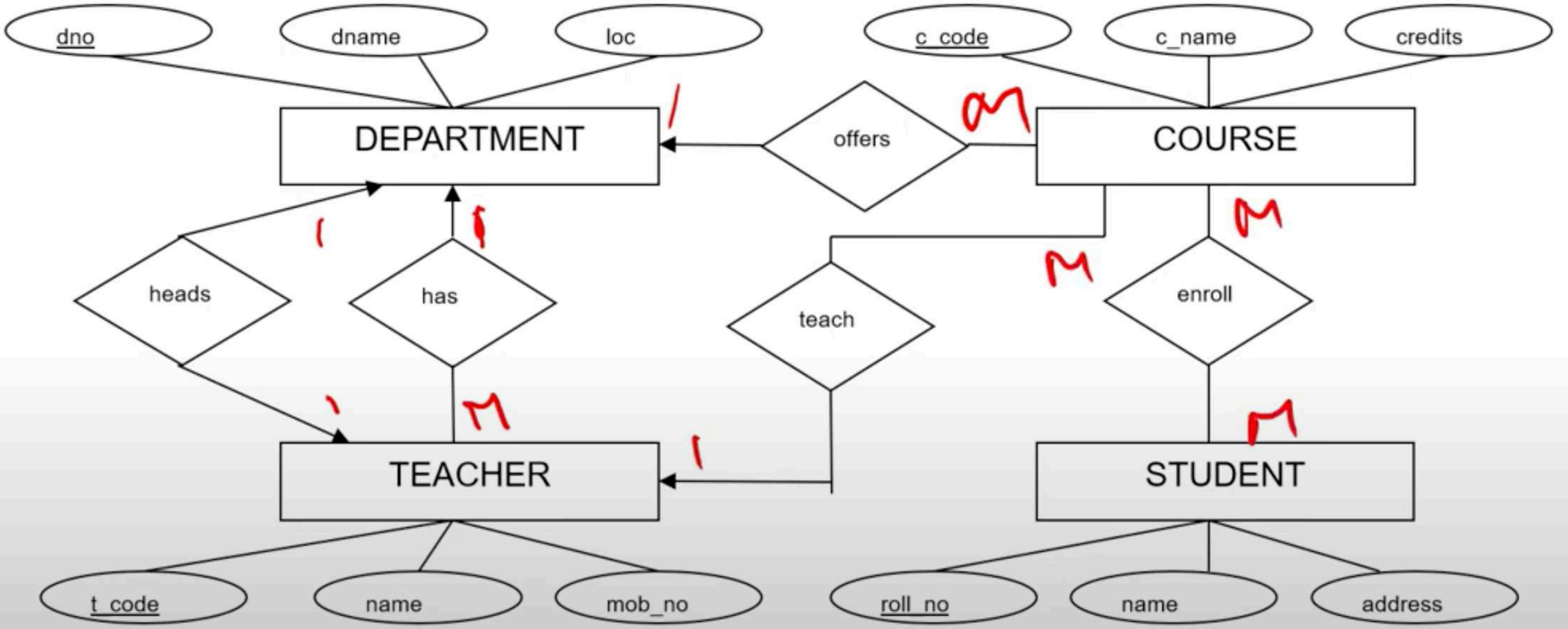
- Relationship are indicated by verbs or roles in the requirement sheet.
- So, we have to read each line of requirement sheet one by one and identify the verb between the nouns or entity sets.

Second Step:
To find relationships among these entities

- Consider, a university contains many departments.
- Each department can offer any number of courses.
- Many teachers can work in a department. A teacher can work only in one department.
- For each department there is a role of Head which is performed by the Teacher. A teacher can act as head of only one department.
- Each teacher can take any number of courses. A course can be taken by only one instructor.
- A student can enroll for any number of courses. Each course can have any number of students.



Step 5:
To draw the complete ER diagram



Steps to Design ER Model

Step-3 and 4: Identify key and Other Attributes
Step5: Designing ER Model

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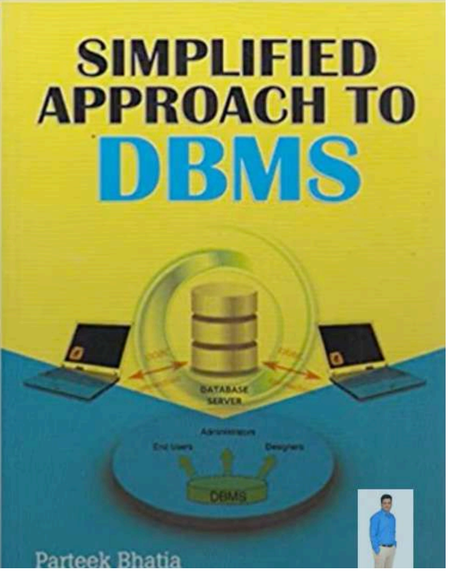
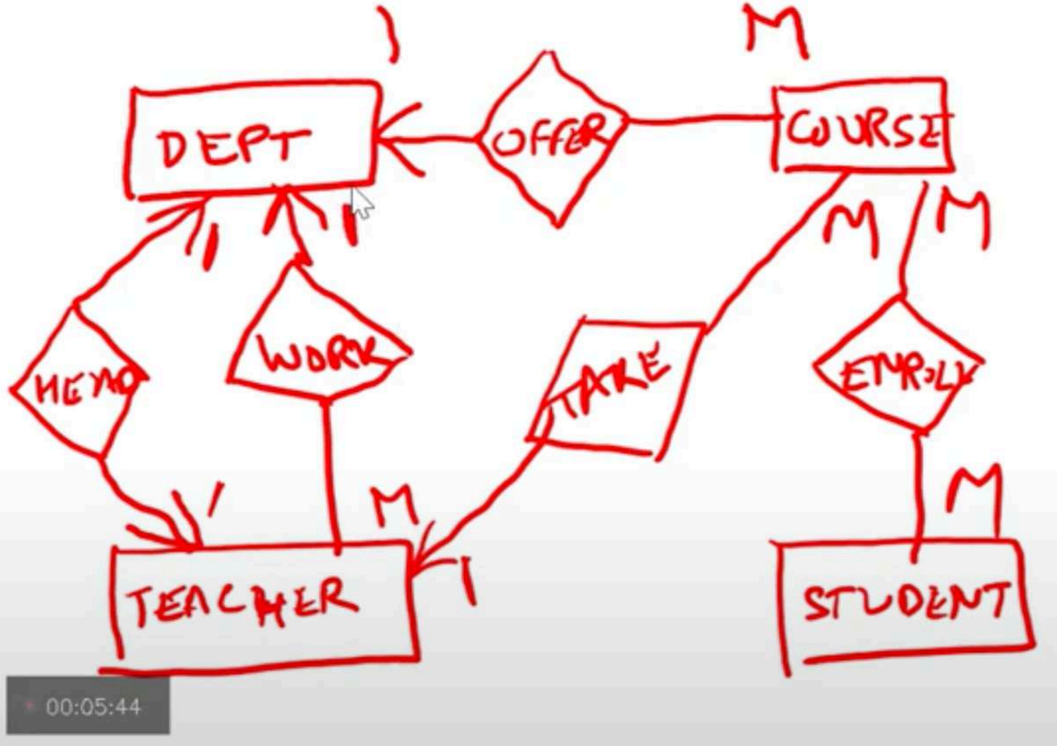


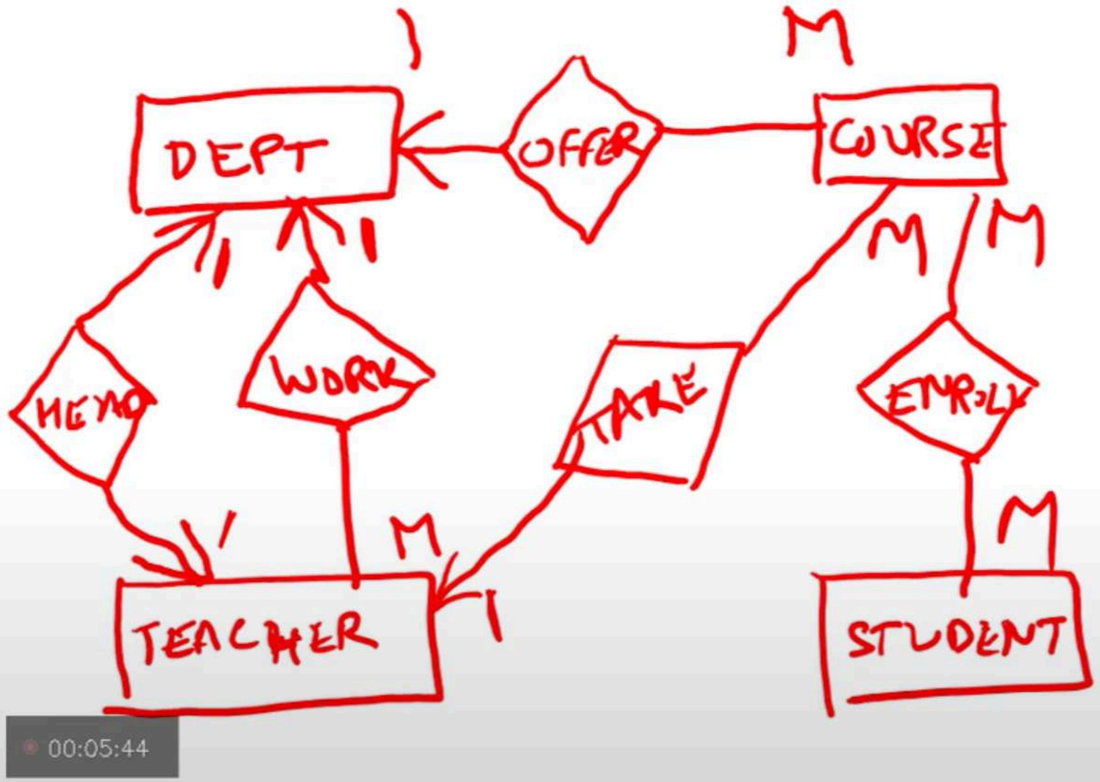
Step 3:
To identify the key attributes

- Following are the primary key attributes for each entity set:
- Dno (Department number) is the key attribute for the Entity DEPARTMENT.
- C_code (Course number) is the key attribute for COURSE Entity.
- Roll_no (Roll number) is the key attribute for STUDENT Entity.
- T_code (Teacher code) is the key attribute for TEACHER Entity.

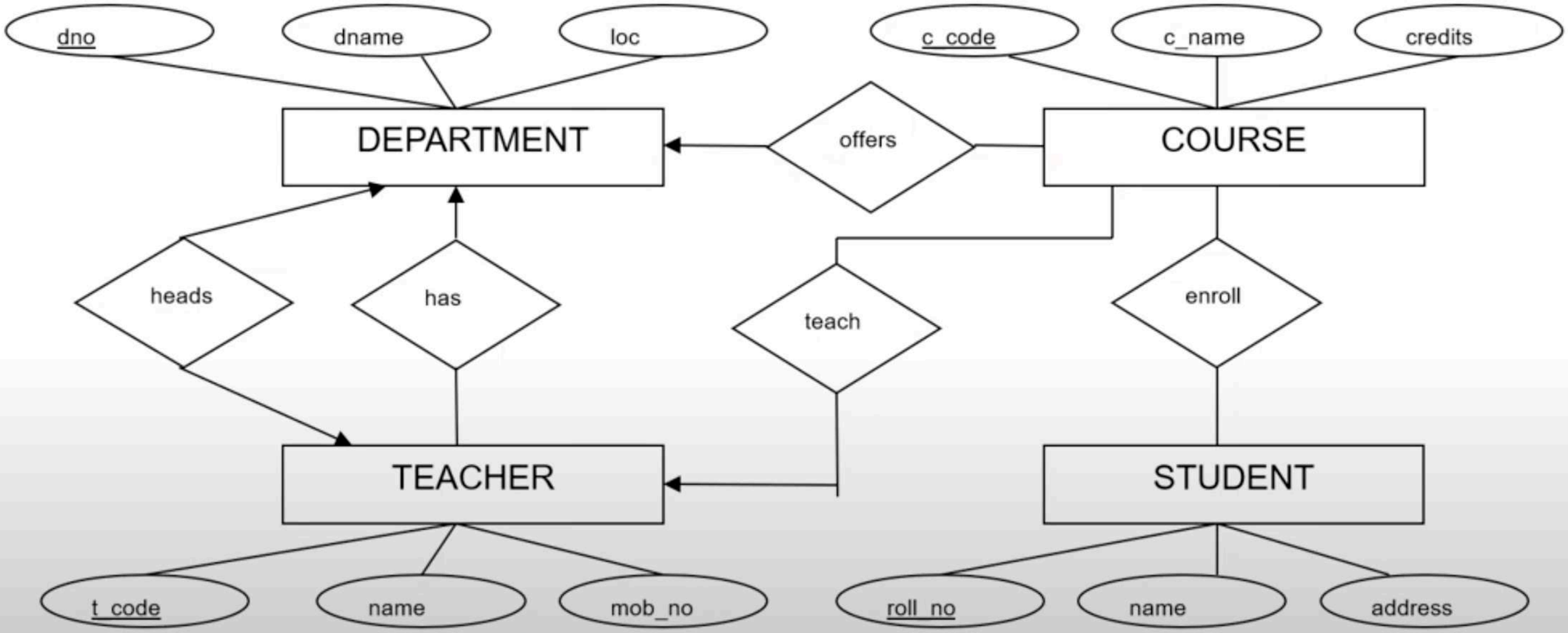


Step 4:
To identify other relevant attributes

- Following are the other relevant attributes for each entity set:
- DEPARTMENT entity will have other relevant attributes as dname, loc.
- For COURSE entity, c_name, credits.
- For TEACHER entity, name, mob_no
- For STUDENT entity, name, address



Step 5:
To draw the complete ER diagram



Strong and Weak Entity Sets

By

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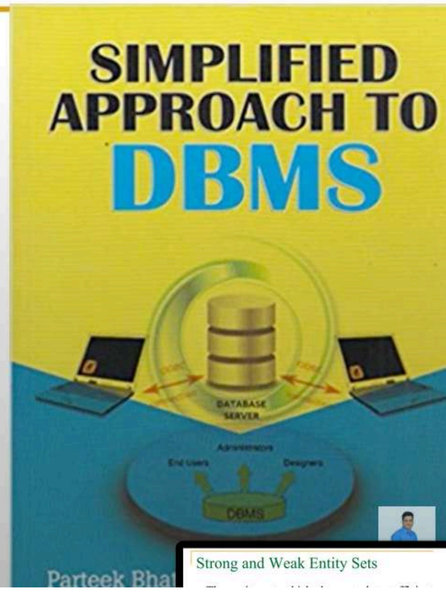


Strong and Weak Entity Sets

- The entity set which does not has sufficient attributes to form a primary key is called as weak entity set.
- An entity set that has a primary key is called as Strong entity set.

Discriminator of Weak Entity Set

- A weak entity set does not have a primary key but we need a means to form the primary key so that we can distinguish entries in the entity set.
- The weak entity set will have some attribute when combined with primary key strong entity set provides uniqueness to it.

Discriminator of Weak Entity Set

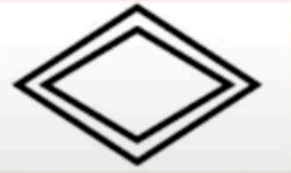
- This attribute of weak entity which can combines with primary key of strong entity set to form its primary key during creation of its table is known as Discriminator or Partial Key of a weak entity set.
- This attribute is indicated with dotted underline.

Case Study: Cust-Loan

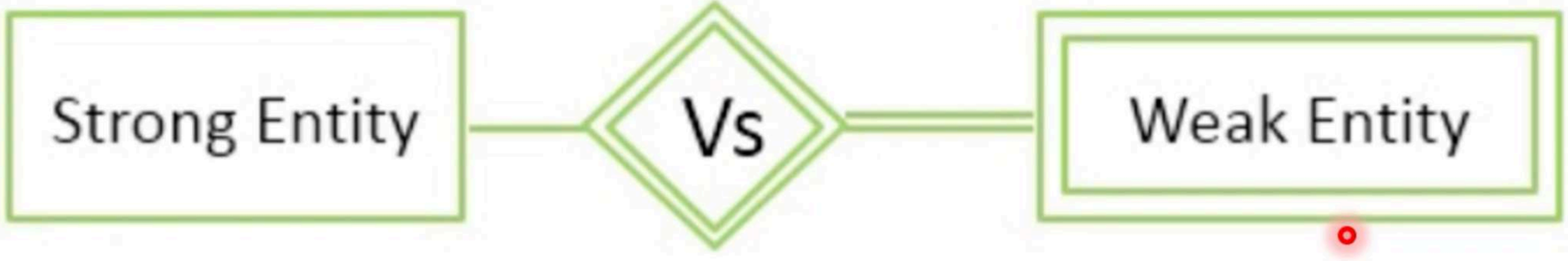
Cust_Id	Cust_name	Cust_add
C1	RAJ	ASR
C2	RAM	JAL
C3	SHAM	DELHI

CUST_ID	Loan_name	Loan_date
C1	Education	12/12/2019
C1	Home	13/12/2010
C3	Education	12/12/2019

Symbols

Symbol	Description
	Weak Entity Set
	Identifying Relationship
	Discriminator or Partial Key

Example

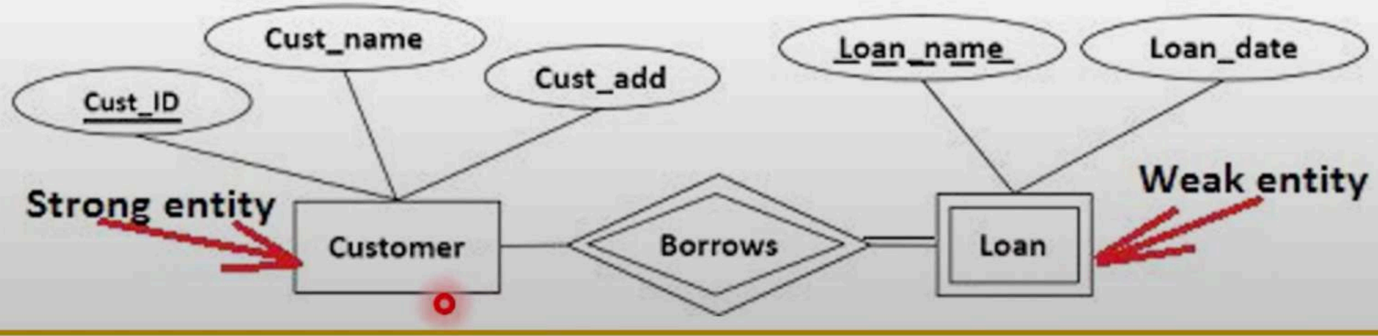


Customer and Loan

Case Study: Cust-Loan

Cust_Id	Cust_name	Cust_add
C1	RAJ	ASR
C2	RAM	JAL
C3	SHAM	DELHI

Loan_name	Loan_date
Education	12/12/2019
Home	13/12/2010
Education	12/12/2019



Strong and Weak Entity Sets

Loan-Payment Case Study

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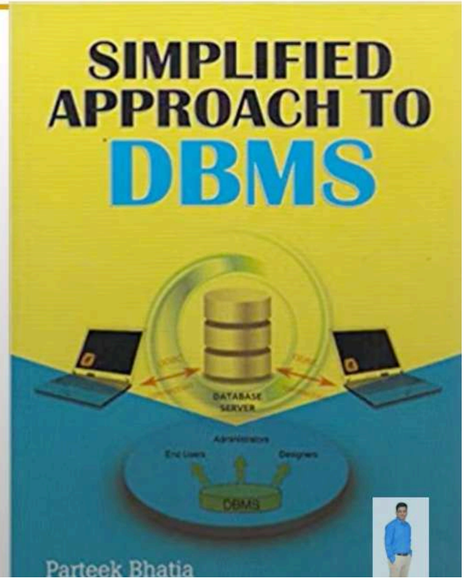
Patiala



Case Study: Loan-Payment

LOANID

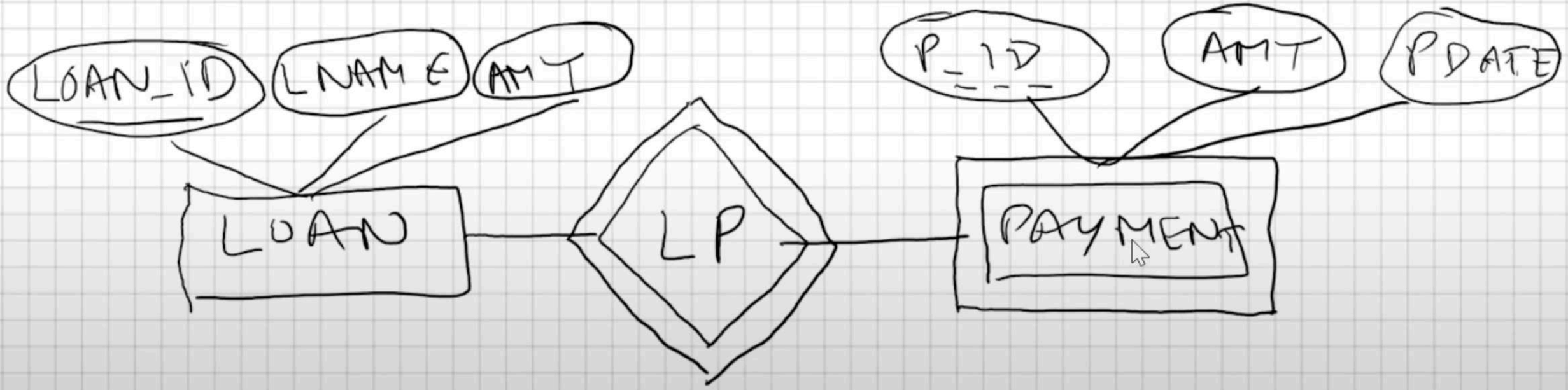
Loan_Id	Loan_name	Amount
L1	Education	10000
L2	Home	20000
L3	Education	10000

	Payment_Id	Amount	Loan_date
L1	1	1000	1/2/2019
L2	1	2000	1/2/2019
L3	1	1000	1/2/2019
L1	2	1000	1/3/2019
L2	2	2000	1/3/2019
L3	2	1000	1/3/2019
L1	3	1000	1/4/2019
L2	3	2000	1/4/2019
L3	3	1000	1/4/2019

Case Study: Loan-Payment

Loan_Id	Loan_name	Amount
L1	Education	10000
L2	Home	20000
L3	Education	10000

Payment_Id	Amount	Payment_date
1	1000	1/2/2019
1	2000	1/2/2019
1	1000	1/2/2019
2	1000	1/3/2019
2	2000	1/3/2019
2	1000	1/3/2019
3	1000	1/4/2019
3	2000	1/4/2019
3	1000	1/4/2019



Cardinality and Participation of a Relationship

By

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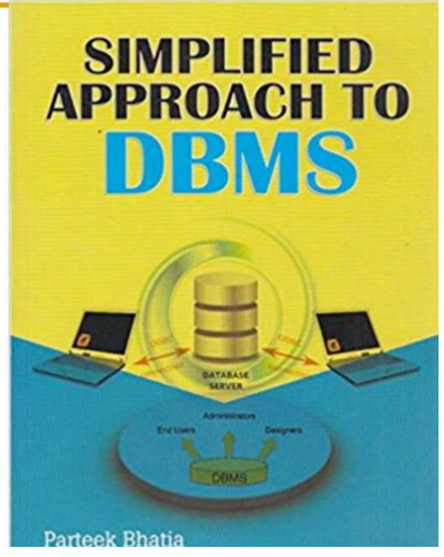


Cardinality in the E-R Diagram

- The cardinality of a relationship is the actual number of related occurrences for each of the two entities.
- E-R diagrams also provide a way to indicate cardinality of the relationship.

Cardinality in the E-R Diagram

- An edge between an entity set and a relationship set can have an associated minimum and maximum cardinality, shown in the form *l..h*, where *l* is the minimum and *h* the maximum cardinality.

Total Participation

- Every entity in the entity set participates in at least one relationship in the relationship set.
- Participation of entity set in the relationship is mandatory.
- Entity cannot exist without relationship.
- Indicated by double line with relationship.

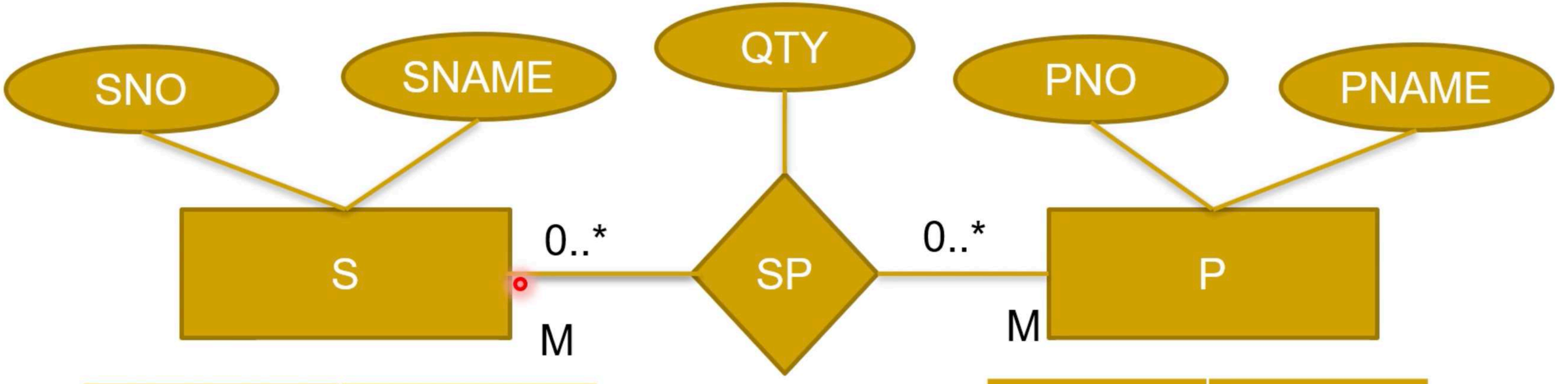
Partial Participation

- Some entities may not participate in any relationship in the relationship set.
- Participation of entity set in the relationship is optional.
- Entity can exist without relationship.
- Indicated by single line connecting with relationship.

Cardinality and Participation Relationship

- A minimum value of 1 indicates total participation of the entity set in the relationship set.
- A minimum value of 0 indicates partial participation of the entity set in the relationship set.
- The label 1..* on an edge is equivalent to a double line.

SUPPLIER-PART Relationship



SNo	Name
S1	RISHAN
S2	RAHAT
S3	RUHI

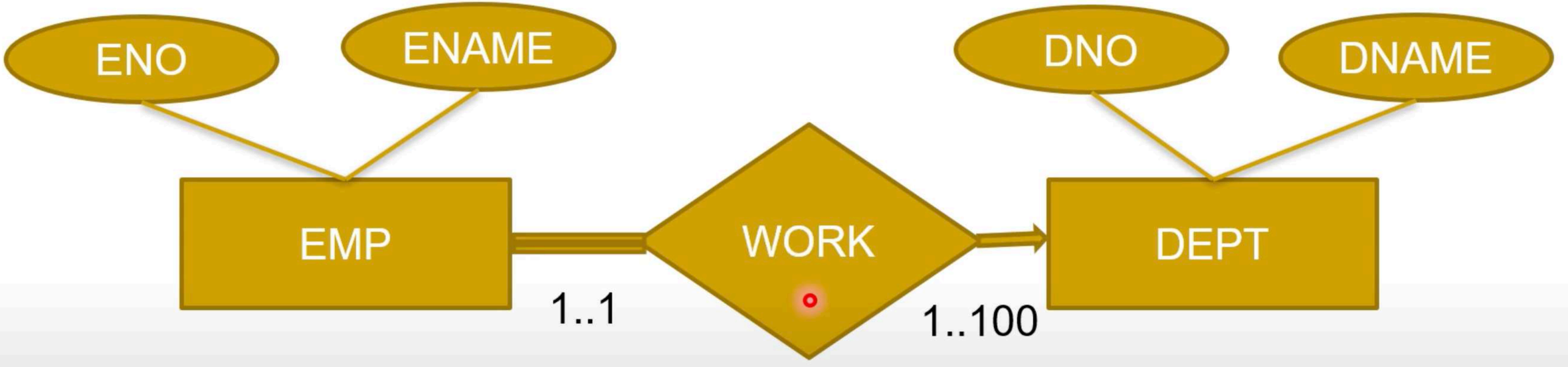
100

150

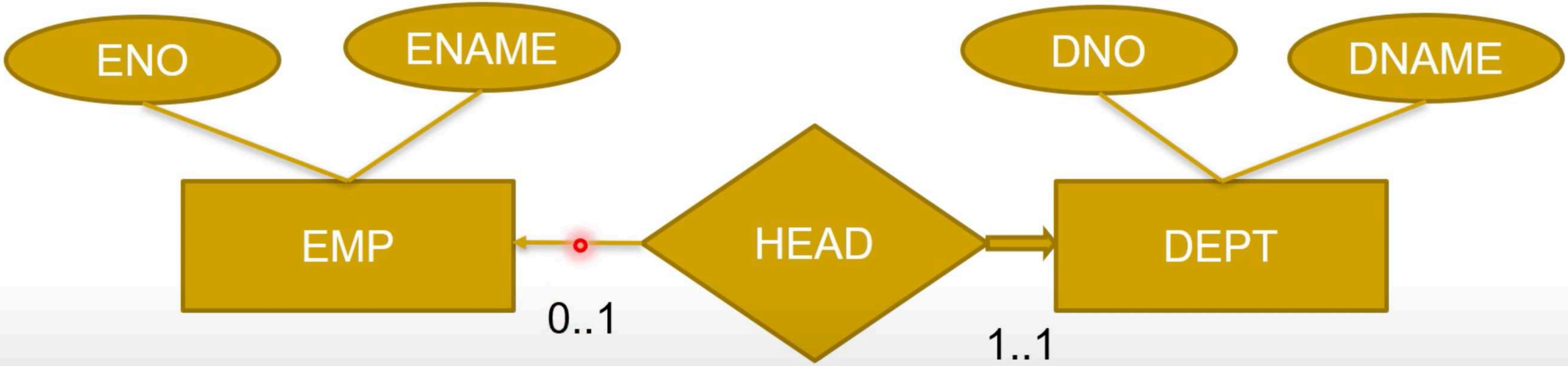
110

PNO	PNAME
P1	PEN
P2	PENCIL
P3	ERASER

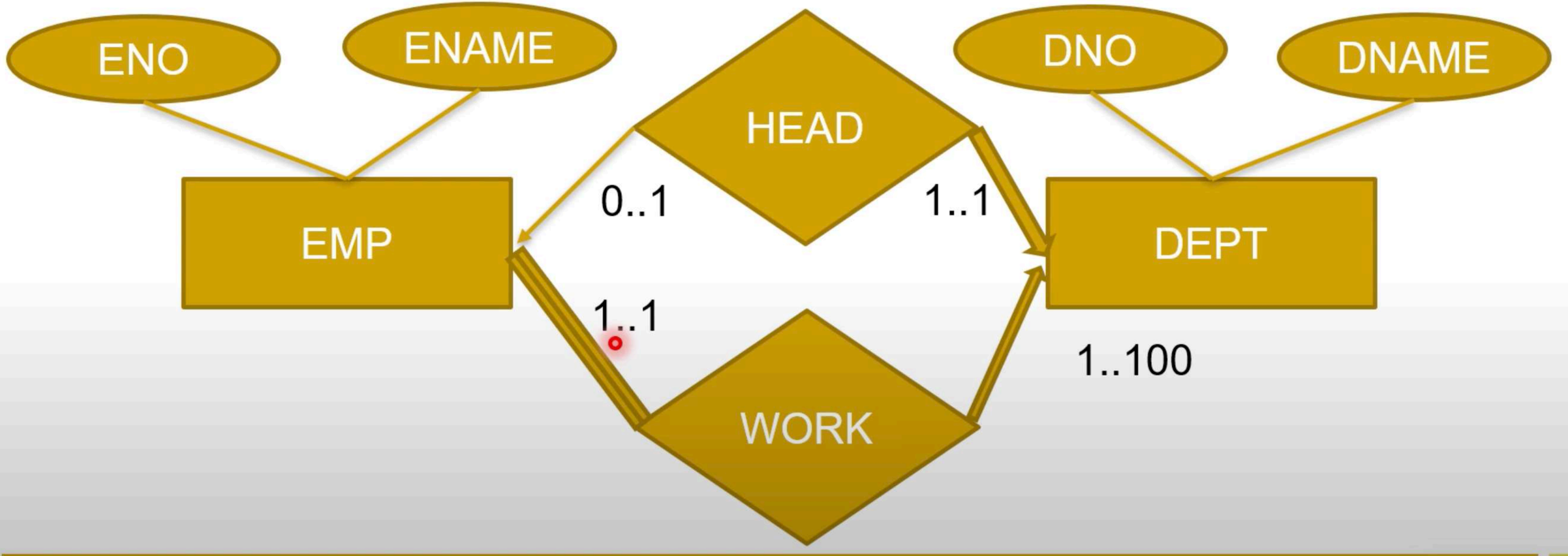
EMP-DEPT Relationships



EMP-DEPT Relationships



EMP-DEPT Relationships



Total and Partial Participation

By

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Department of Computer Science & Engineering

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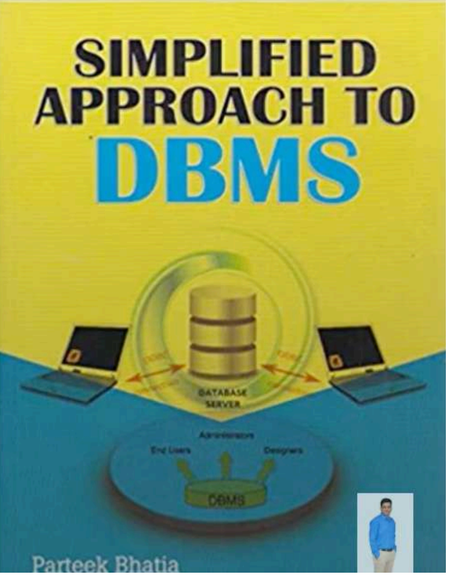

Total Participation

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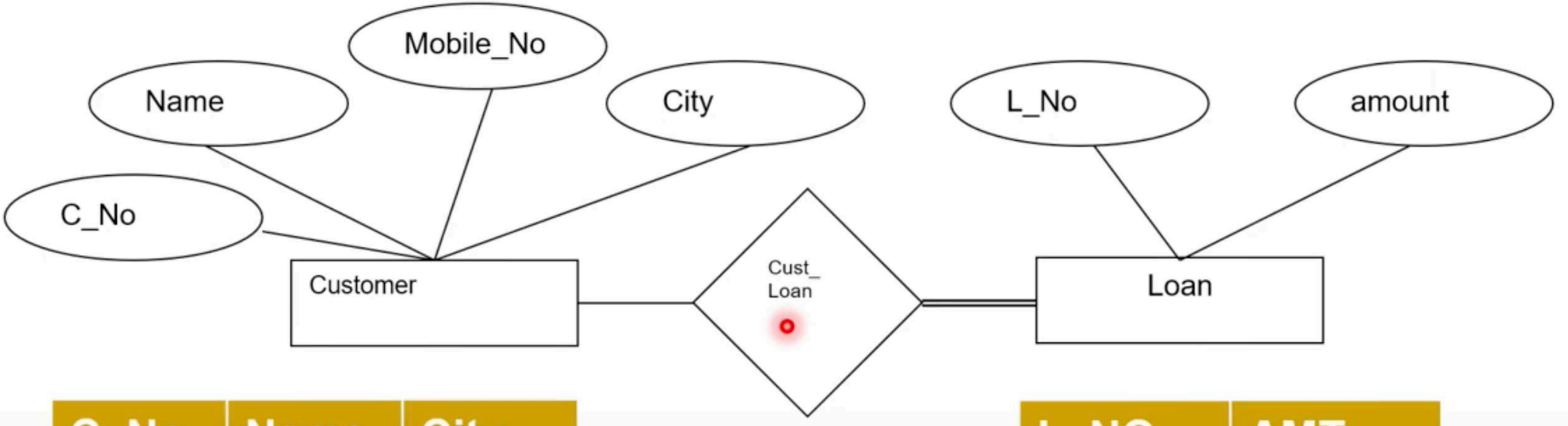
- Indicated by double line with relationship.

CUST-LOAN Relationship



C_No	Name	City
C1	RAJ	ASR
C2	RAM	JAL
C3	SHAM	PTA

L_NO	AMT
L1	10000
L2	20000
L3	10000

Cardinality of a Relationship

By

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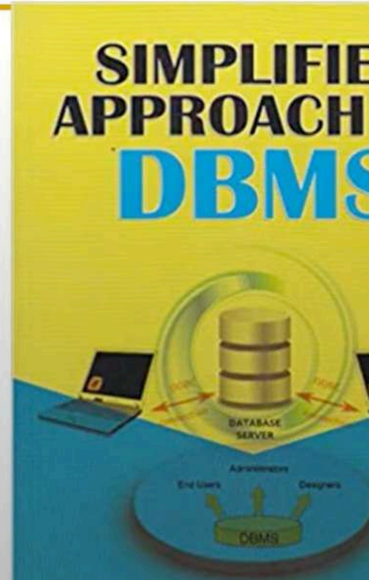
Thapar Institute of Engineering and Technology

Patiala



Cardinality in the E-R Diagram

- The cardinality of a relationship is the actual number of related occurrences for each of the two entities.
- E-R diagrams also provide a way to indicate cardinality of the relationship.

Connectivity of a Relationship

The connectivity of a relationship describes the mapping of associated entity instances in the relationship. The values of connectivity are "one" or "many".

- One to One (1:1)
- One to Many (1:M)
- Many to One (M:1)
- Many to Many (M:M)

Cardinality in the E-R Diagram

- The cardinality of a relationship is the actual number of related occurrences for each of the two entities.
- E-R diagrams also provide a way to indicate cardinality of the relationship.

Cardinality in the E-R Diagram

- An edge between an entity set and a relationship set can have an associated minimum and maximum cardinality, shown in the form *l..h*, where *l* is the minimum and *h* the maximum cardinality.

Difference between Connectivity and Cardinality of Relationship

Connectivity	Cardinality
The connectivity of a relationship describes the mapping of associated entity instances in the relationship. The values of connectivity are "one" or "many".	The cardinality of a relationship is the actual number of related occurrences for each of the two entities.
Four Types: One to One (1:1) One to Many (1:M) Many to One (M:1) Many to Many (M:M)	An edge between an entity set and a relationship set can have an associated minimum and maximum cardinality, shown in the form *l..h*, where *l* is the minimum and *h* the maximum cardinality.

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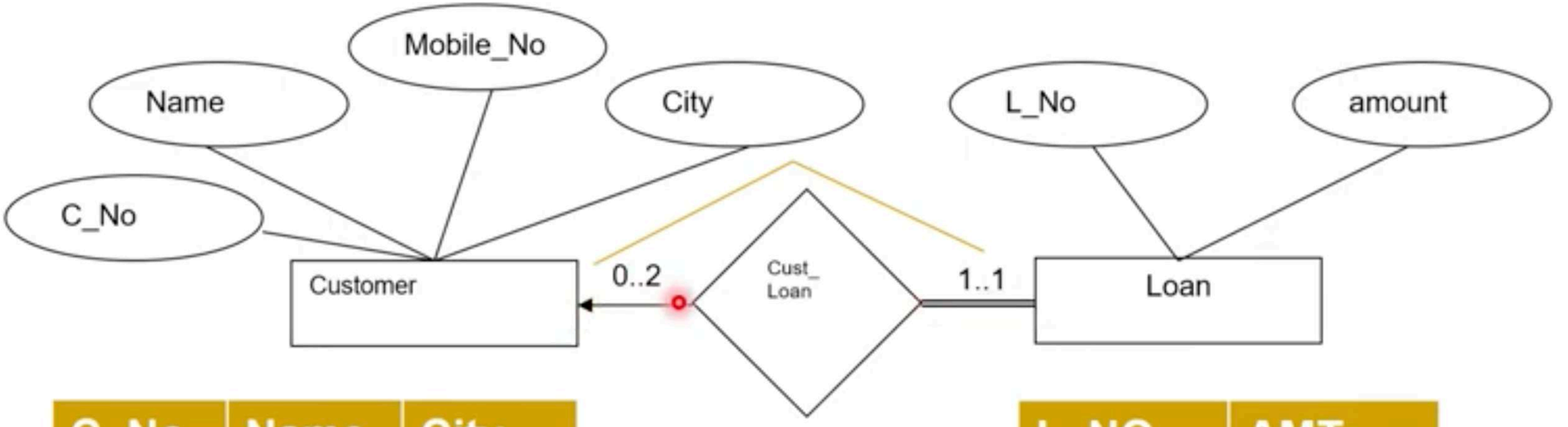
CUST-LOAN Relationship



C_No	Name	City
C1	RAJ	ASR
C2	RAM	JAL
C3	SHAM	PTA

L_NO	AMT
L1	10000
L2	20000
L3	10000

THE END

ER MODEL 2

DBMS

ER Model
Degree of Relationships

By
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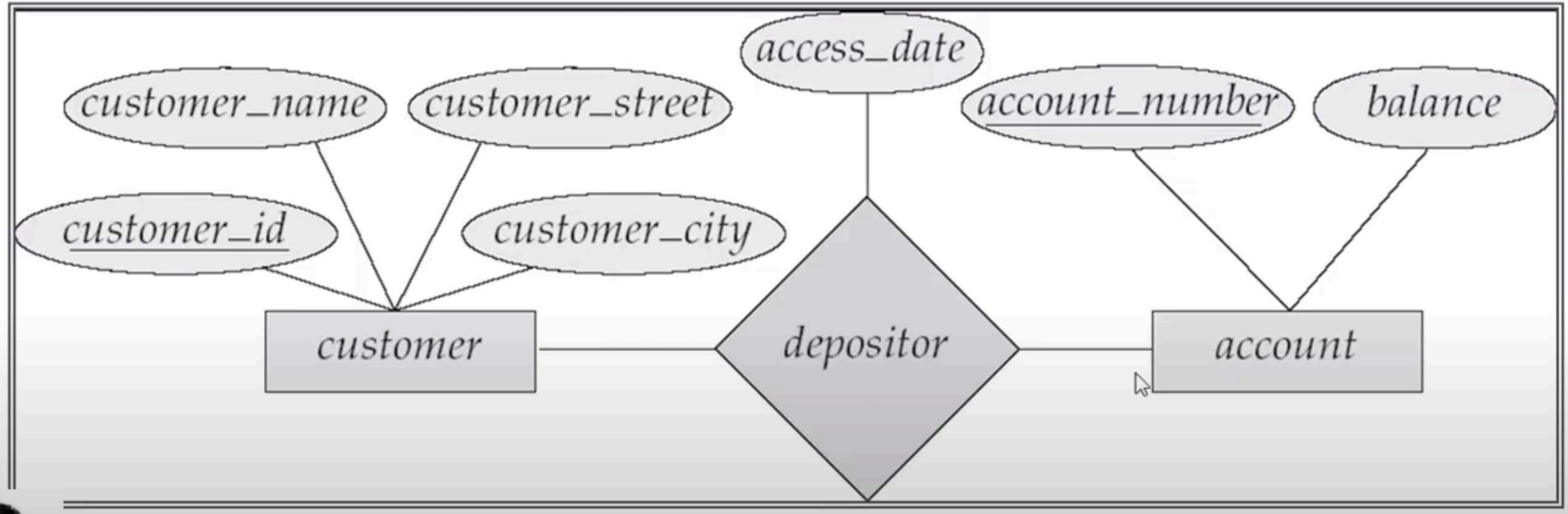
Patiala

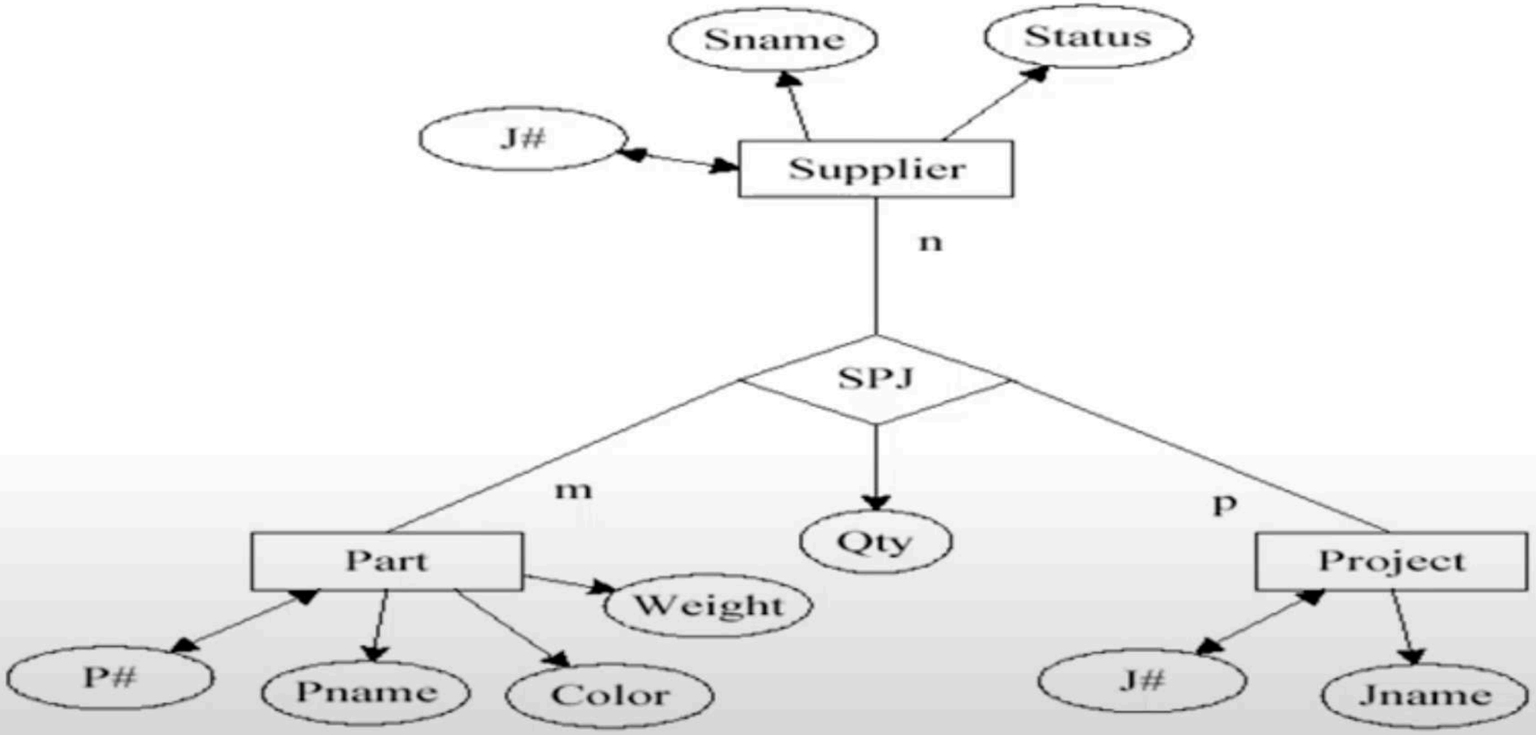
Degree of a Relationship

The degree of a relationship is the number of entities associated with the relationship. The n-ary relationship is the general form for degree n. Special cases are the binary, and ternary, where the degree is 2, and 3, respectively.

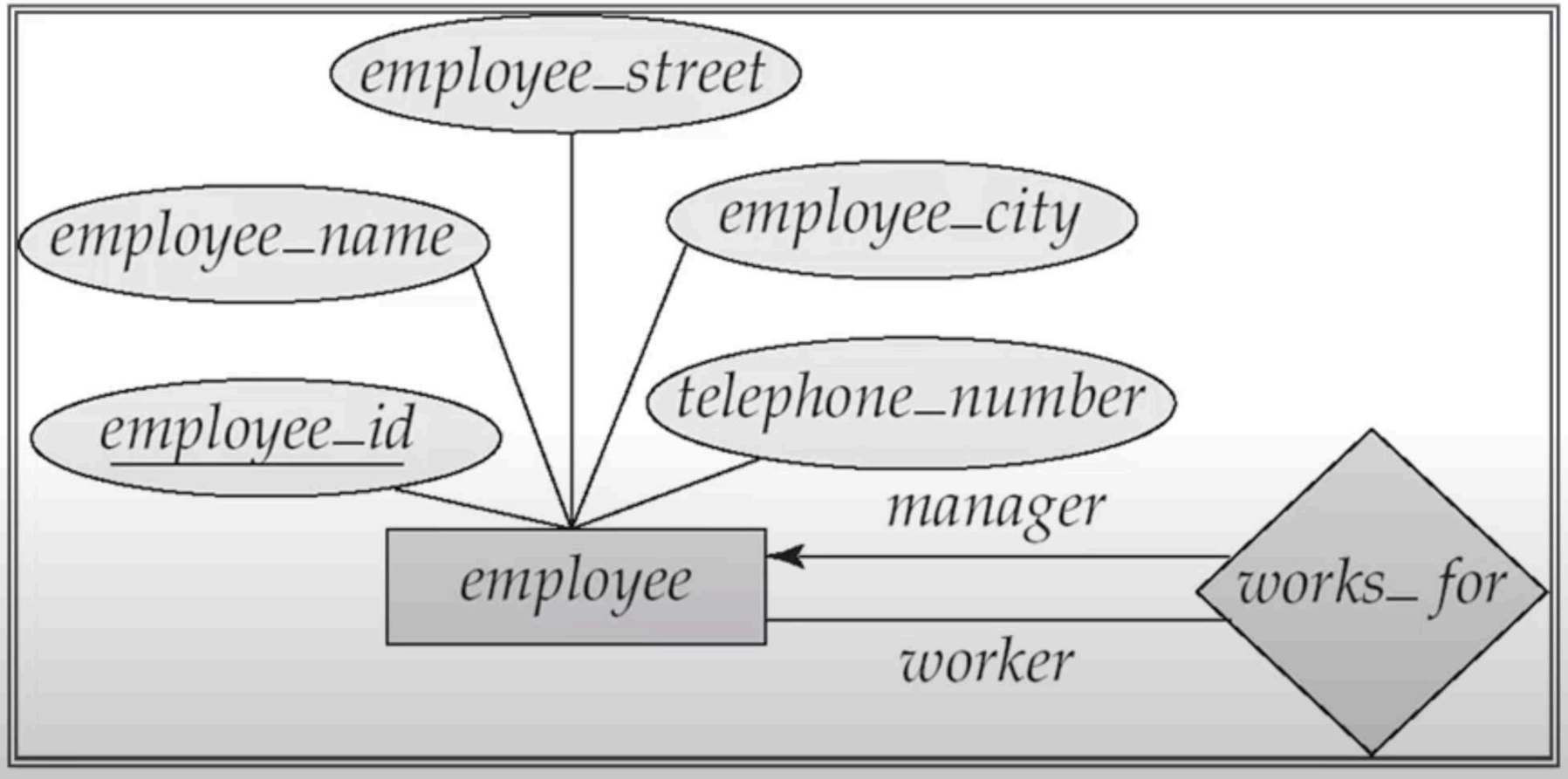
Binary Relationship



Ternary Relationship



Unary Relationship



Designing of Database

Entity-Relationship Model

By
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Patiala, India

How to design the database?

There are two approaches

- E-R Modeling: Identifying entity and relations
- Normalization: Refinement of database designing

Database Design Techniques

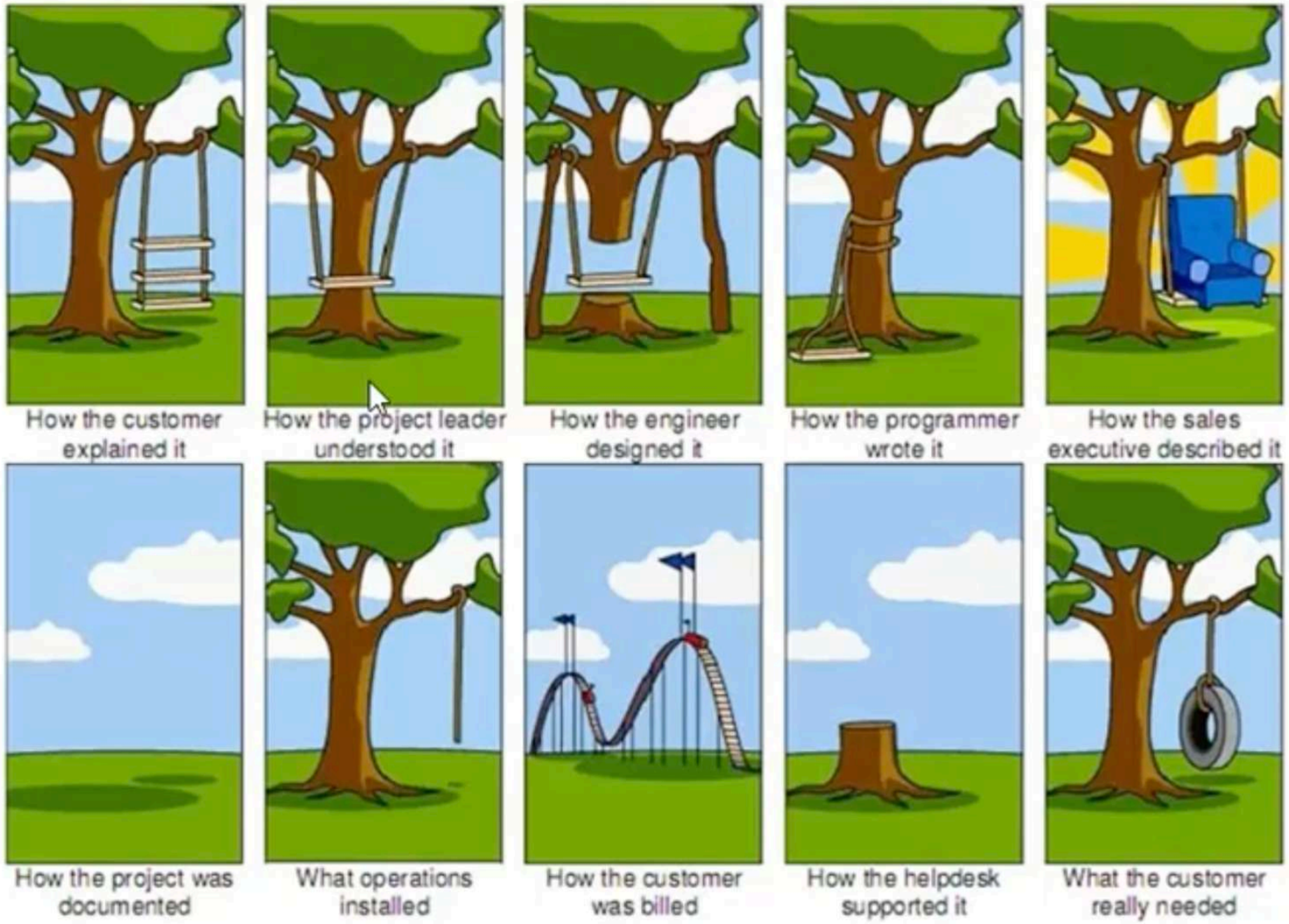
- Top down Approach
  - ER Modeling
- Bottom Up Approach
  - Normalization

Need of ER Model

- ER Model is used to convert software requirements written in textual form into visual representation.
- Because
  - One picture is equivalent to thousand words.

What comes to your mind when you see this..

A Normal Scenario



Basic Constructs of ER Model

By
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Basic Constructs of E-R Modeling

- A *database* can be modeled as:
  - a collection of entities,
  - relationship among entities.
- An **entity** is a real world object that exists and is distinguishable from other objects.
  - Example: specific person, company, event, plant

Basic Constructs of E-R Modeling

- An **entity set** is a set of entities of the same type that share the same properties.
  - Example: set of all persons, companies, trees, holidays
- Entities have ***attributes***
  - Example: people have *names* and *addresses*

Correlation between different models

OOP	ER Model/ER Diagram	Relational Model
Class	Entity Set	Table
Object	Entity	Row
Attribute	Attribute	Column

Relationship

- A Relationship represents an association between two or more entities.

Examples

- Employees belong to department
- Customer take loans

Relationship Set *borrower*

321-12-3123	Jones	Main	Harrison
019-28-3746	Smith	North	Rye
677-89-9011	Hayes	Main	Harrison
555-55-5555	Jackson	Dupont	Woodside
244-66-8800	Curry	North	Rye
963-96-3963	Williams	Nassau	Princeton
335-57-7991	Adams	Spring	Pittsfield

customer

L-17	1000
L-23	2000
L-15	1500
L-14	1500
L-19	500
L-11	900
L-16	1300

loan

E-R Model
Types of Attributes and Its Symbols

By
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Attributes

Attributes describe the properties of the entity of which they are associated.

- Simple
- Composite
- Single-value
- Multi-value
- Derived

Simple Vs Composite Attribute

- Simple Attribute
  - Cannot be divided into simpler components
  - Examples: Age of employee, Roll number of students
- Composite Attribute
  - Can be divided into simpler components
  - Examples: Name of employee can be First Name and Middle Name; Address of Student can be House Number, Locality

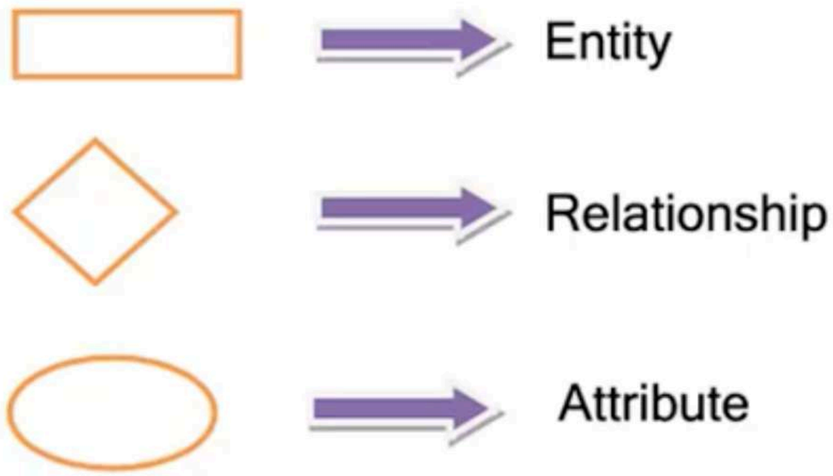
Single Value Vs Multiple Values Attribute

- Single value Attribute
  - Can have only single value
  - Examples: Roll number of students; Father Name
- Multi-values attribute
  - Can have more than one value
  - Examples: Mobile Number, Hobbies, Skills

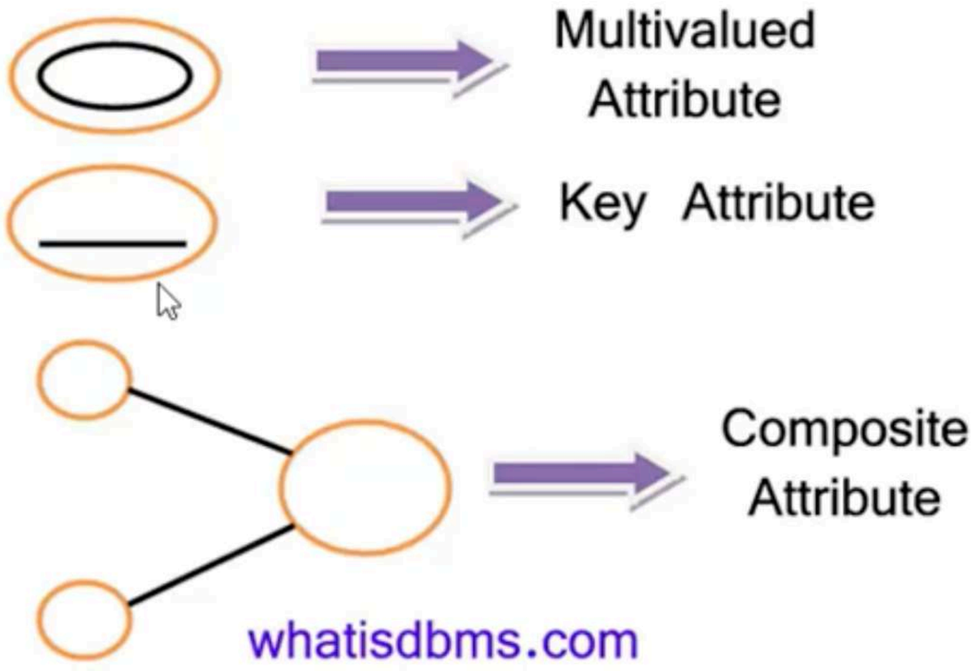
Stored Vs Derived Attribute

- Stored Attribute
  - Attribute that need to be stored permanently
  - Example: Name of student, Roll Number of student
- Derived Attribute
  - Attribute that can be calculate based on other attributes.
  - Example: Age can be calculated based on Date of Birth

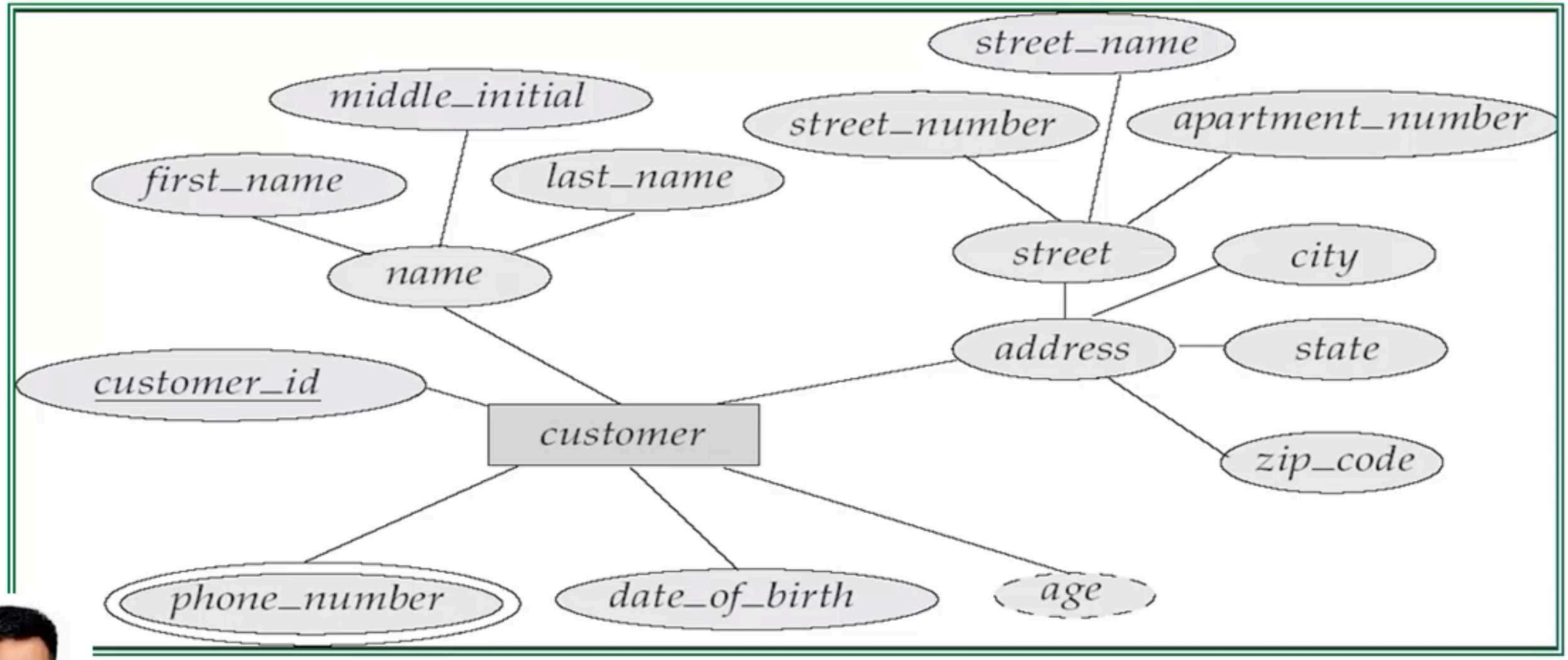
Symbols used to represent these constructs



Symbols used to represent these constructs



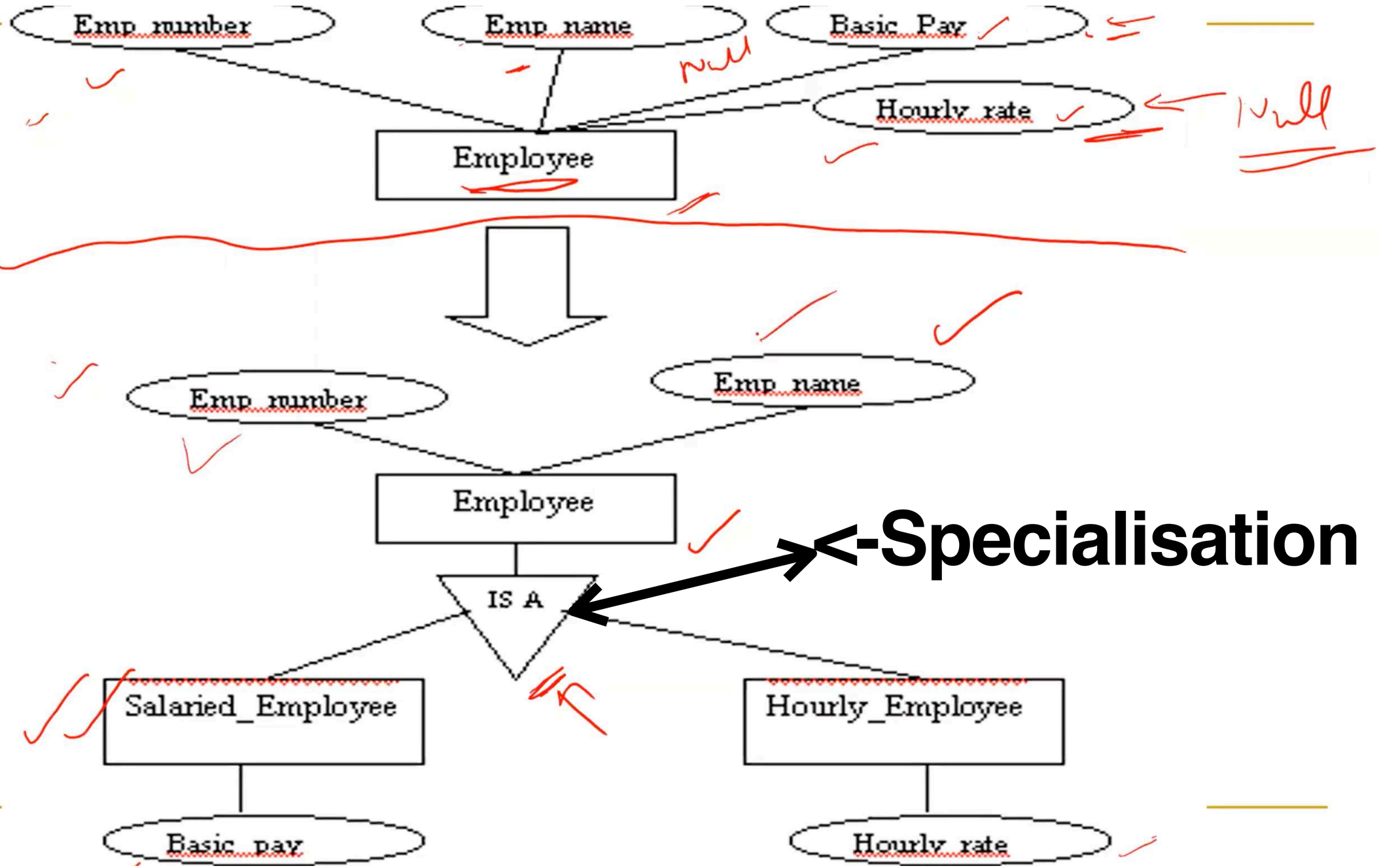
Example


street_name
middle_initial
street_number
apartment_number
first_name
last_name
street
city
name
address
state
customer_id
customer
zip_code
phone_number
date_of_birth
age

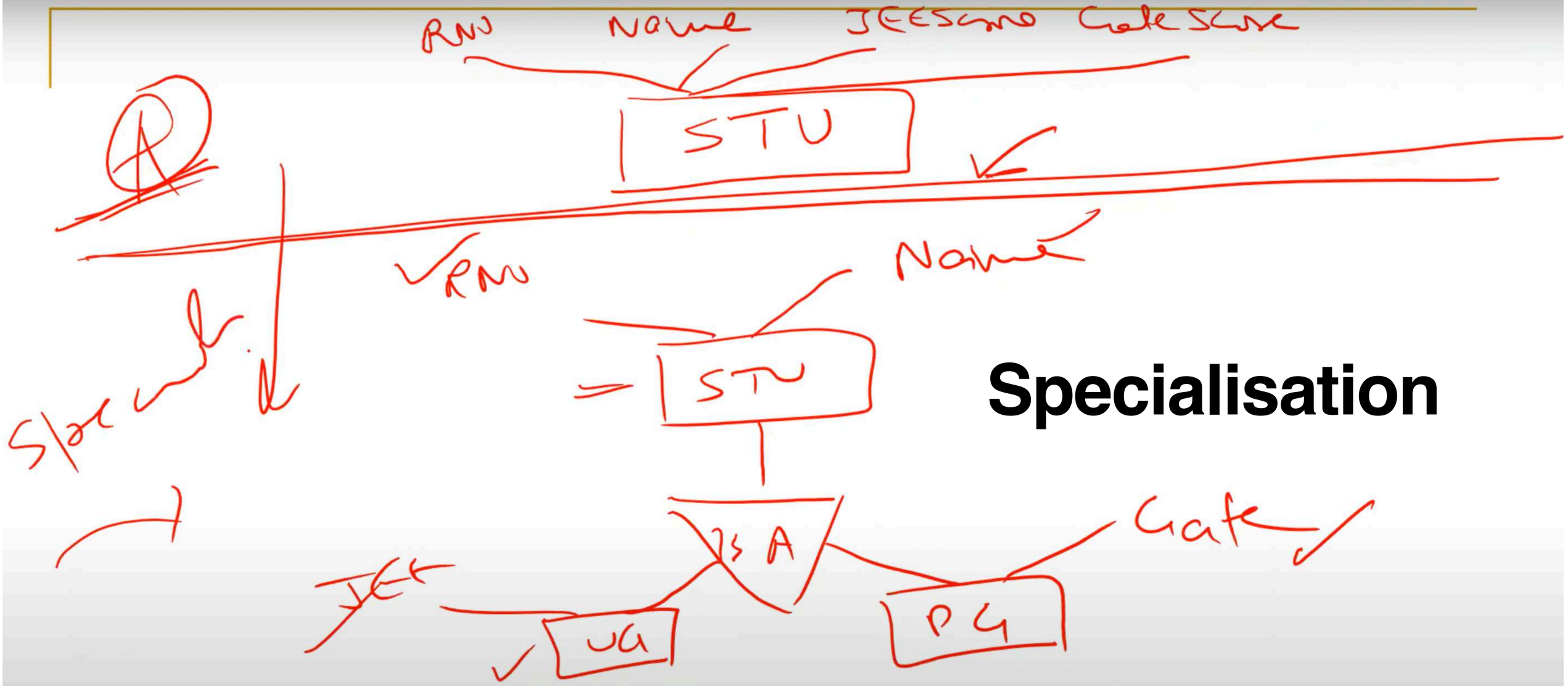
Generalization: A bottom-up design process

A generalization hierarchy is a form of abstraction that specifies that two or more entities that share common attributes can be generalized into a higher-level entity type called a supertype or generic entity. The lower level of entities becomes the subtype, or categories, to the super type. Subtypes are dependent entities.

Generalization is used to emphasize the similarities among lower-level entity sets and to hide differences. It makes ER diagram simpler because shared attributes are not repeated. Generalization is denoted through a triangle component labeled 'IS A",



<-Specialisation



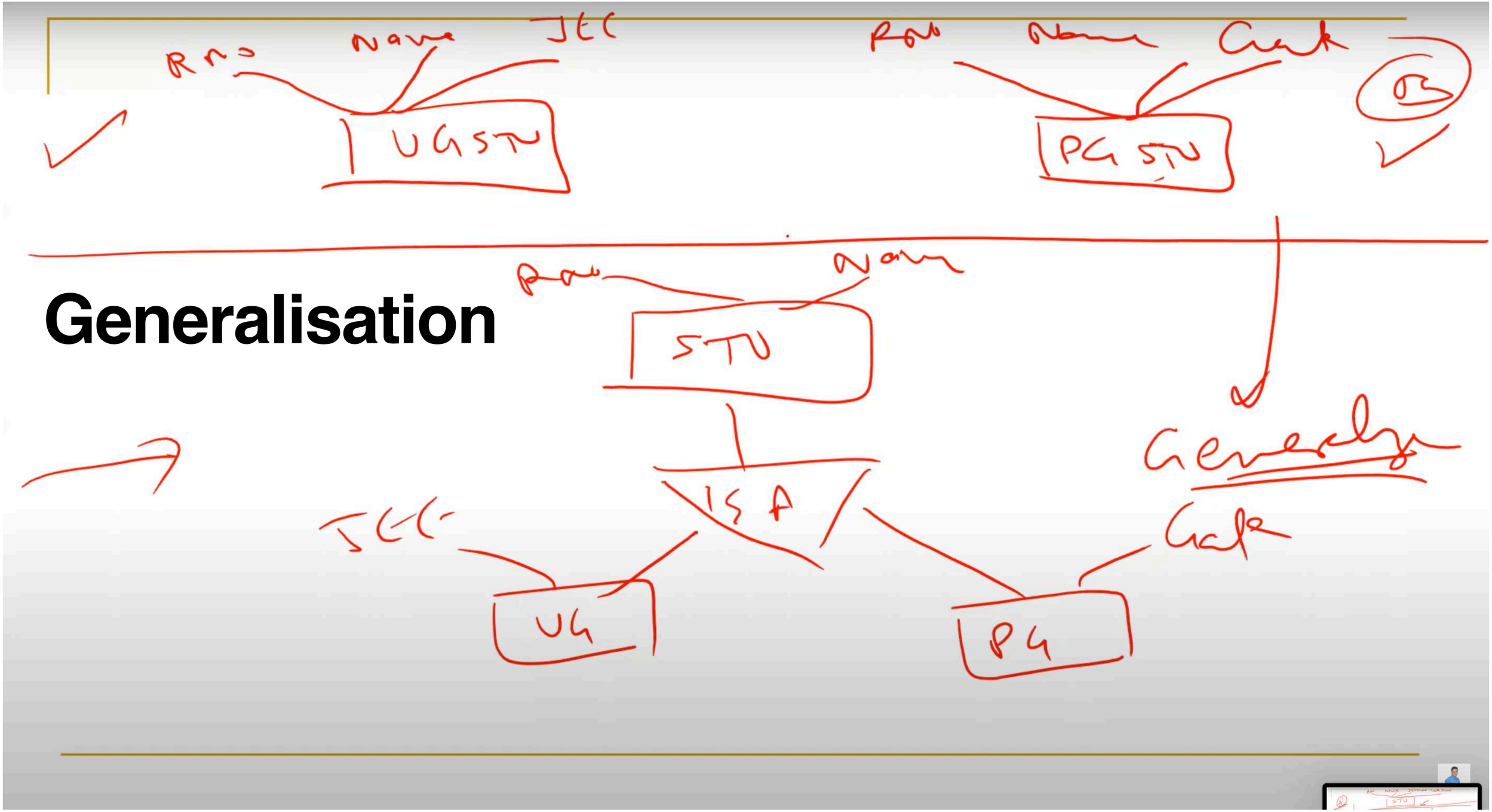
Specialisation

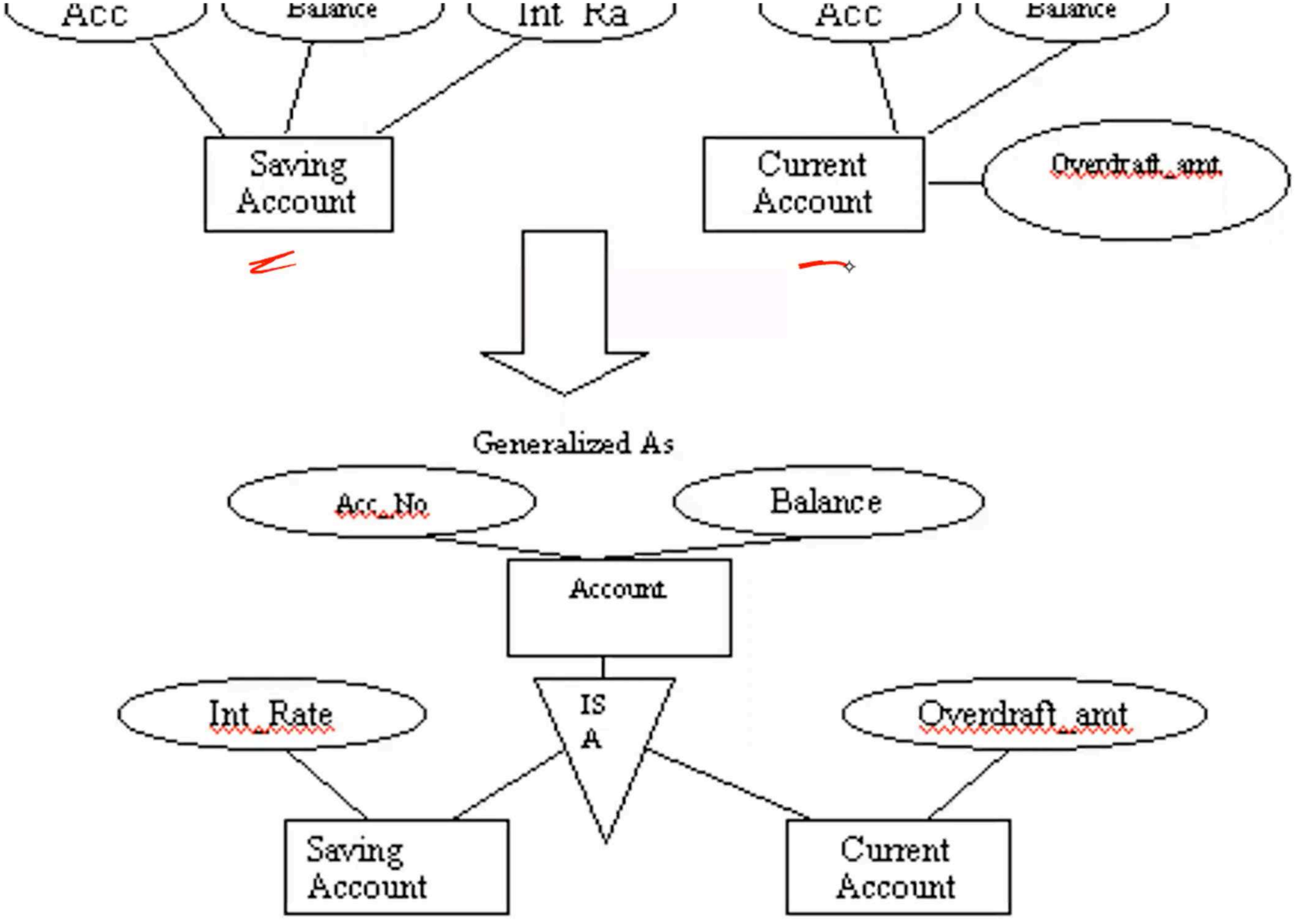
Specialization: Top-down design process

Specialization is the process of taking subsets of a higher-level entity set to form lower level entity sets. It is a process of defining a set of subclasses of an entity type, which is called as superclas of the specialization. The process of defining subclass is based on the basis of some distinguish characteristics of the entities in the super class.

For example, specialization of the Employee entity type may yield the set of subclasses namely Salaried_Employee and Hourly_Employee on the method of pay

Generalisation




Acc
Balance
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Acc
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Saving Account
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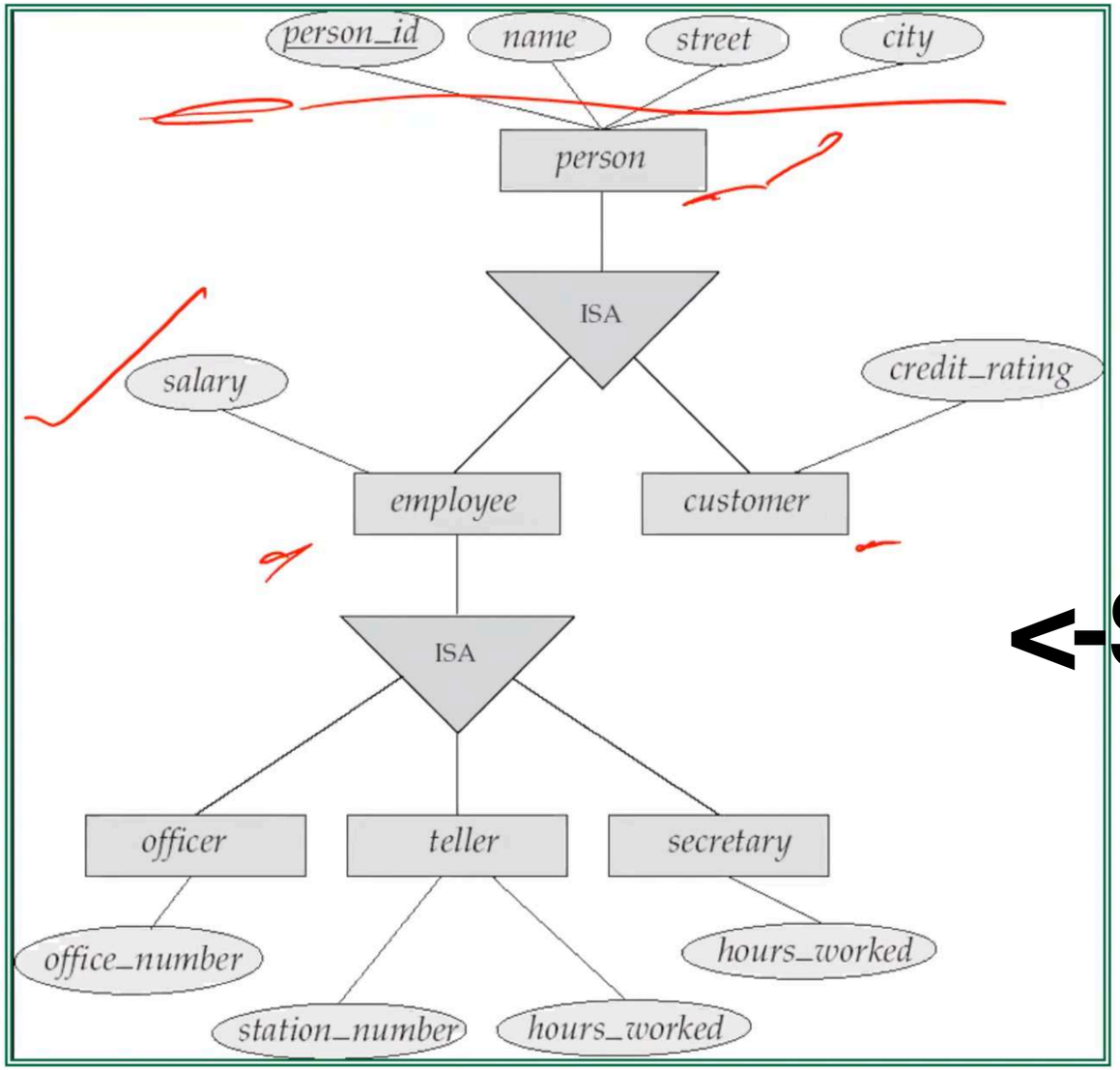
Overdraft_amt
Generalized As
Acc_No
Balance
Account
Int_Rate
IS A
Overdraft_amt
Saving Account
Current Account

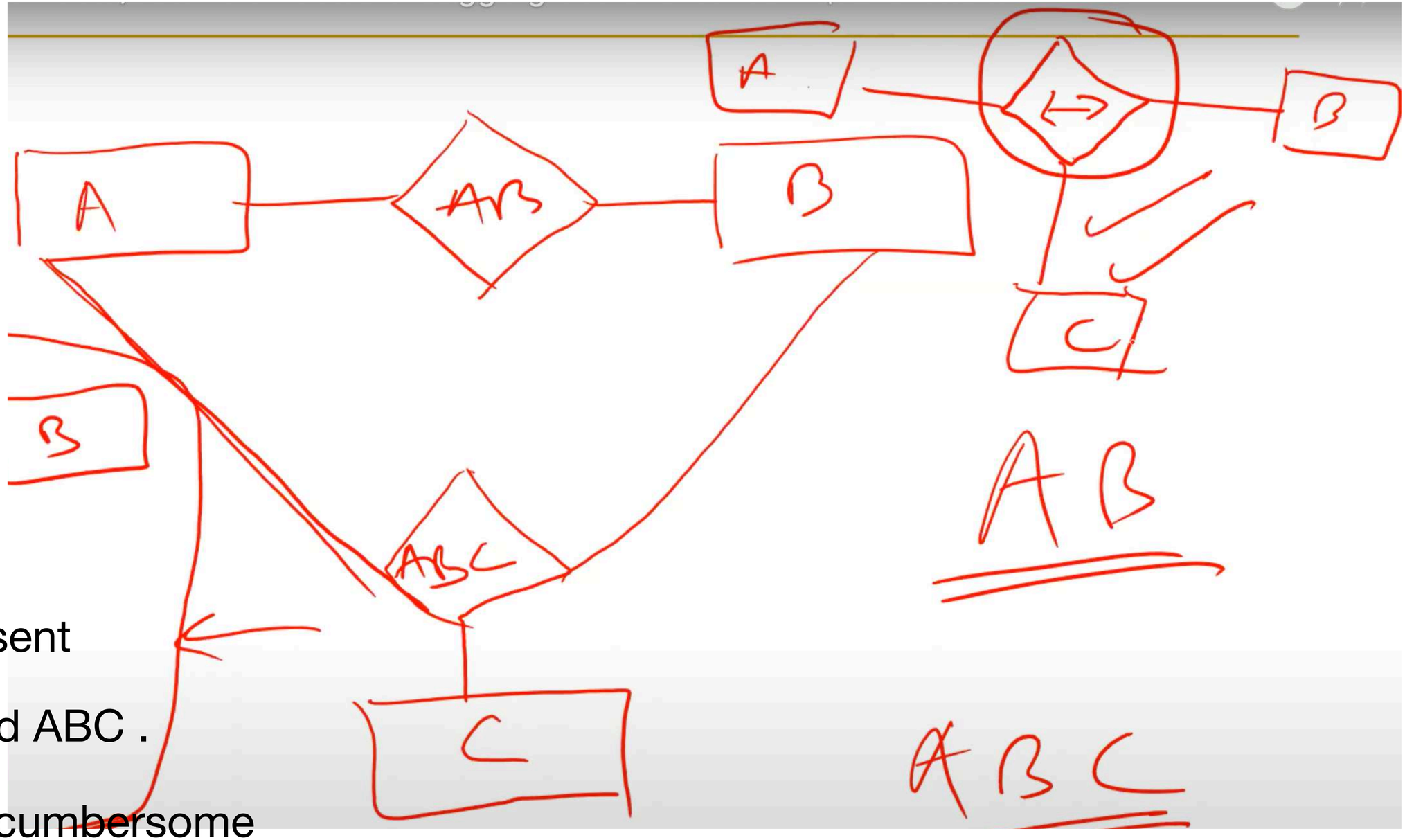


<-Specialisation

Aggregation

One limitation of the E-R model is that it cannot express relationships among relationships.

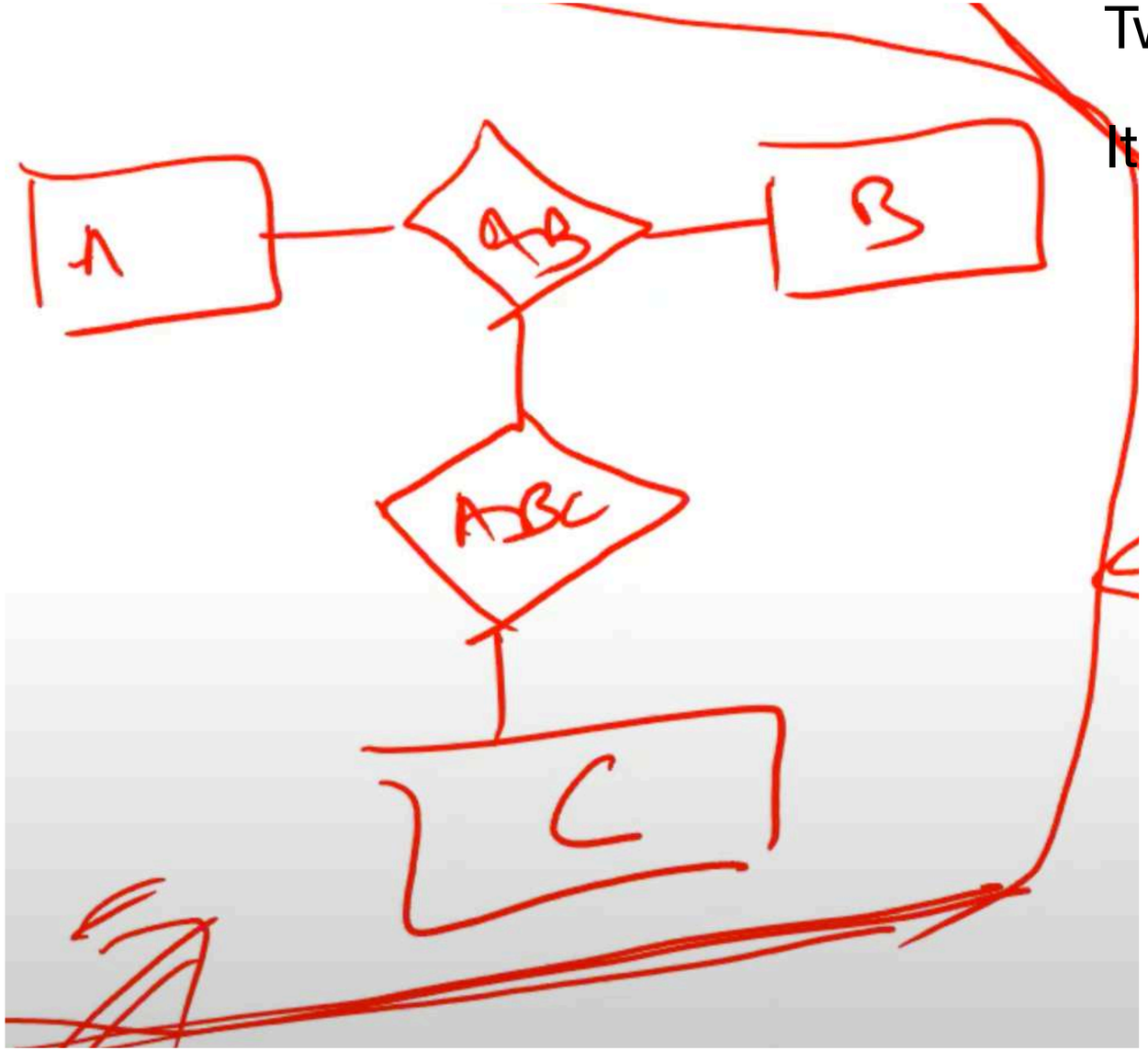
The best way to model a situation like this is by the use of aggregation. Thus, the relationship set work_on relating the entity sets Employee, Branch and Job is a higher-level entity set. Such an entity set is treated in the same manner, as is any other entity set. We can then create a binary relationship Manages between work_on and Manager to represent who manages what tasks.



We want to represent

Relation of AB and ABC .

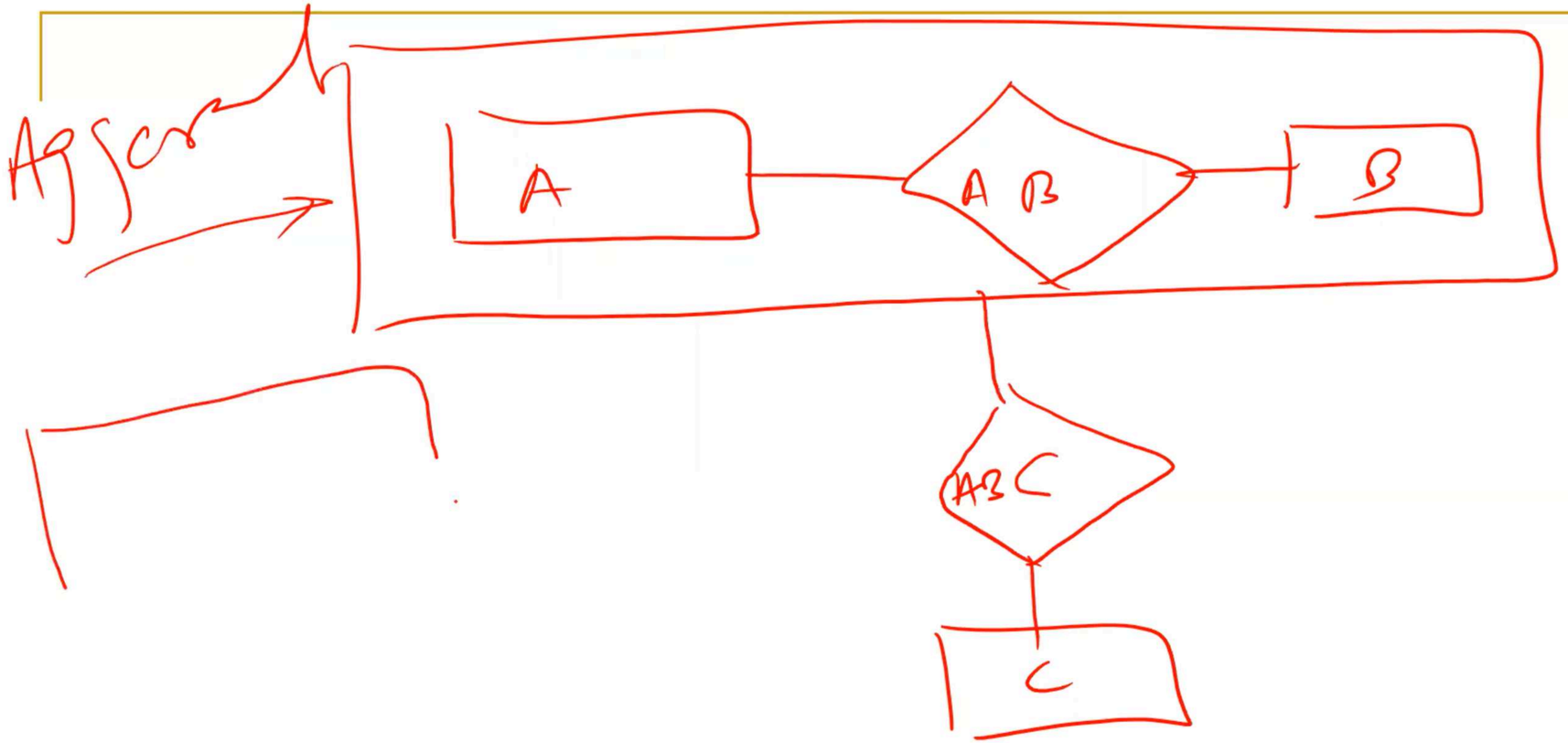
This will be quite cumbersome



This can’t be done.

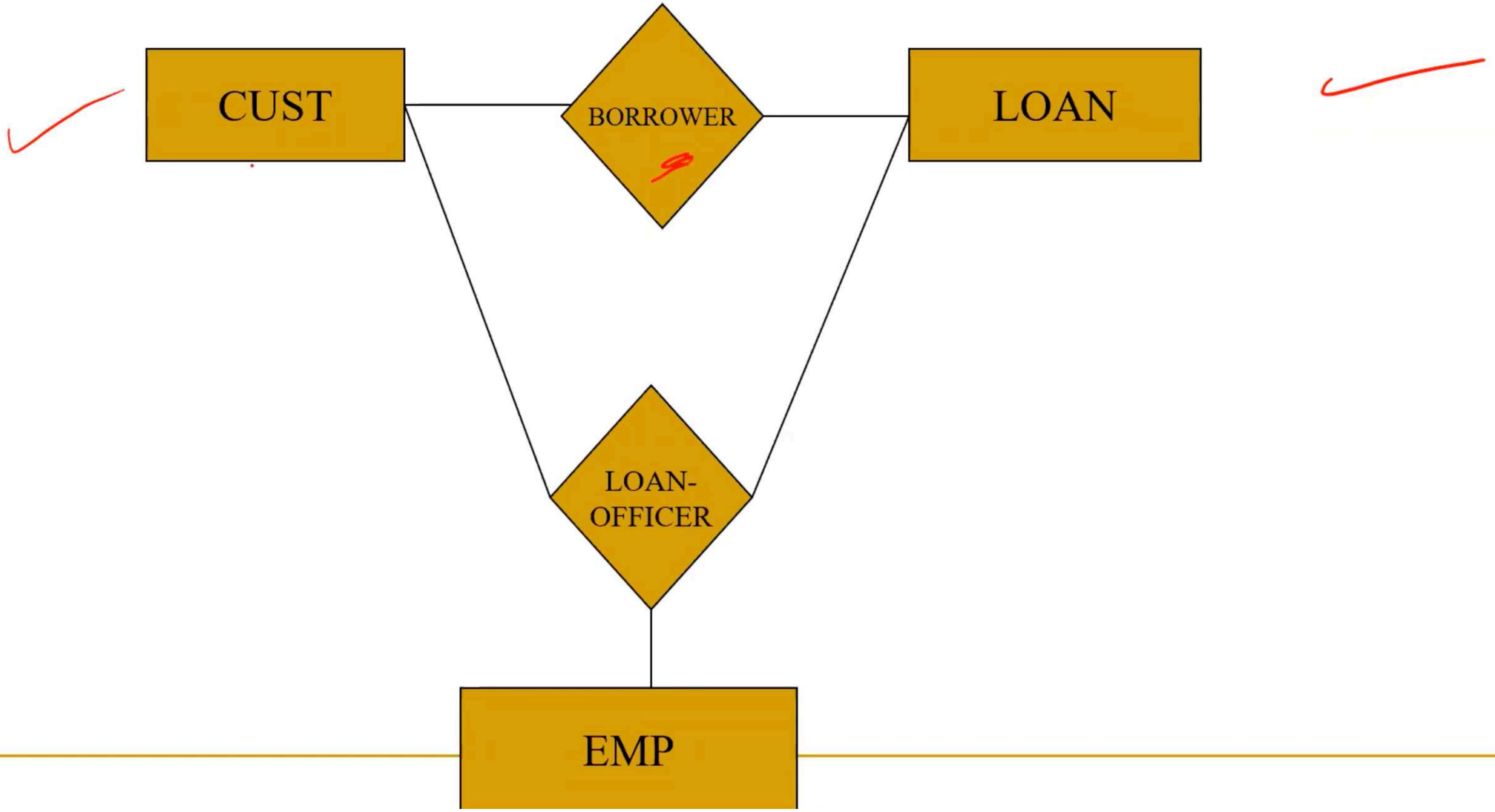
Two diamond (or relation) can’t be linked. .

It can be linked to only entity

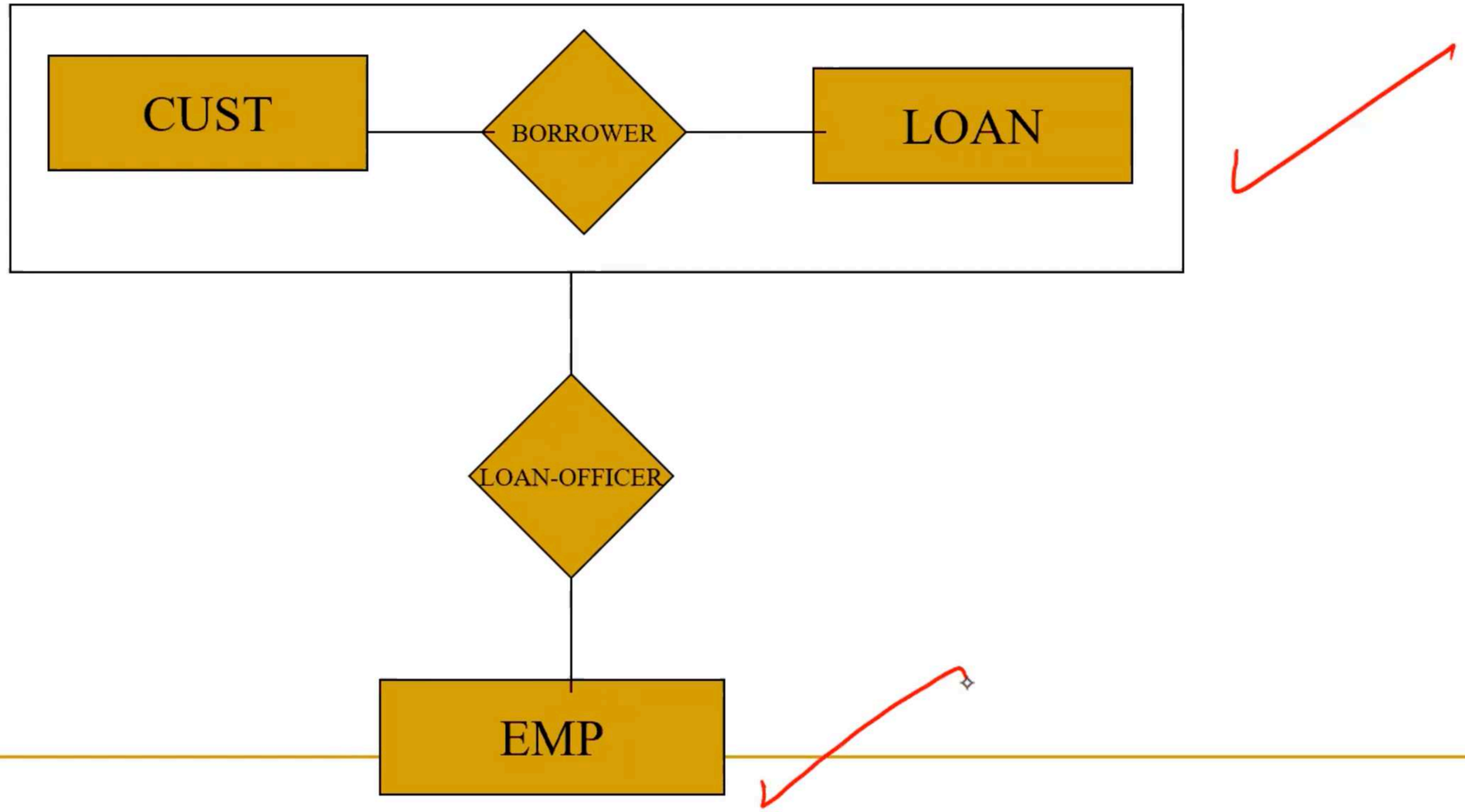


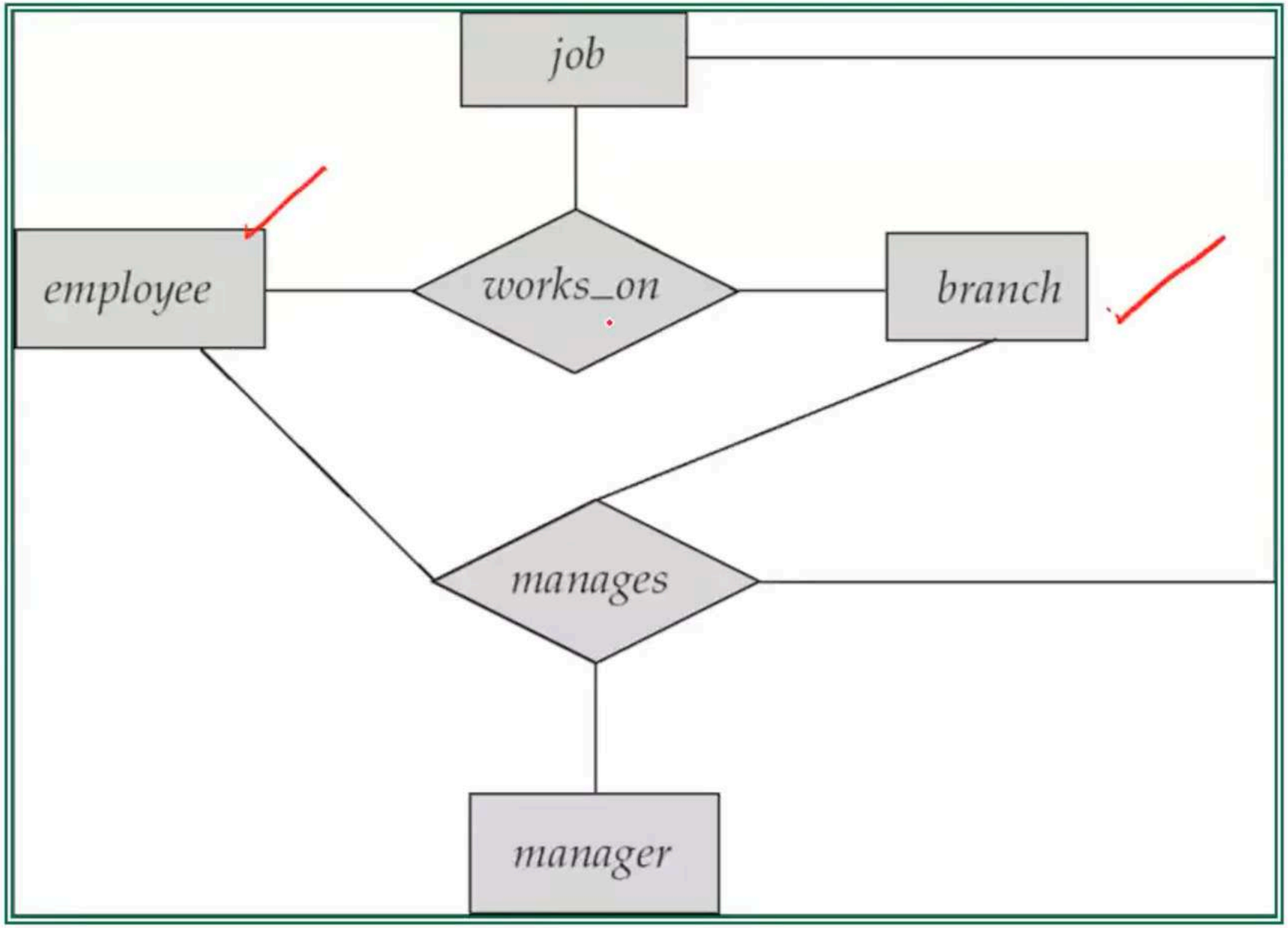
So, we aggregate , by creating a box around called entity set.

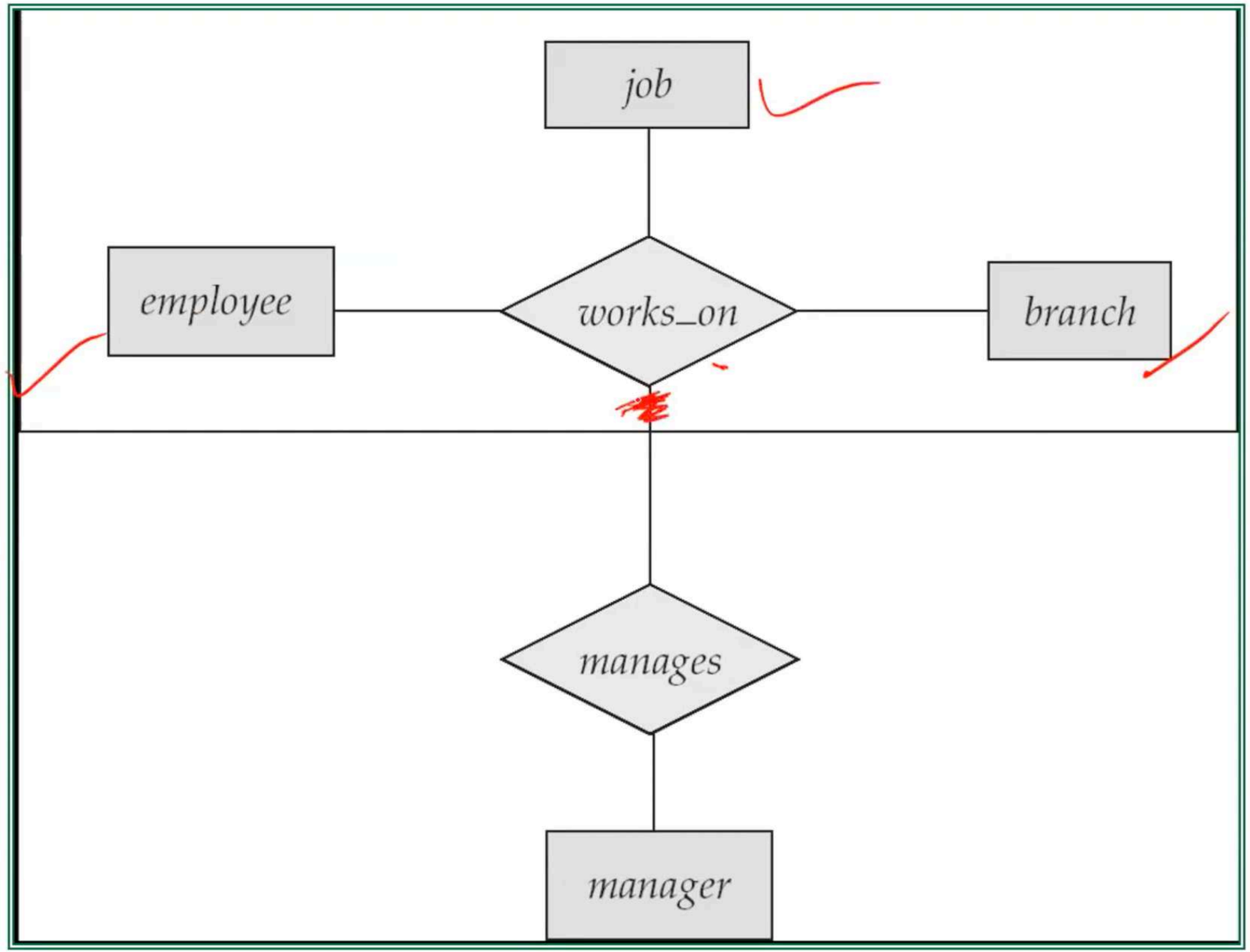
Suppose a customer loan pair may have a bank emp Who is a loan officer for that particular pair.



The best way to model the situation is to use aggregation. Aggregation is asn abstraction through which relationship are treated as higher level entities




job
employee
works_on
branch
manages
manager


job
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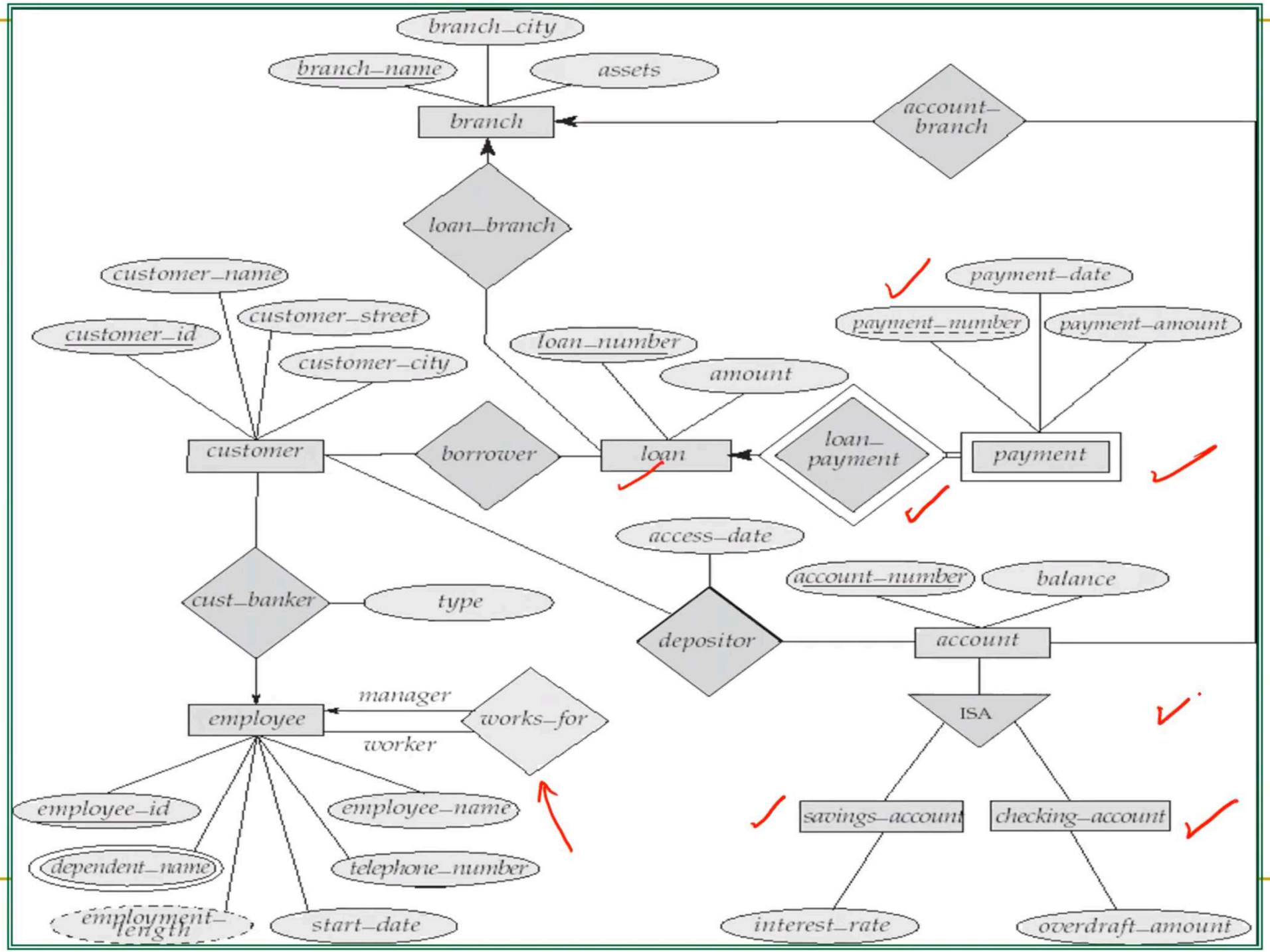
branch_city
branch_name
assets
branch
account–branch
loan_branch
customer_name
customer_street
customer_id
customer_city
customer
borrower
loan_number
amount
loan
loan–payment
payment_date
payment_number
payment_amount
payment
access_date
account_number
balance
cust_banker
type
depositor
account
manager
employee
works_for
worker
ISA
employee_id
employee_name
dependent_name
telephone_number
employment–length
start_date
savings_account
checking_account
interest_rate
overdraft_amount

Supplier Part Database

- Design ER model for Supplier part database, where one supplier can supply multiple parts and for a give part there are multiple suppliers. Whenever supplier supplies some part we have to maintain the qty in which part is supplied. Every Supplier has unqiue Sno, and other field of interest are Name and City. Sameway, every part has unique Pno and other field of interest are Name and Color.

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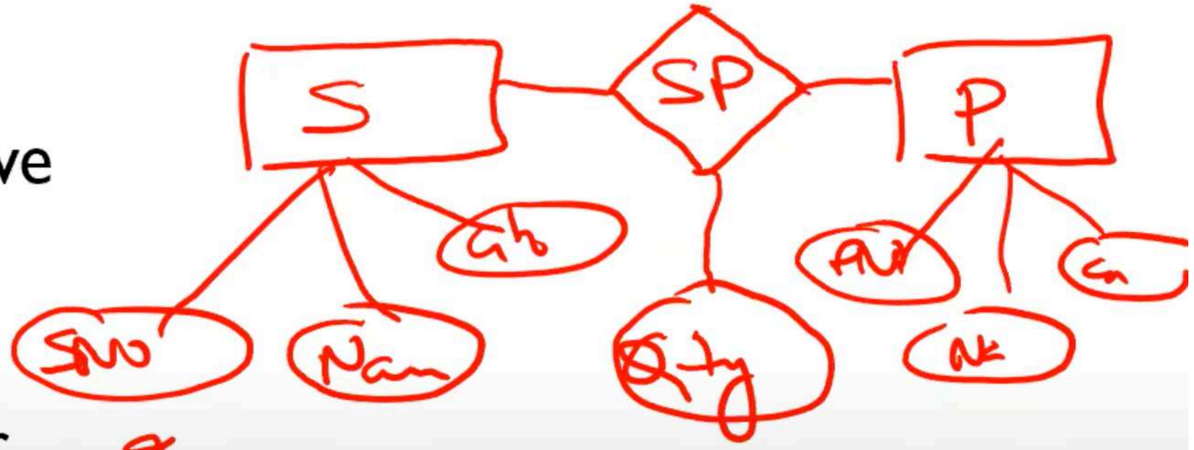

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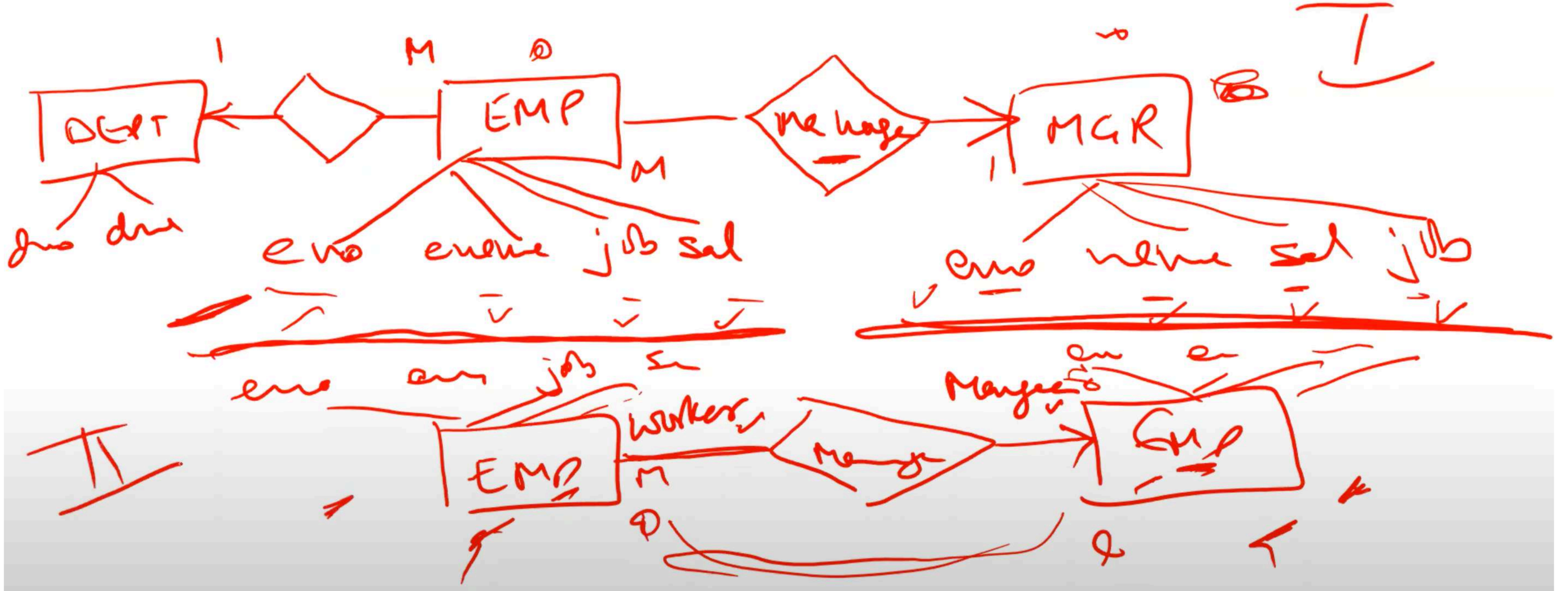
ER to tables

E-R Model to capture relationship between Emp and Manager



Here, (in previous slide) we face an issue,

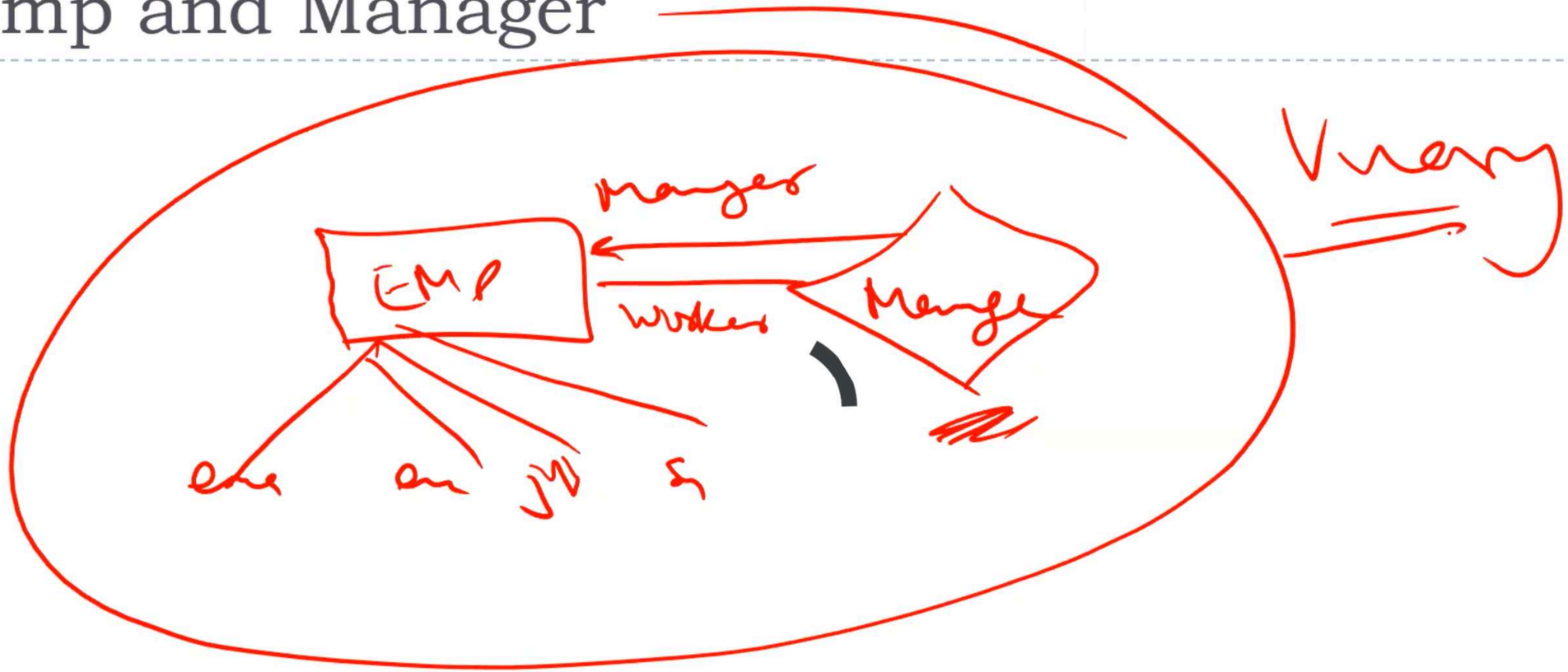
We see that both manager and employee have same set of attributes.

So, the first approach we can do is, create two entities of employee and manager as done in I .

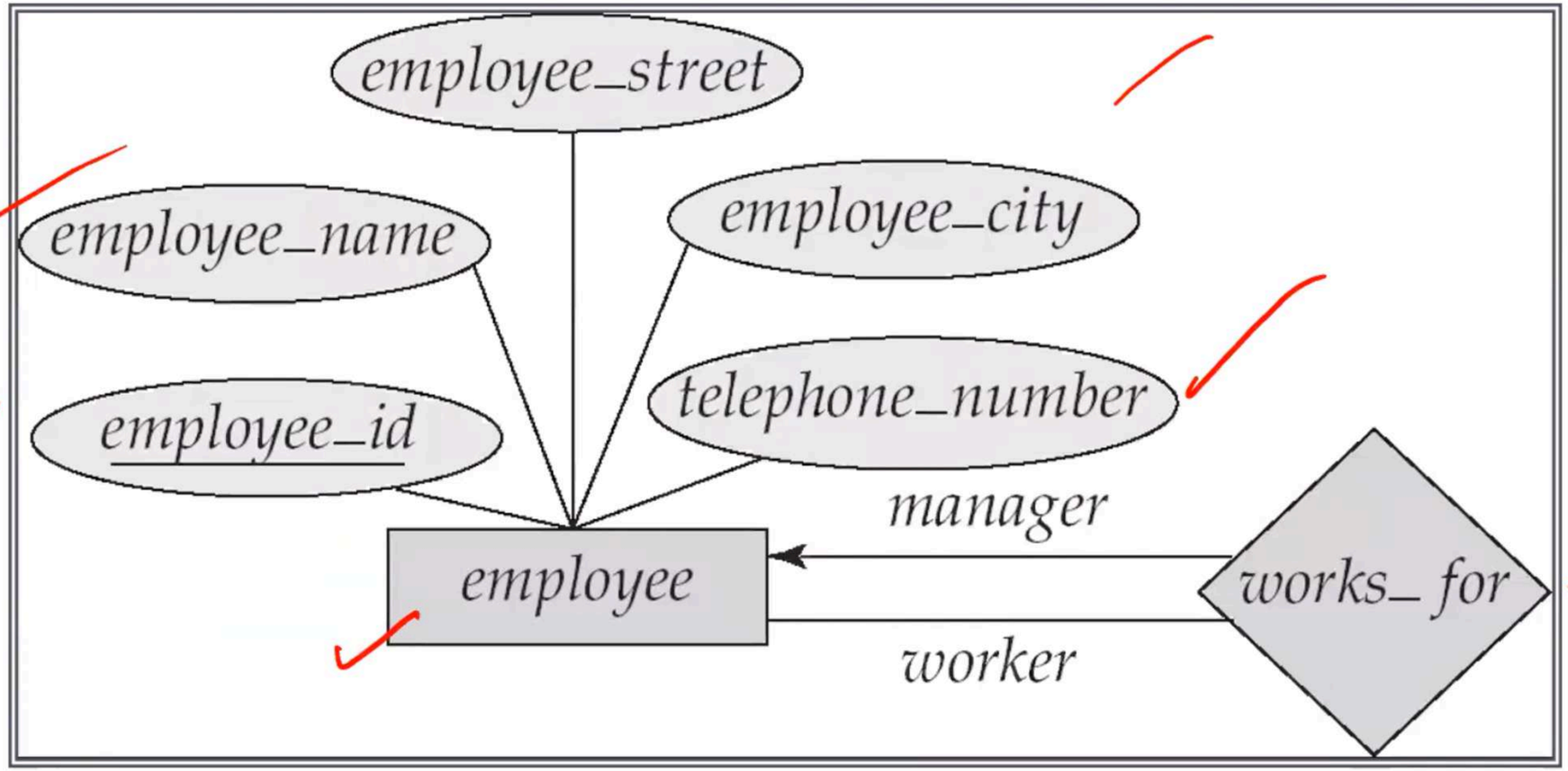
Second approach we can do is , create two entity both of employee (as managers are also employees)
and then above the relation arrow show that one is manager and one is employee.

This approach, discussed in next slide is, we can create a unary relation between employee only ,
and above arrow we can show that one is manager and one is employee.

E-R Model to capture relationship between Emp and Manager



Unary Relationship



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