Overview of Database Management Systems

CST 204
Database Management Systems

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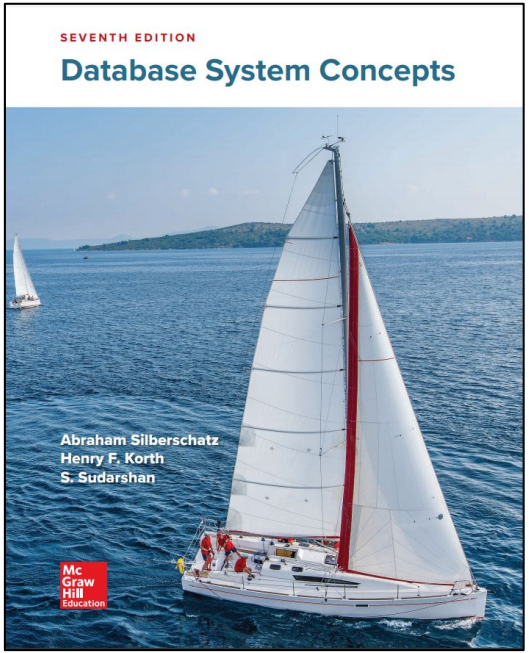
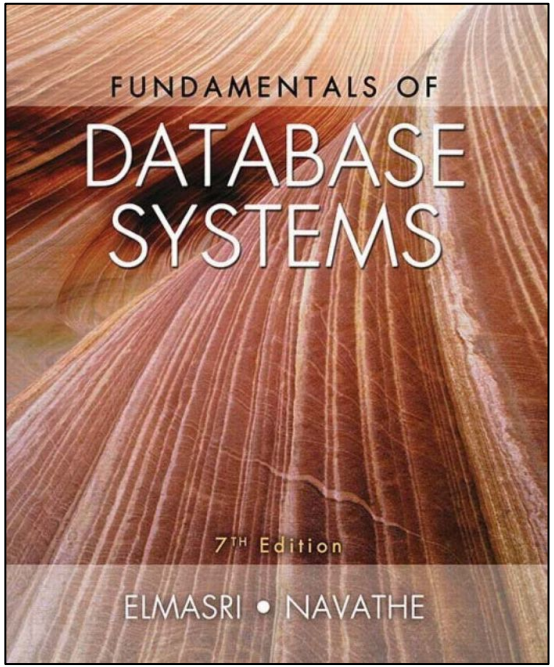
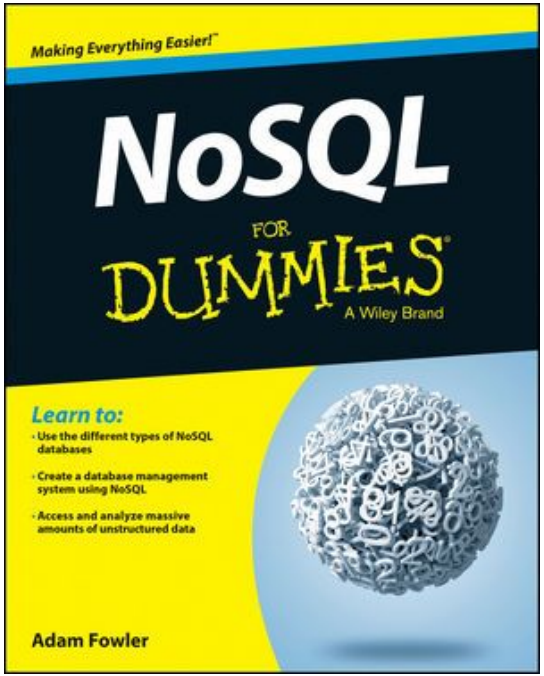
Reference Textbooks







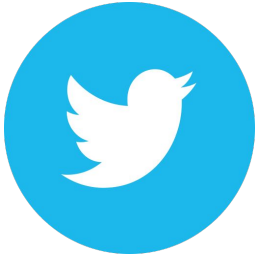
Click on the image to download the text

Database Management Systems- Examples

Source : Google

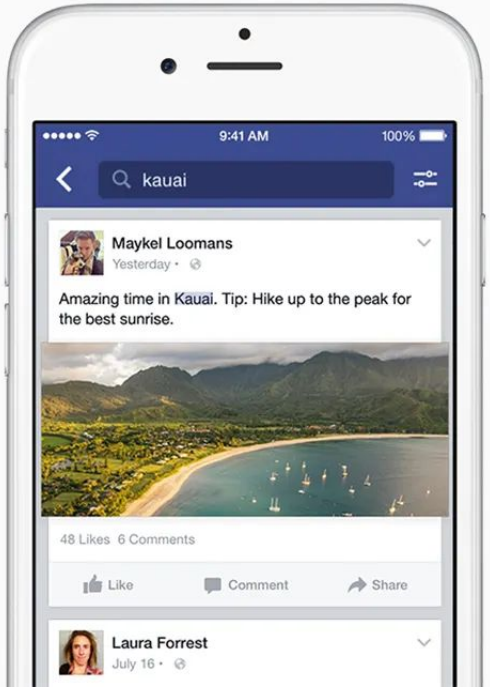
Data is Everywhere ! Data is the New Oil!

Are we dealing with Data?

We deal with it ev’ry day

	A	B	C	D	E
1	Last Name	Sales	Country	Quarter	
2	Smith	$16,753.00	UK	Qtr 3	
3	Johnson	$14,808.00	USA	Qtr 4	
4	Williams	$10,644.00	UK	Qtr 2	
5	Jones	$1,390.00	USA	Qtr 3	
6	Brown	$4,865.00	USA	Qtr 4	
7	Williams	$12,438.00	UK	Qtr 1	
8	Johnson	$9,339.00	UK	Qtr 2	
9	Smith	$18,919.00	USA	Qtr 3	
10	Jones	$9,213.00	USA	Qtr 4	
11	Jones	$7,433.00	UK	Qtr 1	
12	Brown	$3,255.00	USA	Qtr 2	
13	Williams	$14,867.00	USA	Qtr 3	
14	Williams	$19,302.00	UK	Qtr 4	
15	Smith	$9,698.00	USA	Qtr 1	
16					



The Statistics

The amount of data in the world was estimated to be 44 zettabytes at the dawn of 2020 - World Economic Forum

By 2025, the amount of data generated each day is expected to reach 463 exabytes globally - Seagate UK

Google, Facebook, Microsoft, and Amazon store at least 1,200 petabytes of information- Science Focus

The world spends almost $1 million per minute on commodities on the Internet- Visual Capitalist

Click here to read the full article

Difference between Data and Information

DATA : The amount of milk consumed by a person in a month.

Information : Total amount of milk consumed in a month

Information : Amount of Proteins Assimilated

Information : Amount of Fat Assimilated

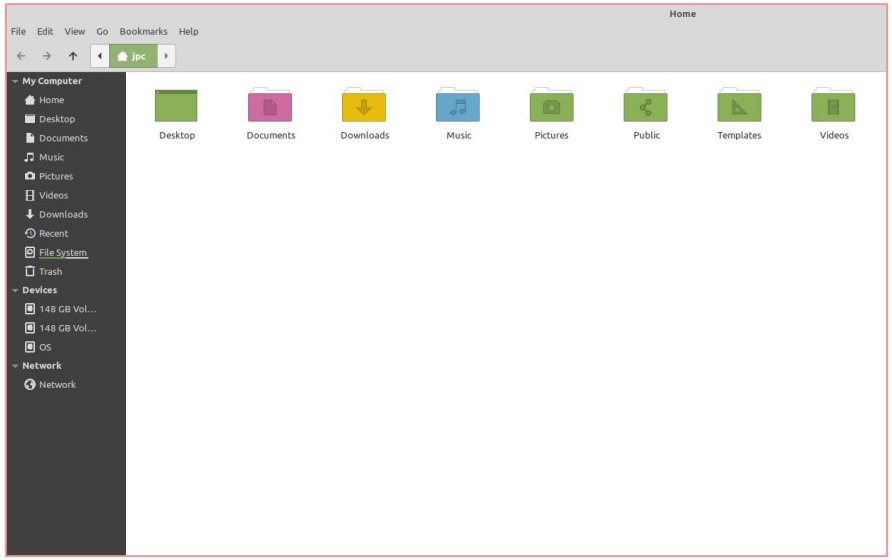
Information : Average Calories gained per day

Database Management System - Definition

"A database-management system (DBMS) is a collection of interrelated data and a set of programs to access those data. The collection of data, usually referred to as the database, contains information relevant to an enterprise. The primary goal of a DBMS is to provide a way to store and retrieve database information that is both convenient and efficient"

- 7th Edition, Database Systems Concepts, Abraham Silberchartz et al

File System v/s DBMS



Catalogue

sno	pno	cost
S1	P1	150
S1	P2	50
S1	P3	100
S2	P4	200
S2	P5	250
S3	P1	250
S3	P2	150
S3	P5	300
S3	P4	250

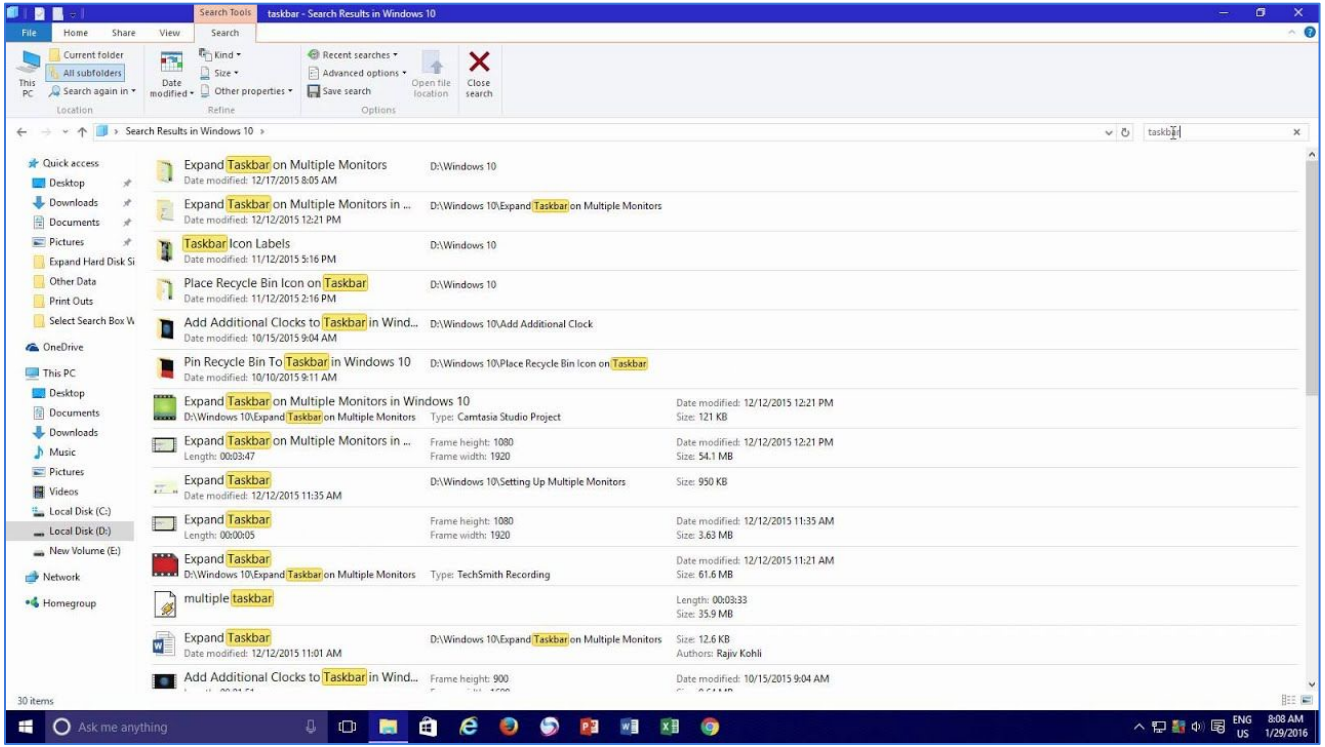
Suppliers

sno	sname	location
S1	M/s Royal furniture	Delhi
S2	M/s Balaji furniture	Bangalore
S3	M/s Premium furniture	Chennai

Parts

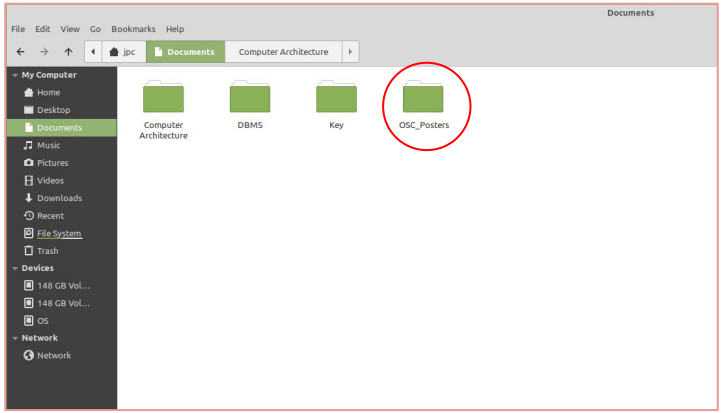
pno	pname	part_spec
P1	Table	Wood
P2	Chair	Wood
P3	Table	Steel
P4	Almirah	Steel
P5	Almirah	Wood

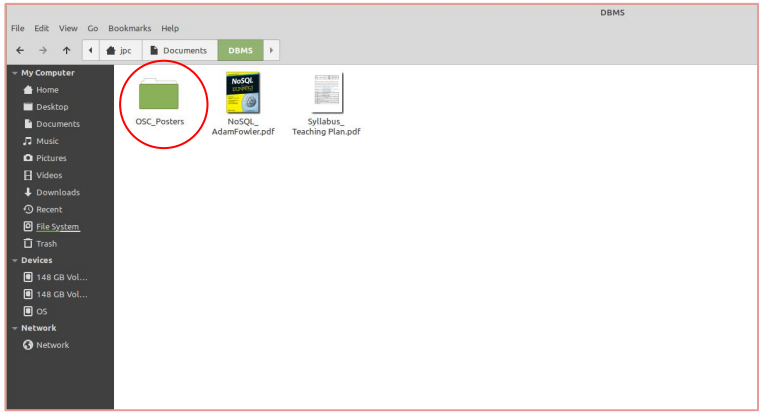
Difficulty in Data Access

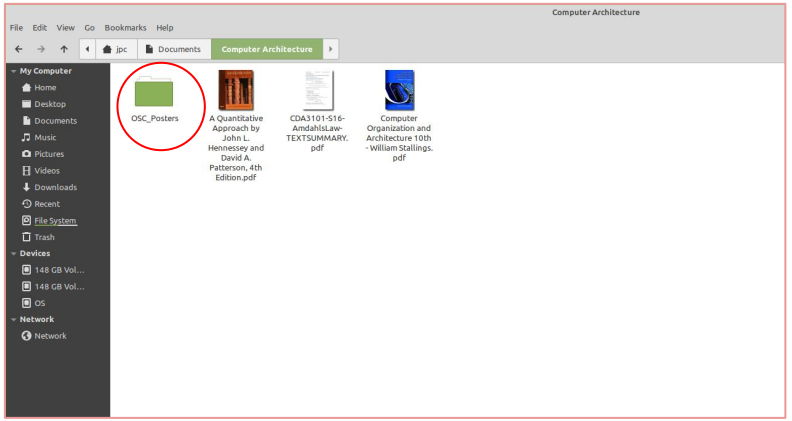


Source : Google

Data Redundancy in File System







Database Table - Sample

Name	Register No:	Department	City	Gender
Michael	NYC023	CSE	Florida	Male
Michelle	NYC029	CSE	Texas	Female
Johann	NYC031	EEE	New York	Female
Jennifer	NYC045	CH	California	Female
David	NYC078	CH	Florida	Male

Database Table - Sample

COLUMNS or ATTRIBUTES

ROWS or TUPLES

Name	Register No:	Department	City	Gender
Michael	NYC023	CSE	Florida	Male
Michelle	NYC029	CSE	Texas	Female
Johann	NYC031	EEE	New York	Female
Jennifer	NYC045	CH	California	Female
David	NYC078	CH	Florida	Male

Concept of Keys in DBMS

Can any attribute uniquely identify a tuple?

Name	Register No:	Department	City	Gender
Michael	NYC023	CSE	Florida	Male
Michelle	NYC029	CSE	Texas	Female
Johann	NYC031	EEE	New York	Female
Jennifer	NYC045	CH	California	Female
David	NYC078	CH	Florida	Male

Concept of Keys in DBMS

Can any attribute uniquely identify a tuple?

Name	Register_No	Department	City	Gender
Michael	NYC023	CSE	Florida	Male
Michelle	NYC029	CSE	Texas	Female
Johann	NYC031	EEE	New York	Female
Jennifer	NYC045	CH	California	Female
David	NYC078	CH	Florida	Male

The attribute Register_No can be treated as a Key

Concept of Keys in DBMS

What about the attribute Name? A Key ?

Name	Register_No	Department	City	Gender
Michael	NYC023	CSE	Florida	Male
Michelle	NYC029	CSE	Texas	Female
Johann	NYC031	EEE	New York	Female
Jennifer	NYC045	CH	California	Female
Michael	NYC078	CH	Florida	Male

The attribute Name cannot be a potential candidate to become a Key

Concept of Keys in DBMS

What about the attributes Department, City , Gender ?

Name	Register_No	Department	City	Gender
Michael	NYC023	CSE	Florida	Male
Michelle	NYC029	CSE	Texas	Female
Johann	NYC031	EEE	New York	Female
Jennifer	NYC045	CH	California	Female
Michael	NYC078	CH	Florida	Male

Could contain replicated data, hence cannot uniquely identify a tuple.

Identify all Key Attributes

Item_ID	Item_Name	Quantity	Rate_Per_Item(In USD)	Rack_ID
001	Pepsi	50	5	A1
002	Mirinda	50	4.75	A1
003	Coca-Cola	35	4.25	A1
004	Canned Tuna	100	10	B1
005	Cornflakes	40	20	C2

Identify all Key Attributes

Cust_ID	Name	E-Mail	SSN	Location
001	Mario	mario@abc.com	089-04-1090	NYC
002	Ibrahim	ib@abc.com	091-17-1099	NYC
003	Julian	jul@abc.com	304-24-0090	NJ
004	Brian	brian@abc.com	201-19-0196	NJ
005	Martin	mar01@abc.com	101-83-8970	TX

Note!

Every database table should have at least one key

Key should be Unique & NOT NULL

All About Keys

Primary Key

Foreign Key

Alternate Key

Super Key

Composite Key

Candidate Key

Candidate Key

Register_No	Roll_No	First_Name	Last_Name	Gender	Phone
10262609	9	George	Hamilton	M	+1(767)123-9809
10262610	10	Martina	Wayne	F	+1(782)890-9159
10262611	11	Mark	Twain	M	+1(504)823-7624
10262612	12	William	Moore	M	+1(067)103-2403

The minimal set of attribute which can uniquely identify a tuple is known as candidate key.

Candidate Key

Register_No	Roll_No	First_Name	Last_Name	Gender	Phone
10262609	9	George	Hamilton	M	+1(767)123-9809
10262610	10	Martina	Wayne	F	+1(782)890-9159
10262611	11	Mark	Twain	M	+1(504)823-7624
10262612	12	William	Moore	M	+1(067)103-2403

The minimal set of attribute which can uniquely identify a tuple is known as candidate key.

Candidate Key

The value of Candidate Key is unique and non-null for every tuple.

There can be more than one candidate key in a relation.

Register_No	Roll_No	First_Name	Last_Name	Gender	Phone

The candidate key can be simple (having only one attribute) or composite as well.

Roll_No	Phone

Super Key

The set of attributes which can uniquely identify a tuple is known as Super Key.

Adding zero or more attributes to candidate key generates super key.

A candidate key is a super key but vice versa is not true.

Super Key

{ Register_No , Roll_No }

{ Register_No , Phone }

{ Roll_No, Phone ,Gender}

Foreign Key

Foreign keys are the columns of a table that points to the primary key of another table. They act as a cross-reference between tables.

Activity Table

Activity_ID	Student_ID	Activity	Points

Student Table

Student_ID	Name	Department	Age

Foreign Key

Foreign keys are the columns of a table that points to the primary key of another table. They act as a cross-reference between tables.

Activity Table

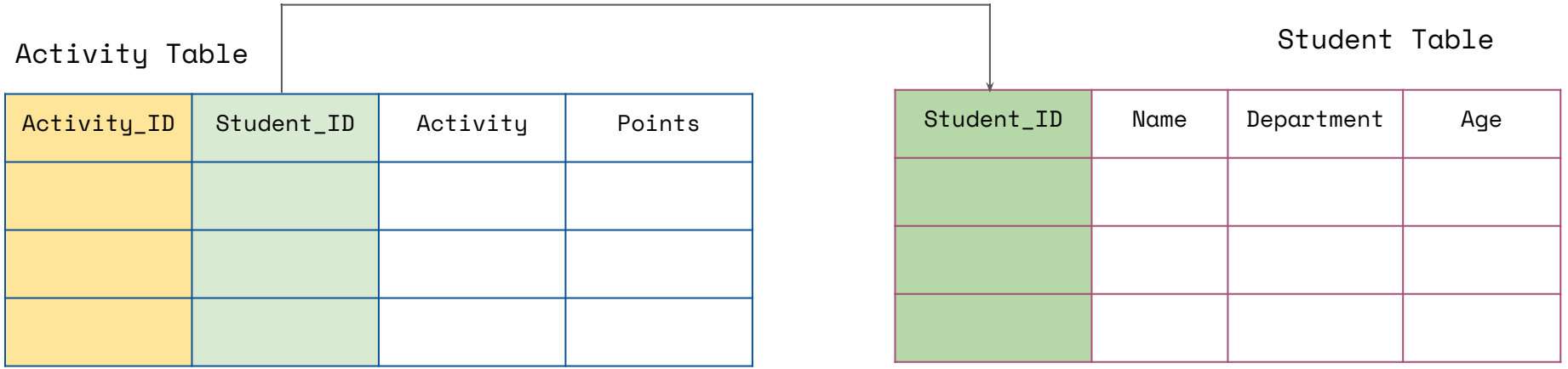
Activity_ID	Student_ID	Activity	Points

Student Table

Student_ID	Name	Department	Age

Foreign Key

Foreign keys are the columns of a table that points to the primary key of another table. They act as a cross-reference between tables.



Foreign Key

Activity Table

Activity_ID	Register_No	Activity	Points
1	CS001	TECH FEST	6
2	CS002	MOOC	50
3	CS071	MOOC	50
4	CS071	INTERNSHIP	20
5	CS044	TECH FEST	6

Student Table

Register_No	Name	Department	Age
CS001	AARON	CS	19
CS002	AASHIN	CS	19
. . .			
CS044	BENNIN	CS	19
. . .			
CS071	JERIN	CS	19
CS072	JEZIN	CS	19

Foreign Key

Activity Table

Activity_ID	Register_No	Activity	Points
1	CS001	TECH FEST	6
2	CS002	MOOC	50
3	CS071	MOOC	50
4	CS071	INTERNSHIP	20
5	CS044	TECH FEST	6

Student Table

Register_No	Name	Department	Age
CS001	AARON	CS	19
CS002	AASHIN	CS	19
. . .			
CS044	BENNIN	CS	19
. . .			
CS071	JERIN	CS	19
CS072	JEZIN	CS	19

Foreign Key

Activity Table

Activity_ID	Register_No	Activity	Points
1	CS001	TECH FEST	6
2	CS002	MOOC	50
3	CS071	MOOC	50
4	CS071	INTERNSHIP	20
5	CS044	TECH FEST	6

Refer Student Table with Register_No = 'CS001'

Student Table

Register_No	Name	Department	Age
CS001	AARON	CS	19
CS002	AASHIN	CS	19
. . .			
CS044	BENNIN	CS	19
. . .			
CS071	JERIN	CS	19
CS072	JEZIN	CS	19

Foreign Key

Activity Table

Activity_ID	Register_No	Activity	Points
1	CS001	TECH FEST	6
2	CS002	MOOC	50
3	CS071	MOOC	50
4	CS071	INTERNSHIP	20
5	CS044	TECH FEST	6

Refer Student Table with Register_No = 'CS001'

Student Table

Register_No	Name	Department	Age
CS001	AARON	CS	19
CS002	AASHIN	CS	19
. . .			
CS044	BENNIN	CS	19
. . .			
CS071	JERIN	CS	19
CS072	JEZIN	CS	19

Retrieving the Data

Cust_ID	Name	E-Mail	SSN	Location
001	Mario	mario@abc.com	089-04-1090	NYC
002	Ibrahim	ib@abc.com	091-17-1099	NYC
003	Julian	jul@abc.com	304-24-0090	NJ
004	Brian	brian@abc.com	201-19-0196	NJ
005	Martin	mar01@abc.com	101-83-8970	TX

Retrieve me the list of all people who are from NYC. Possible???

Retrieving the Data

Cust_ID	Name	E-Mail	SSN	Location
001	Mario	mario@abc.com	089-04-1090	NYC
002	Ibrahim	ib@abc.com	091-17-1099	NYC
003	Julian	jul@abc.com	304-24-0090	NJ
004	Brian	brian@abc.com	201-19-0196	NJ
005	Martin	mar01@abc.com	101-83-8970	TX

Retrieve me the list of all people who are from NYC. Possible???

Displaying the Result

Cust_ID	Name	E-Mail	SSN	Location
001	Mario	mario@abc.com	089-04-1090	NYC
002	Ibrahim	ib@abc.com	091-17-1099	NYC

Updating the Database

Cust_ID	Name	E-Mail	SSN	Location
001	Mario	mario@abc.com	089-04-1090	NYC
002	Ibrahim	ib@abc.com	091-17-1099	NYC
003	Julian	jul@abc.com	304-24-0090	TX
004	Brian	brian@abc.com	201-19-0196	NJ
005	Martin	mar01@abc.com	101-83-8970	NYC

Can I change the E-Mail of Mario to mario09@abc.com ? Possible?

Updating the Database

Cust_ID	Name	E-Mail	SSN	Location
001	Mario	mario09@abc.com	089-04-1090	NYC
002	Ibrahim	ib@abc.com	091-17-1099	NYC
003	Julian	jul@abc.com	304-24-0090	TX
004	Brian	brian@abc.com	201-19-0196	NJ
005	Martin	mar01@abc.com	101-83-8970	NYC

Can I change the E-Mail of Mario to mario09@abc.com ? Possible?

Updating Multiple Rows at a time

Roll_No	Register_No	Name	Location	Remarks
1	CS001	Mario	NYC	Hosteler
2	CS002	Ibrahim	NYC	Hosteler
3	CS003	Julian	TX	Hosteler
4	CS004	Brian	NJ	Day-scholar
5	CS005	Martin	NYC	Hosteler

Update the Remarks of all student from NYC to 'Day-scholar'

Updating Multiple Rows at a time

Roll_No	Register_No	Name	Location	Remarks
1	CS001	Mario	NYC	Hosteler
2	CS002	Ibrahim	NYC	Hosteler
3	CS003	Julian	TX	Hosteler
4	CS004	Brian	NJ	Day-scholar
5	CS005	Martin	NYC	Hosteler

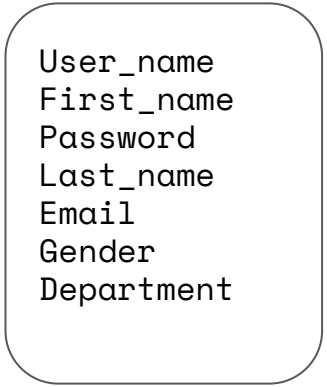
Update the Remarks of all student from NYC to 'Day-scholar'

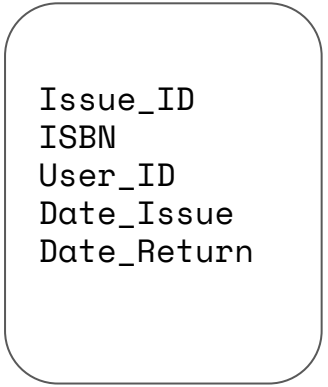
Updated Database Table

Roll_No	Register_No	Name	Location	Remarks
1	CS001	Mario	NYC	Day-scholar
2	CS002	Ibrahim	NYC	Day-scholar
3	CS003	Julian	TX	Hosteler
4	CS004	Brian	NJ	Day-scholar
5	CS005	Martin	NYC	Day-scholar

Update the Remarks of all student from NYC to 'Day-scholar'

Simple Database Application





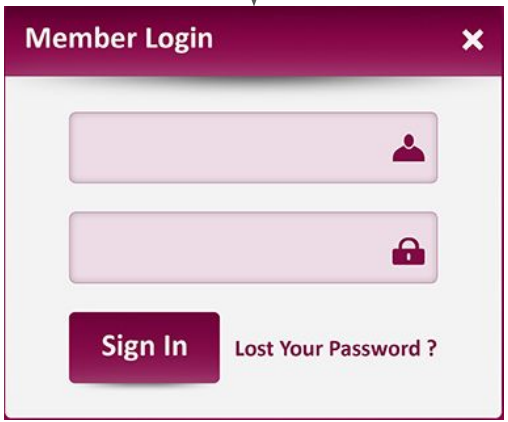
Simple Database Application

Issue_ID
ISBN
User_ID
Date_Issue
Date_Return

ISBN
Book_Name
Author
Price

user_name
password

User_name
First_name
Password
last_name
Email
Gender
department



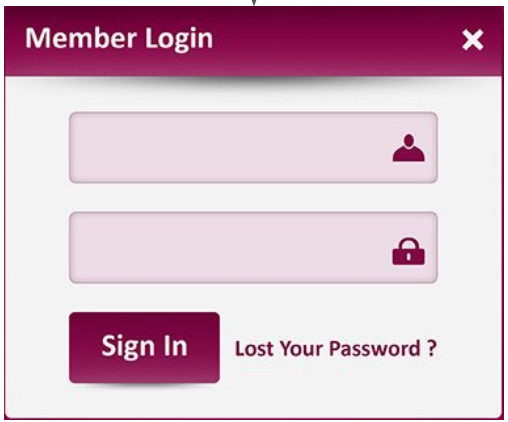
Simple Database Application

Issue_ID
ISBN
User_ID
Date_Issue
Date_Return

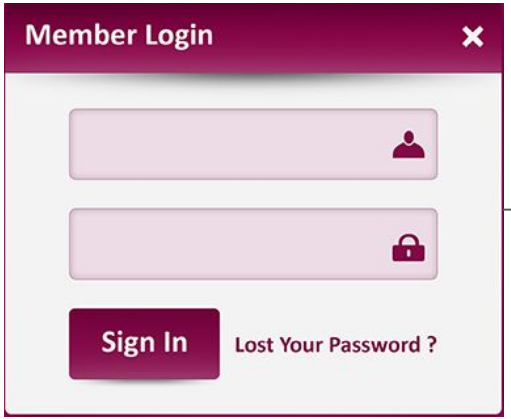
ISBN
Book_Name
Author
Price

user_name
password

User_name
First_name
Password
last_name
Email
Gender
department



Simple Database Application



user_name	password
jordan.cs	@Jordan_XYZ
michael.cs	Mich_94@000
. . .	. . .
anna.ee	109anna_89**

Simple Database Application

user_name	password
jordan.cs	@Jordan_XYZ
michael.cs	Mich_94@000
. . .	. . .
anna.ee	109anna_89**

Simple Database Application

user_name	password
jordan.cs	@Jordan_XYZ
michael.cs	Mich_94@000
. . .	. . .
anna.ee	109anna_89**

Simple Database Application

user_name	password
jordan.cs	@Jordan_XYZ
michael.cs	Mich_94@000
. . .	. . .
anna.ee	109anna_89**

Simple Database Application

GRANT ACCESS

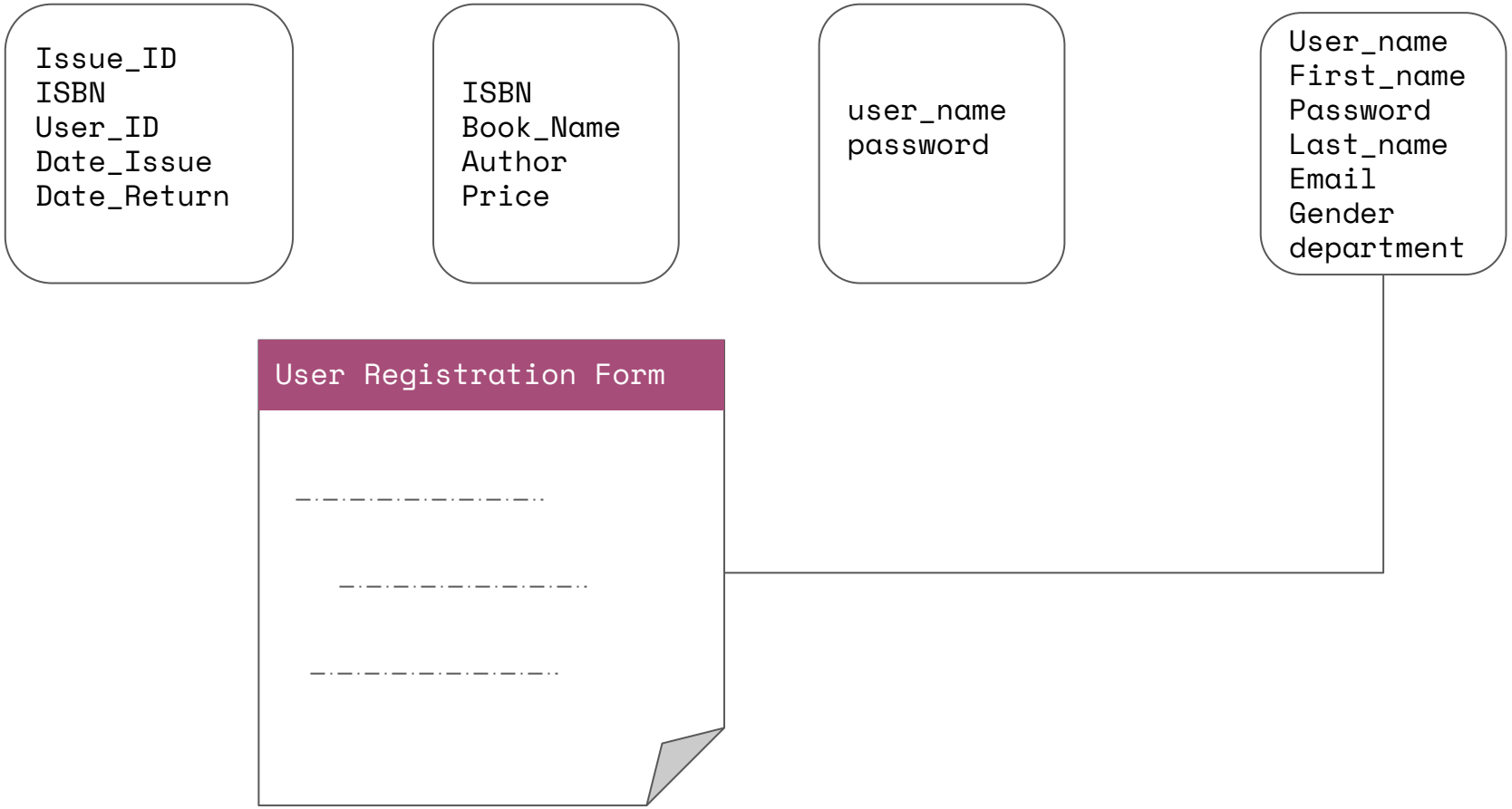
user_name	password
jordan.cs	@Jordan_XYZ
michael.cs	Mich_94@000
. . .	. . .
anna.ee	109anna_89**

Simple Database Application

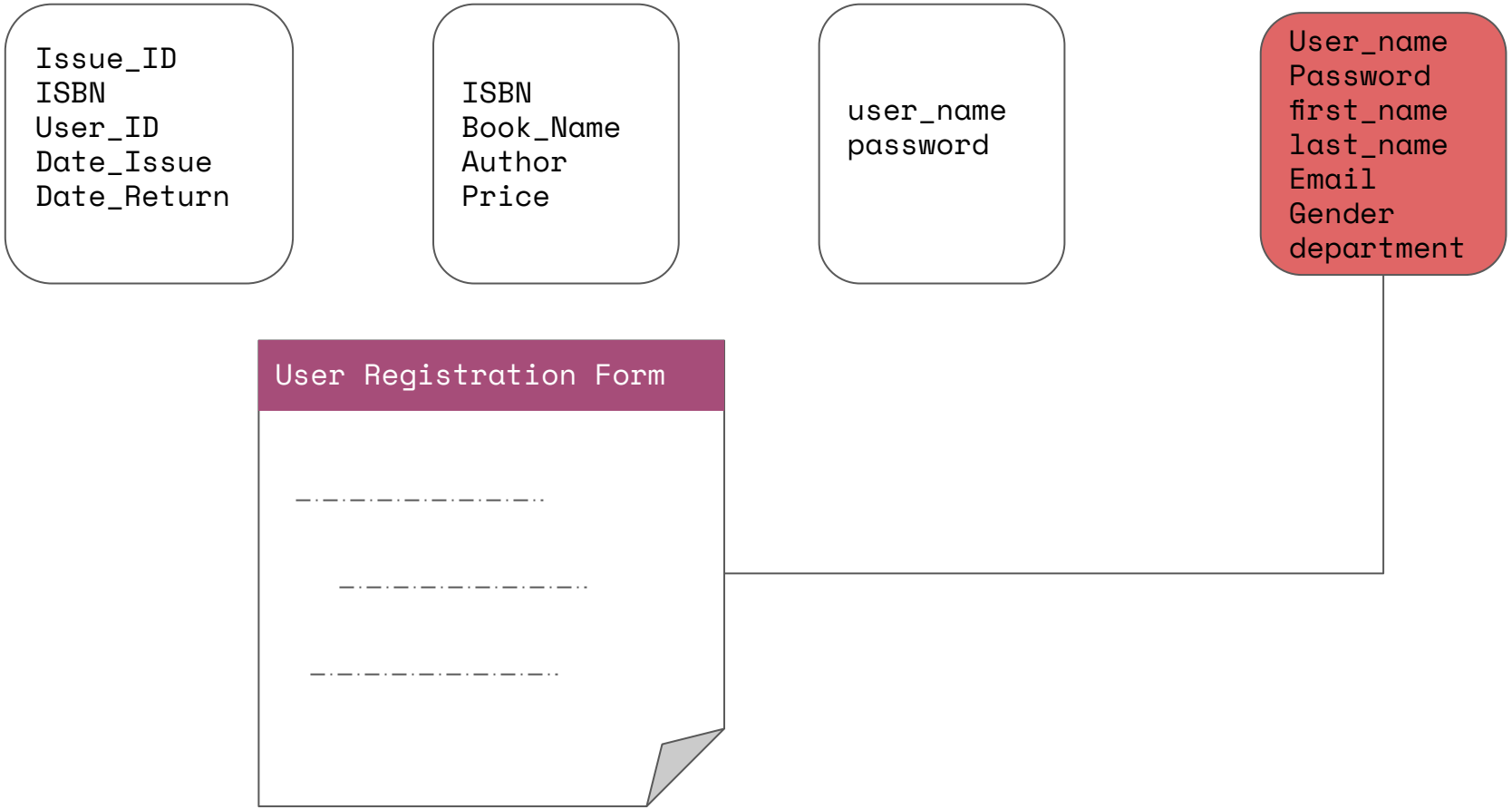
ACCESS DENIED

user_name	password
jordan.cs	@Jordan_XYZ
michael.cs	Mich_94@000
. . .	. . .
anna.ee	109anna_89**

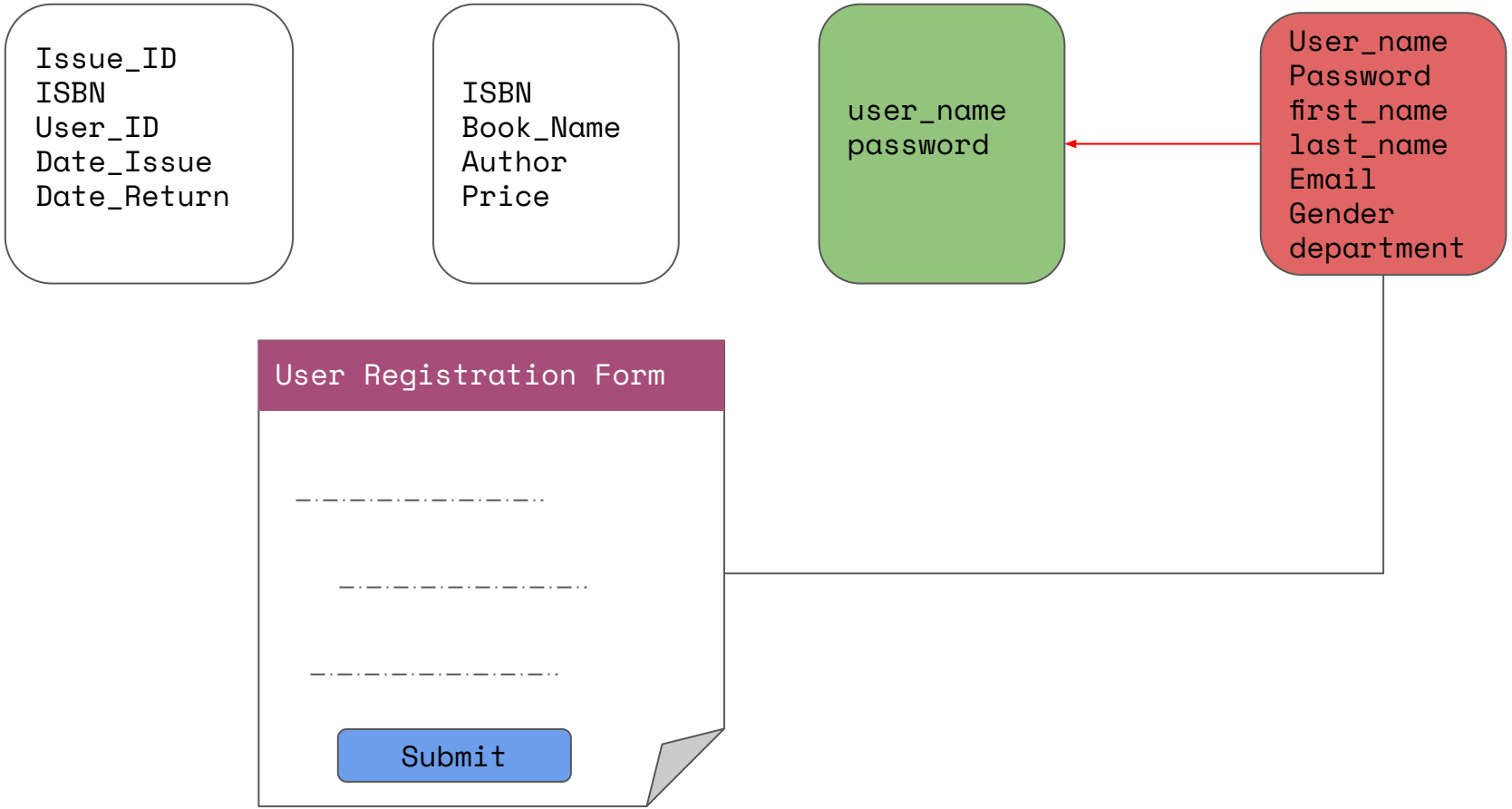
Simple Database Application



Simple Database Application



Simple Database Application



User_Name	Password	First_Name	Last_Name	EMail	Gender	Department

username	password

User_Name	Password	First_Name	Last_Name	EMail	Gender	Department
jacob.pc	12345	Jacob	P Cherian	jpc@gmail.com	Male	CSE

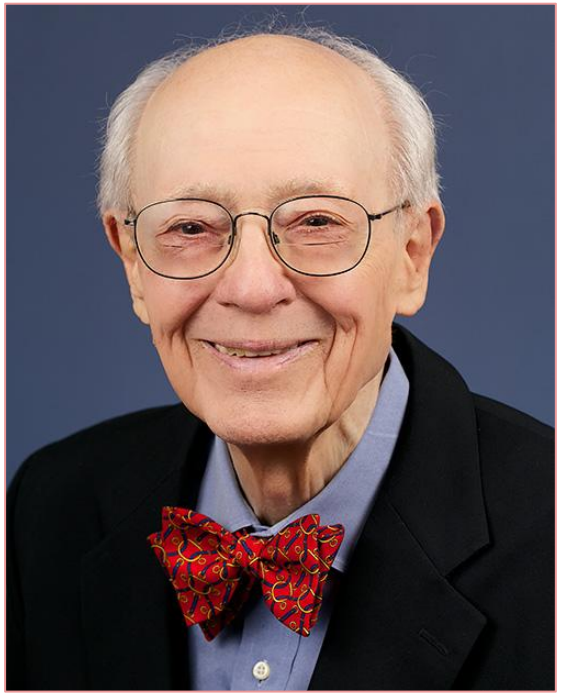
When Submit Button is Clicked

username	password
jacob.pc	12345

Entity Relationship (ER) Diagrams

Recommended Reading : Click Here

History of ER Models (Click Me!)



Charles Bachman

Peter Chen

Entity & Entity Set

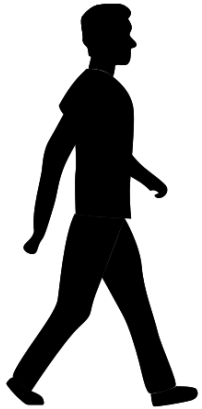
An entity is a “thing” or “object” in the real world that is distinguishable from all other objects.

For example, each person in a college is an entity.

An entity has a set of properties, and the values for some set of properties must uniquely identify an entity.

An entity set is a set of entities of the same type that share the same properties, or attributes

Example- Entities



- Name
- E_Mail
- Gender
- Phone
- Location

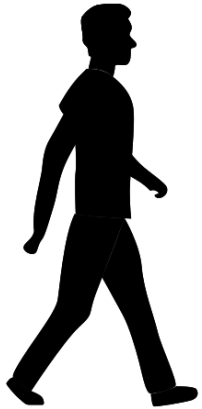
Name	E_Mail	Gender	Phone	Location

Table : Person

Each entity has a value for each of its attributes

Example- Entities

ENTITY



ENTITY TYPE: PERSON

Name

E_Mail

Gender

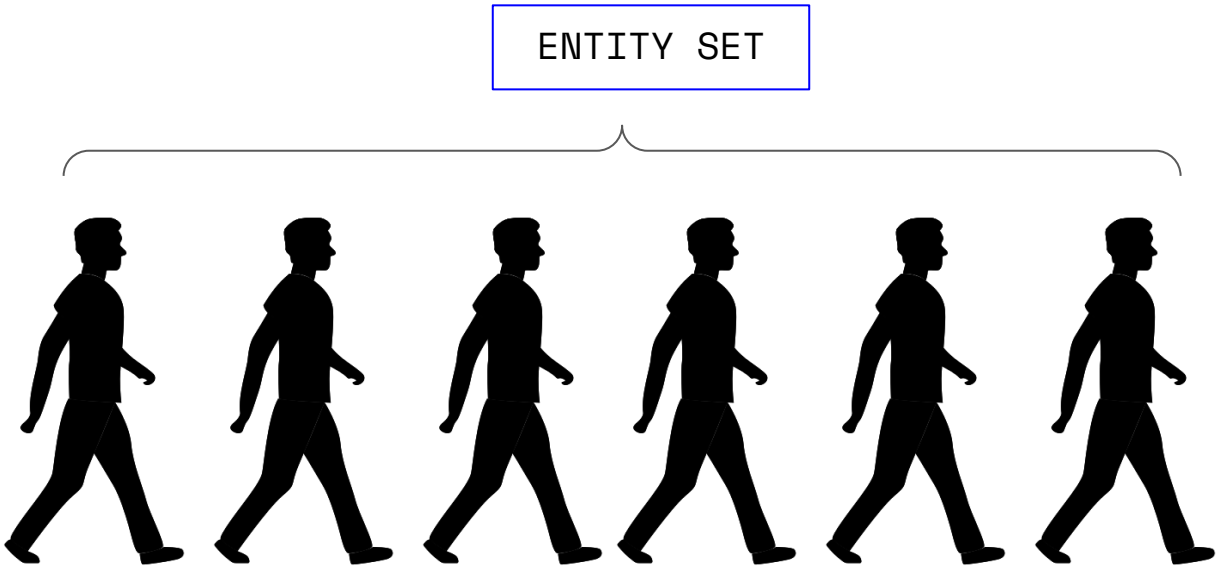
Phone

Location

ATTRIBUTES/CHARACTERISTICS

Entity Set- Example

A database thus includes a collection of entity sets, each of which contains any number of entities of the same type.



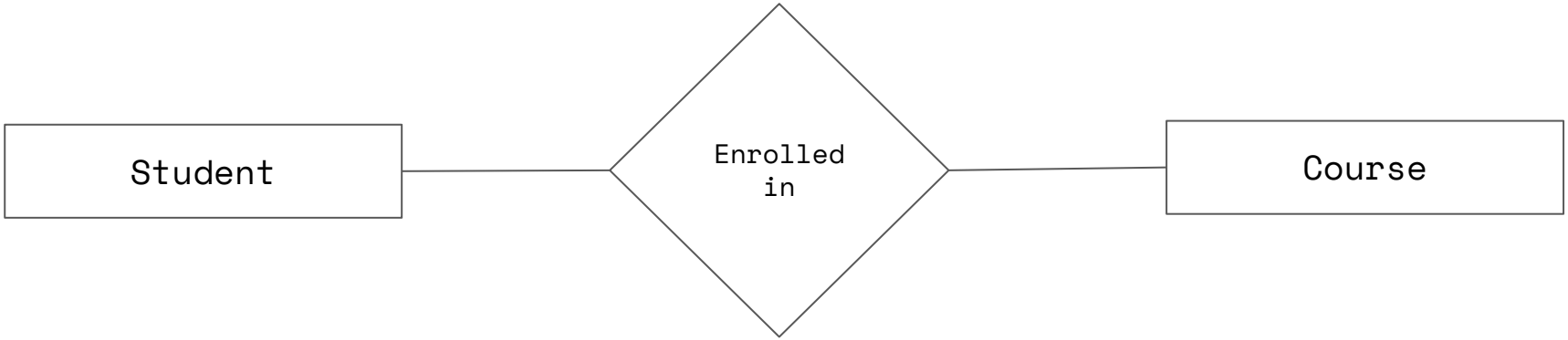
Entity Set Constitutes the db Table

Name	E_Mail	Gender	Phone	Location
Mario	mario@abc.com	M	201	NJ
Ibrahim	ib@abc.com	M	202	NJ
Julian	jul@abc.com	M	203	NJ
Brian	brian@abc.com	M	204	NJ
Martin	mar01@abc.com	M	301	NJ

For eg: Julian is an entity of type person

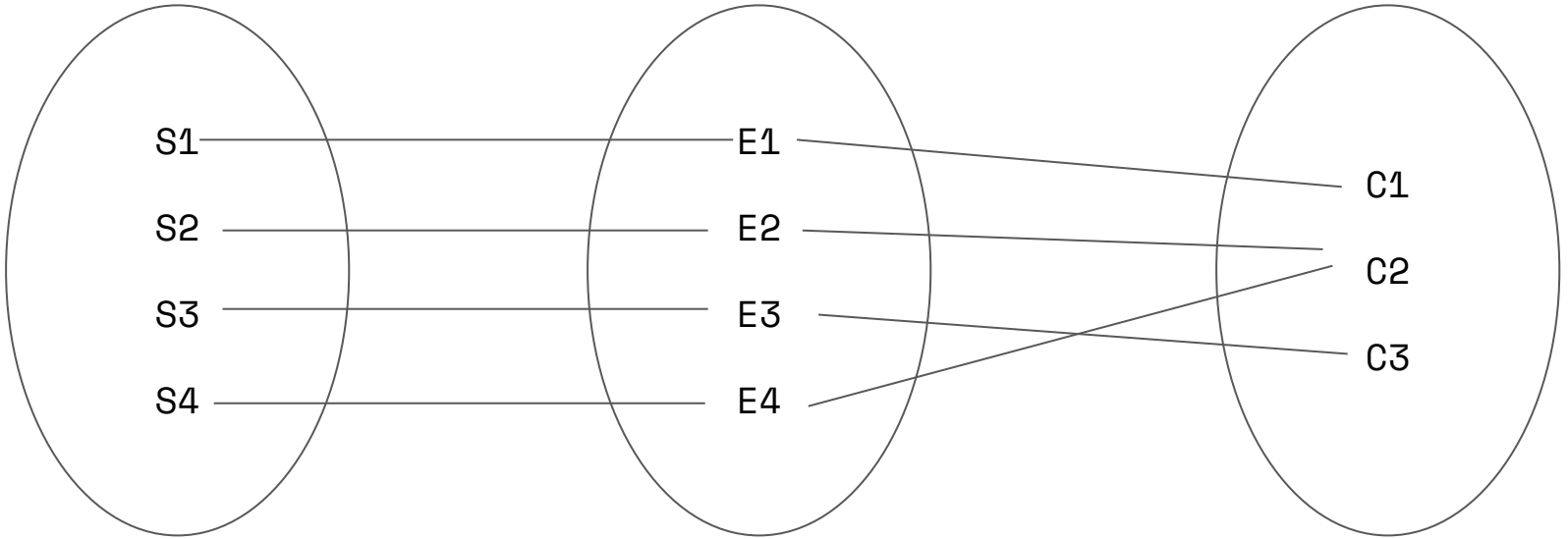
Relationship

A relationship type represents the association between entity types



Relationship Set

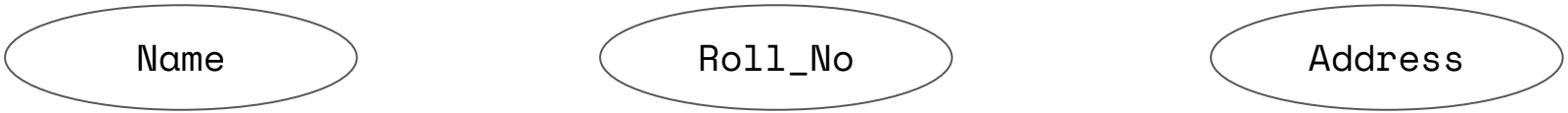
A set of relationships of same type is known as relationship set.



Types of Attributes

Simple Attribute

An attribute which cannot be further subdivided into components is a simple attribute.



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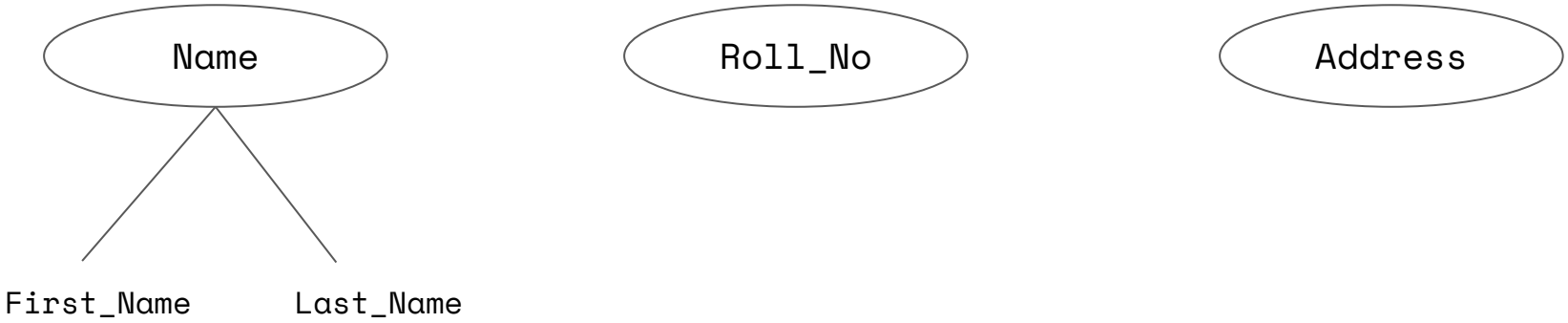

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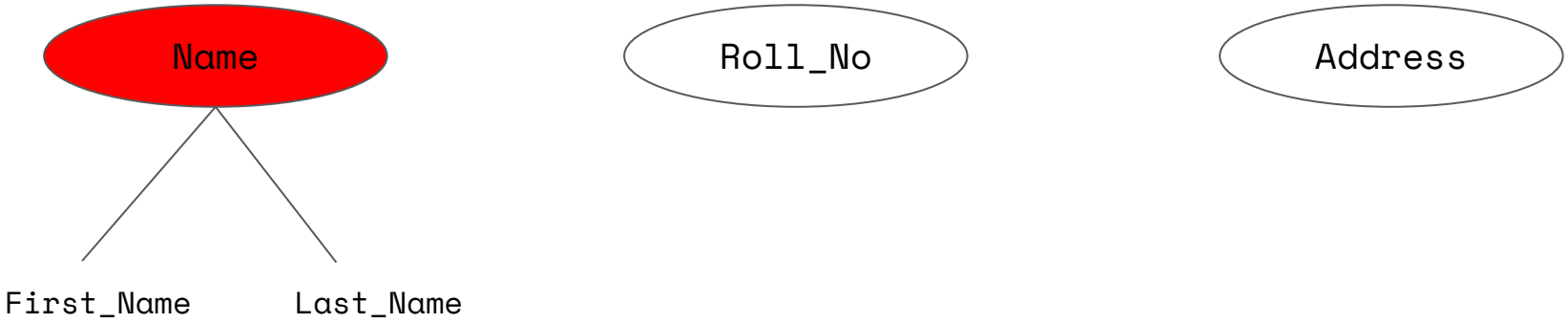

Simple Attribute

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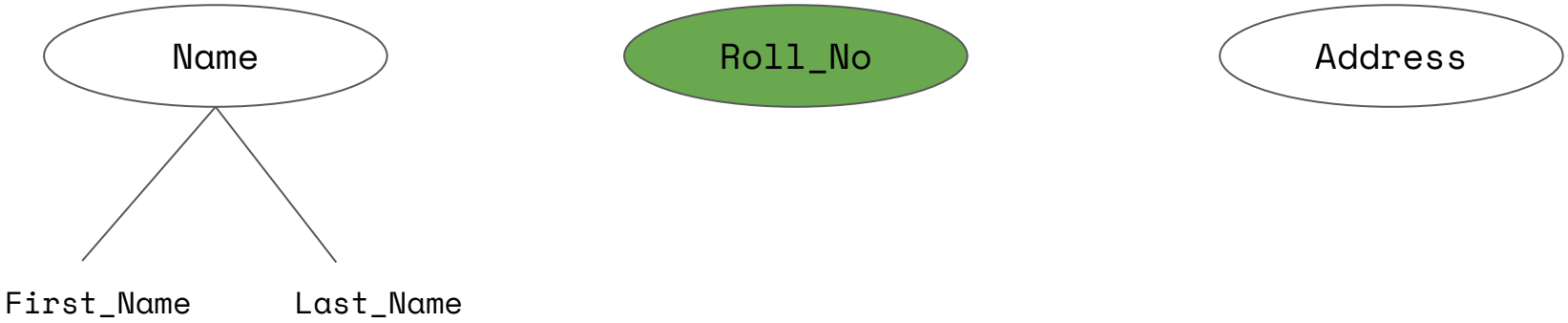

Simple Attribute

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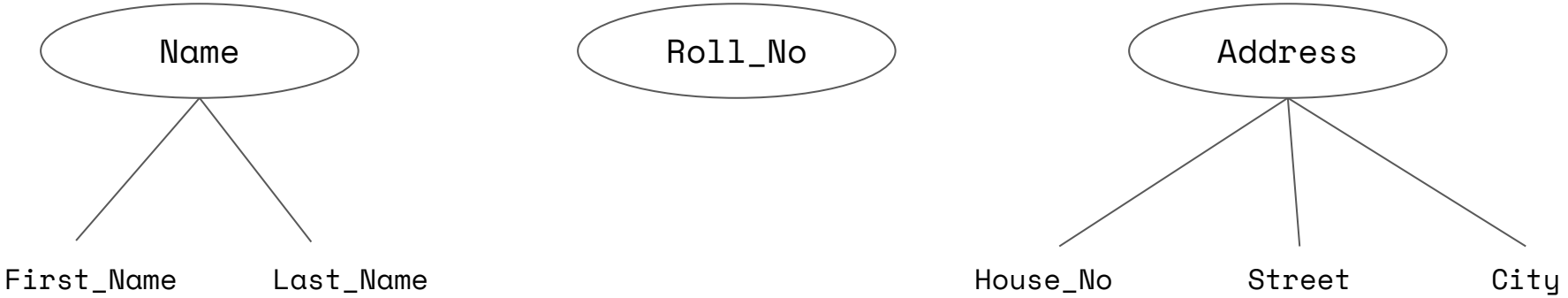

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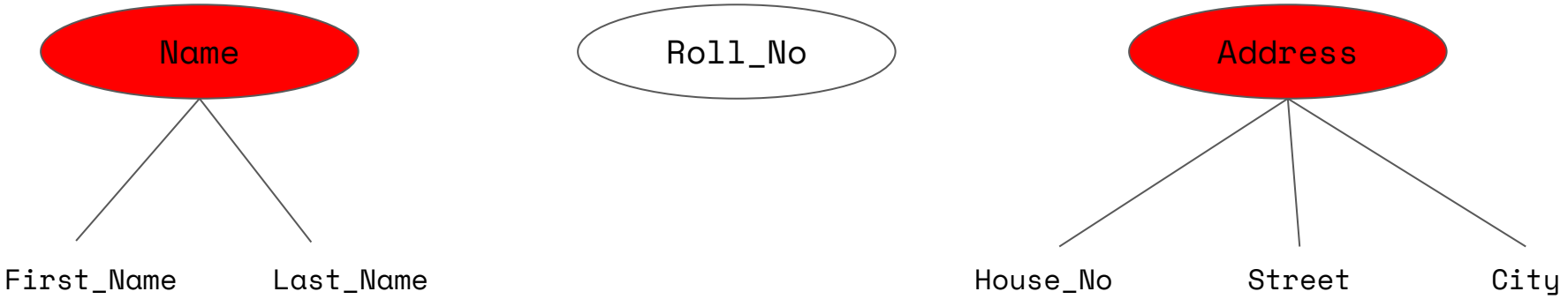
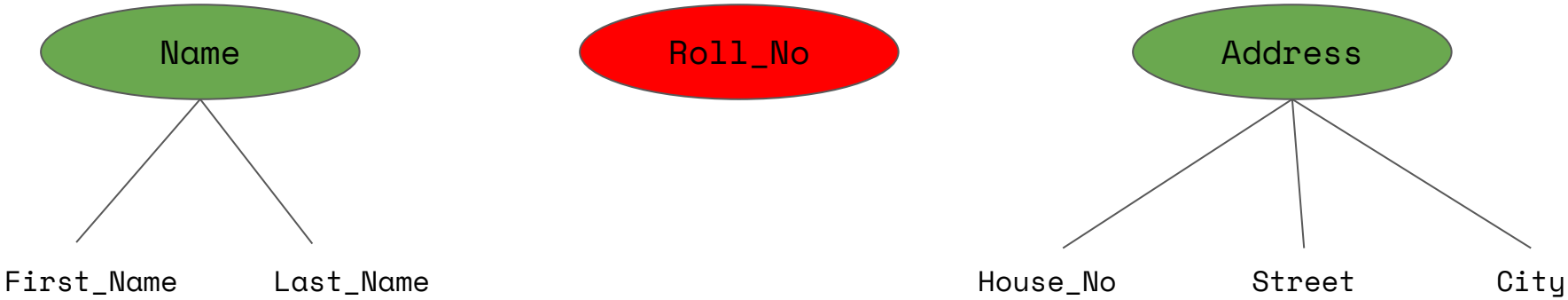


Composite Attribute

An attribute which can be split into components is a composite attribute.



Single-valued Attribute

Single-valued attribute is an attribute that can have only a single value.

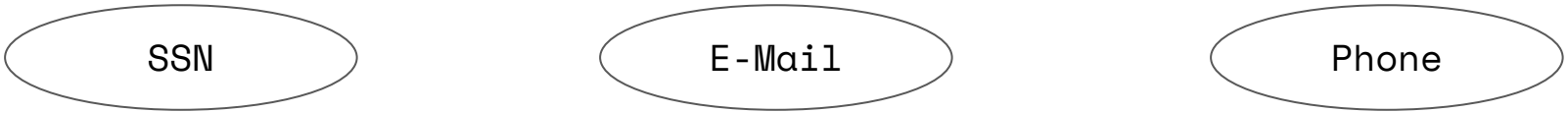
Single-valued Attribute

Single-valued attribute is an attribute that can have only a single value.

A person can only have a single Social Security Number

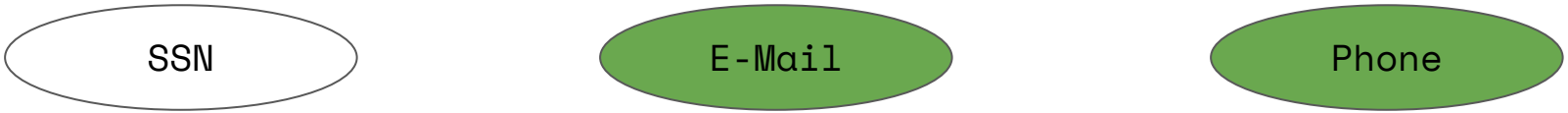
Multi-valued Attribute

The attribute which can take up more than a single value for each entity instance is multi-valued attribute.



Multi-valued Attribute

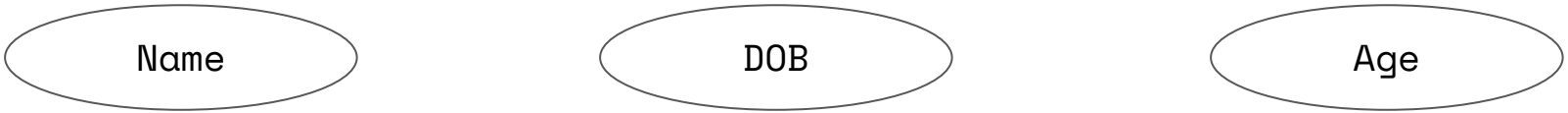
The attribute which can take up more than a single value for each entity instance is multi-valued attribute.



A person can have more than one E-Mail ID & Phone Number

Derived Attribute

An attribute that can be derived from other attributes is derived attribute.



Derived Attribute

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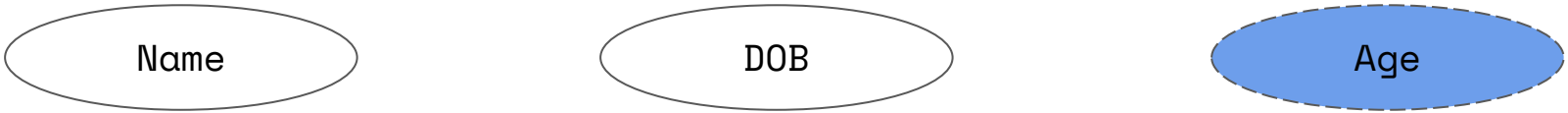
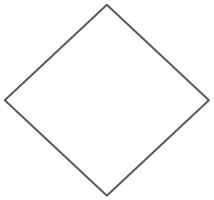


Age is a derived attribute as it's value can be calculated from the Date of Birth (DOB) Attribute

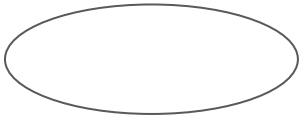
Representing ER Diagrams

Symbols used in ER

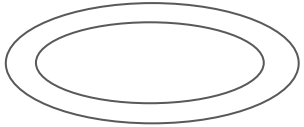
Entity



Relationship

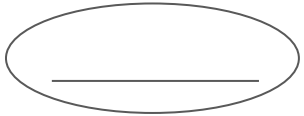


Attribute

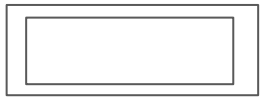


Multi-valued Attribute

Derived Attribute



Key Attribute



Weak Relationship

Entity along with Attributes

Represent an Entity *Student* with it's attributes Name, Roll_No , Address , DOB , Age

Entity along with Attributes

Represent an Entity *Student* with it's attributes Name, Roll_No , Address , DOB , Age

Entity along with Attributes

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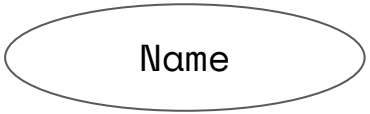
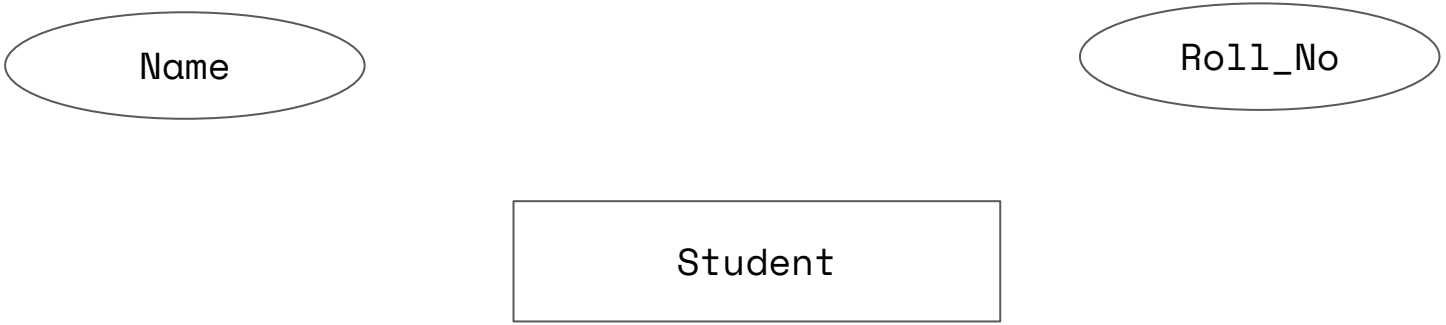


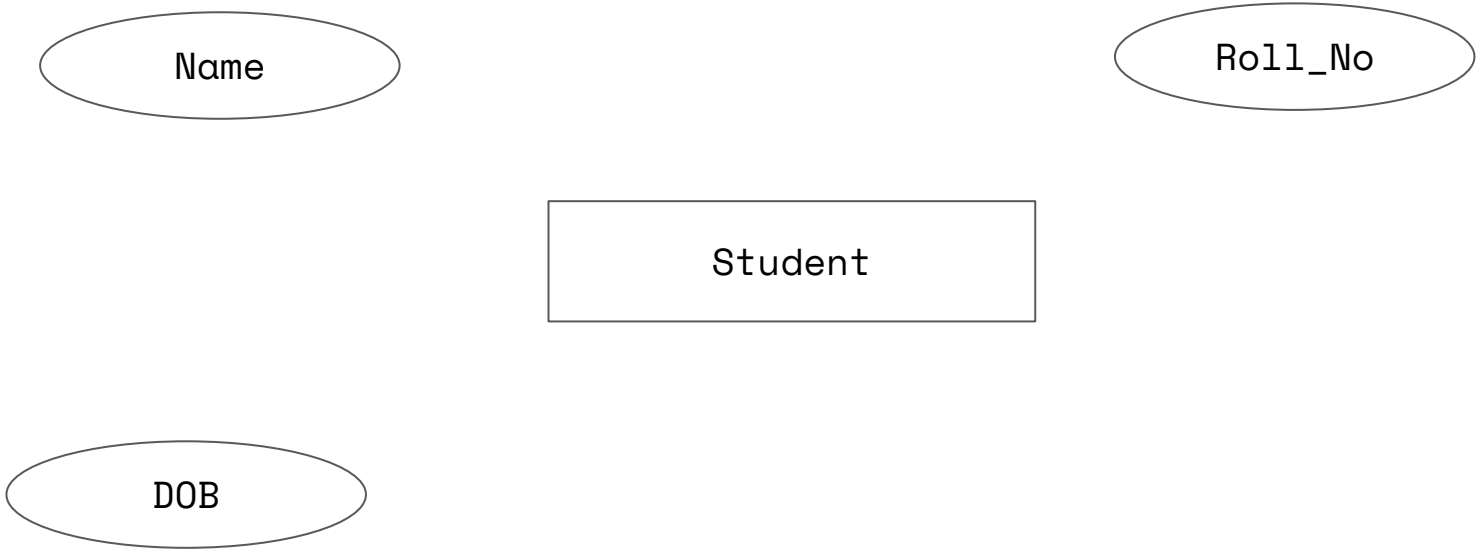
Entity along with Attributes

Represent an Entity *Student* with it's attributes Name, Roll_No , Address , DOB , Age



Entity along with Attributes

Represent an Entity *Student* with it's attributes Name, Roll_No , Address , DOB , Age



Entity along with Attributes

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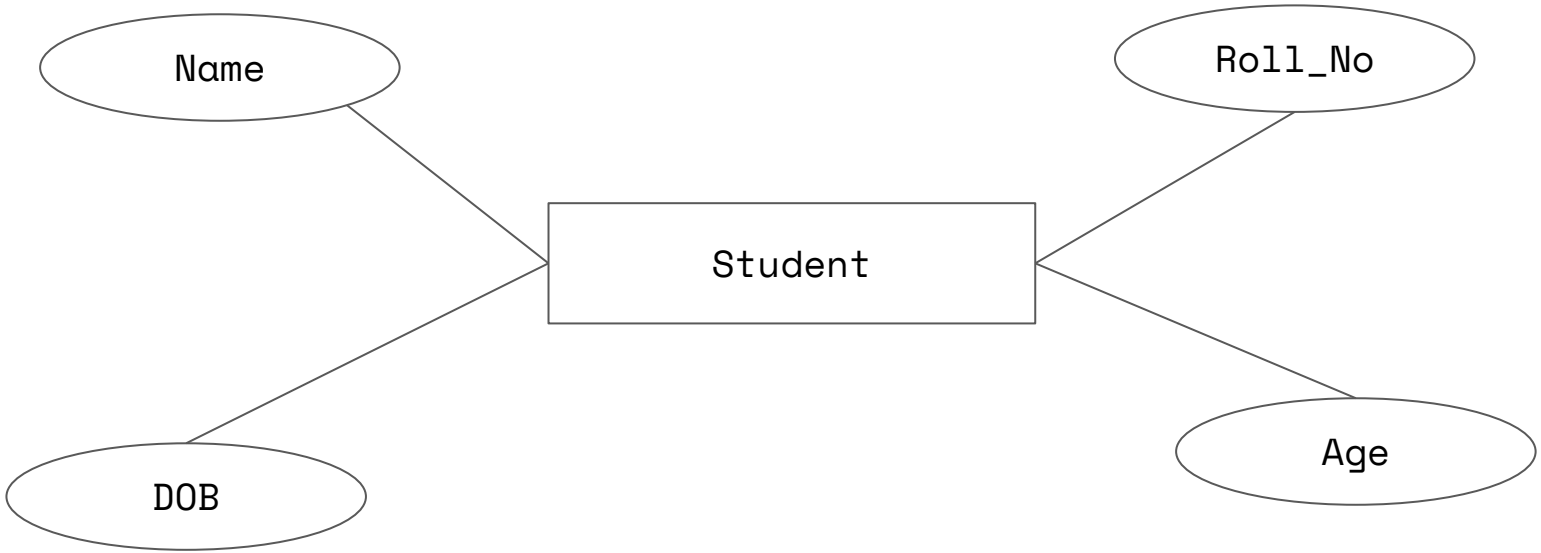
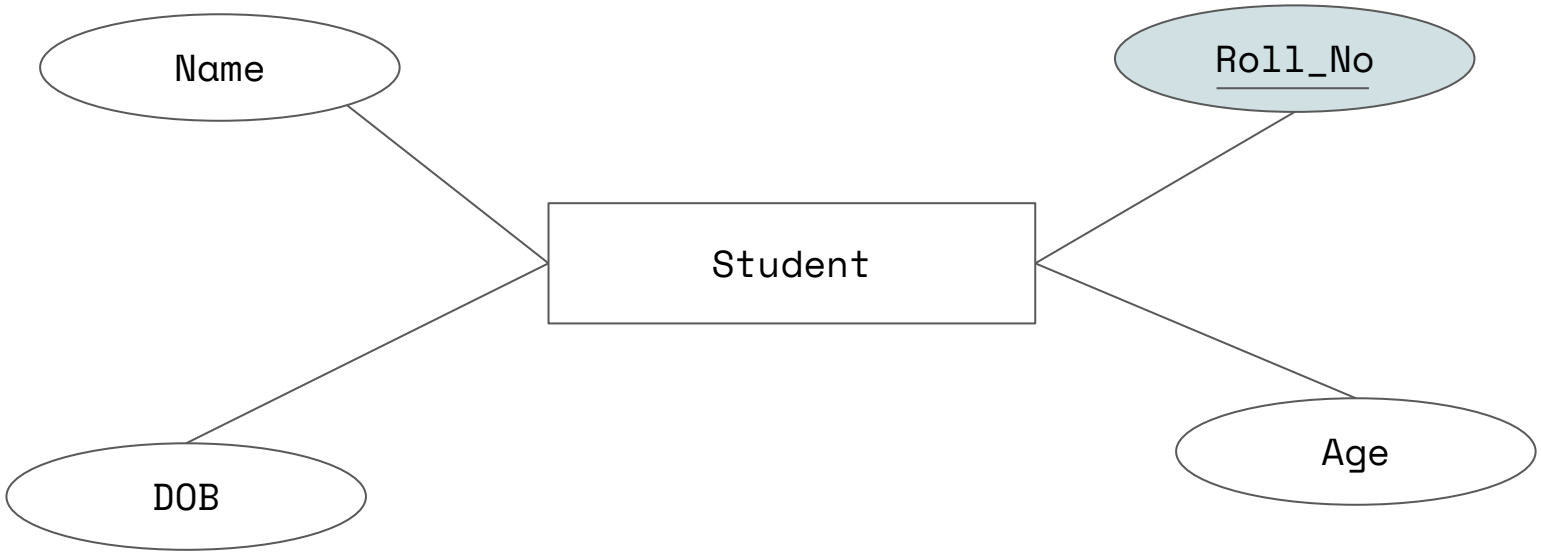


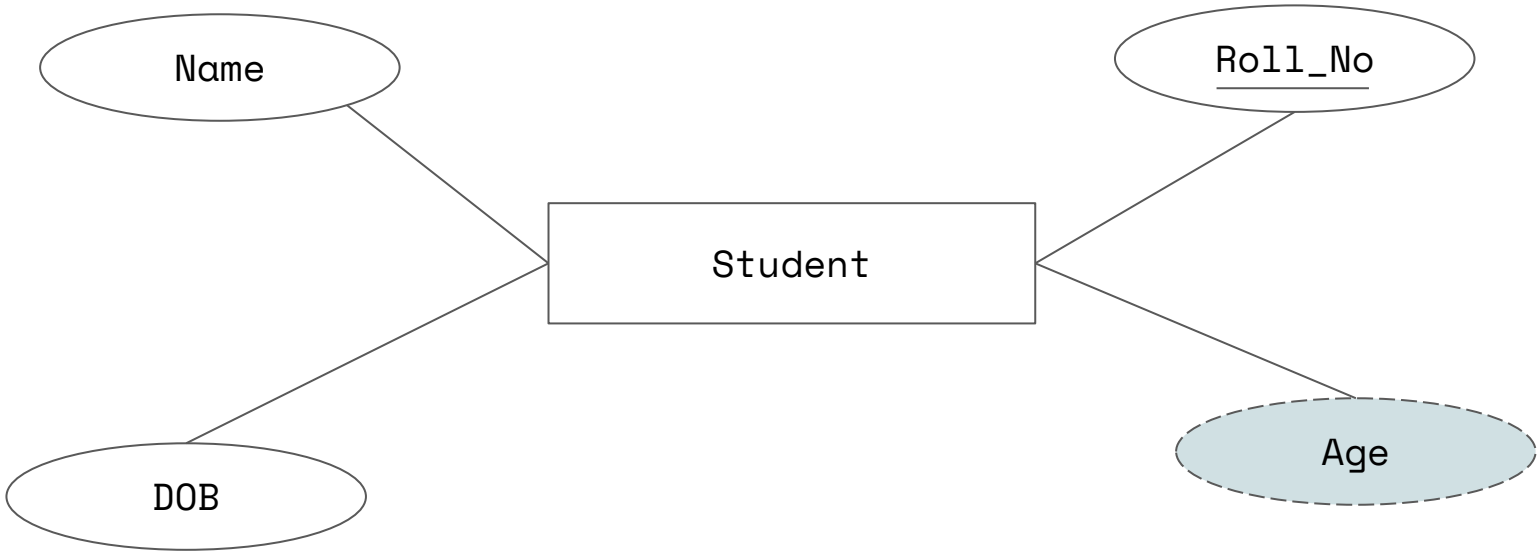
Entity along with Attributes

Represent an Entity *Student* with it's attributes Name, Roll_No , Address , DOB , Age



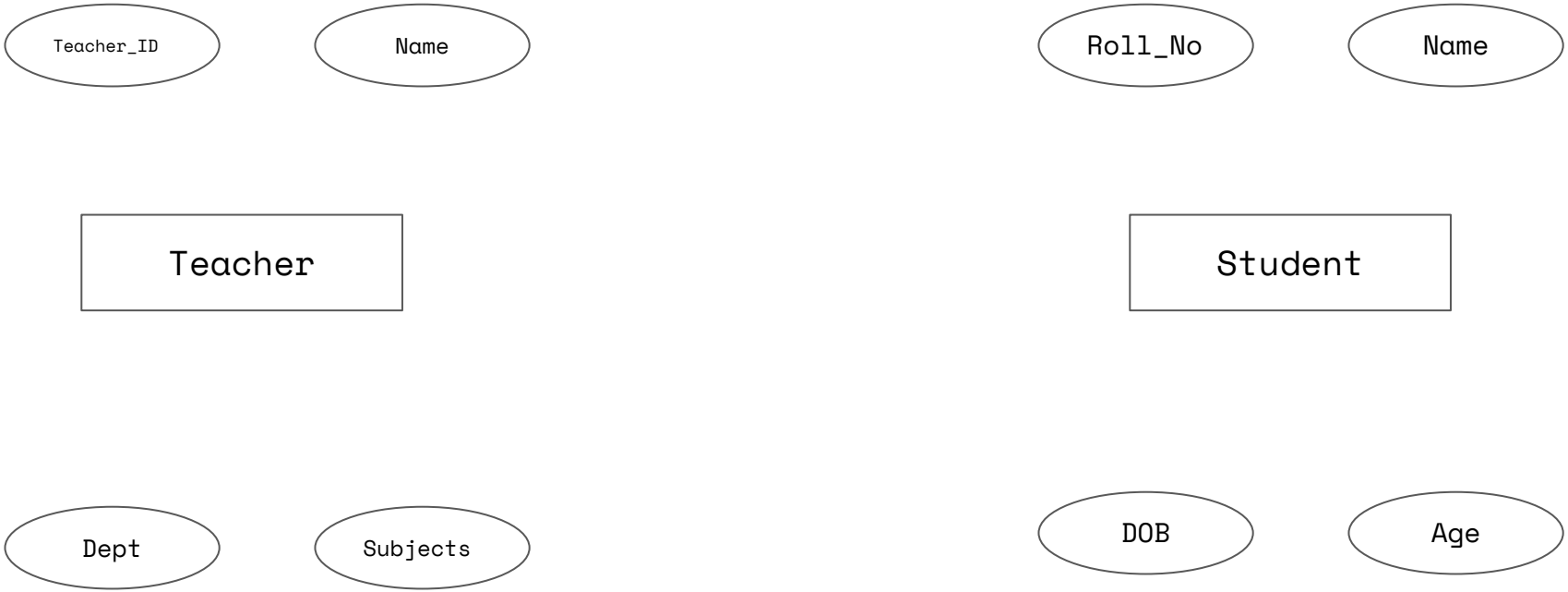
Entity along with Attributes

Represent an Entity *Student* with it's attributes Name, Roll_No , Address , DOB , Age



Representing a Relationship

Representing a Relationship



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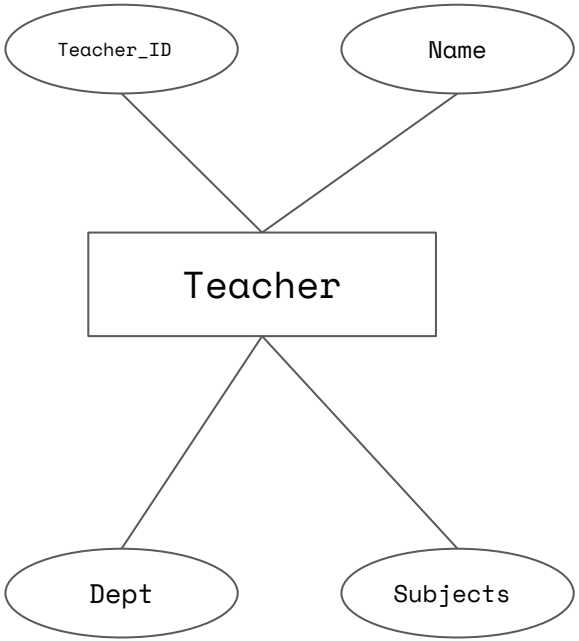

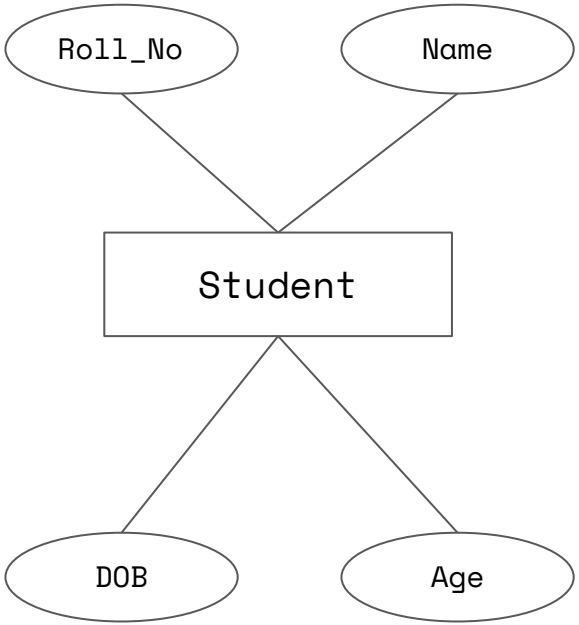

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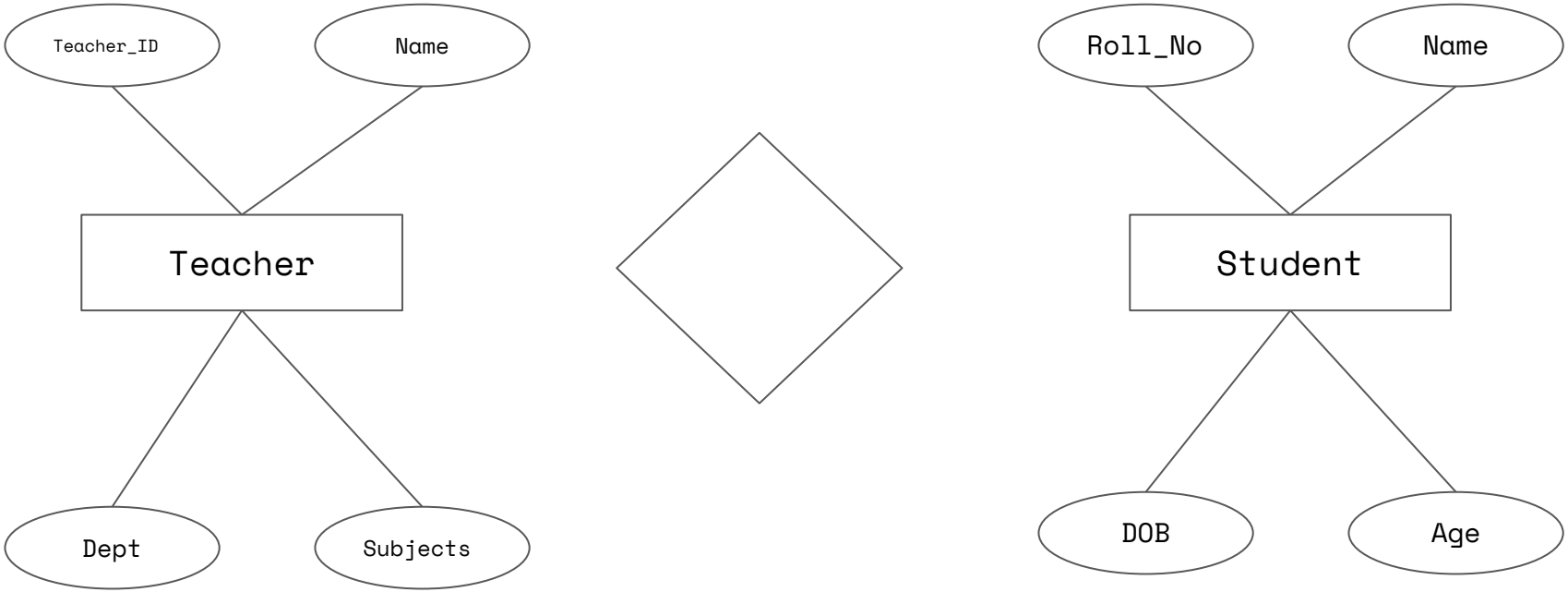
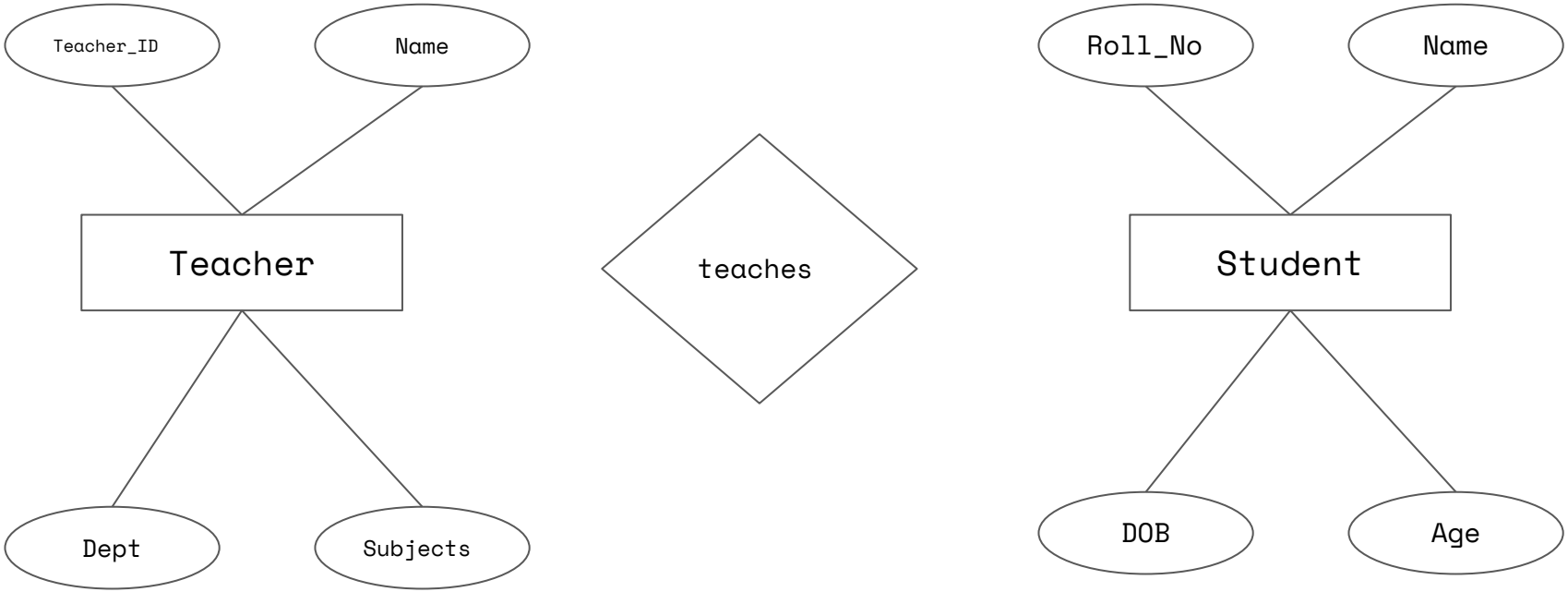
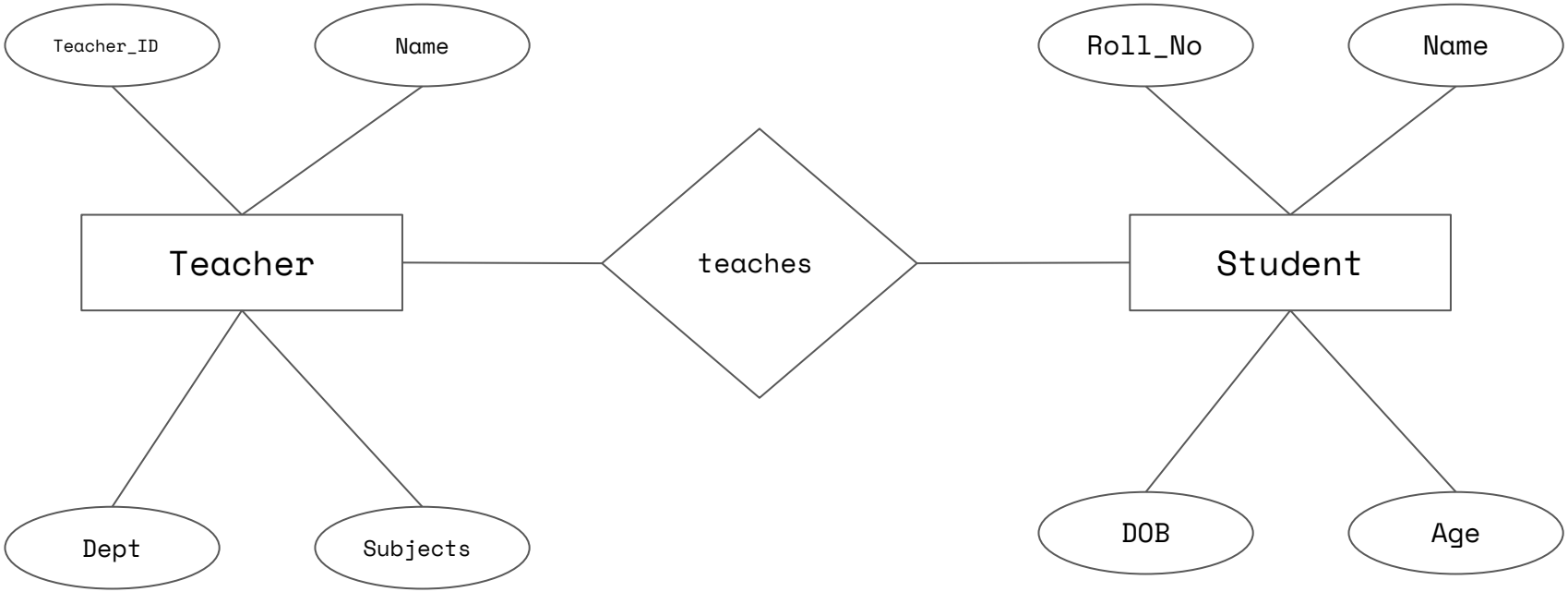


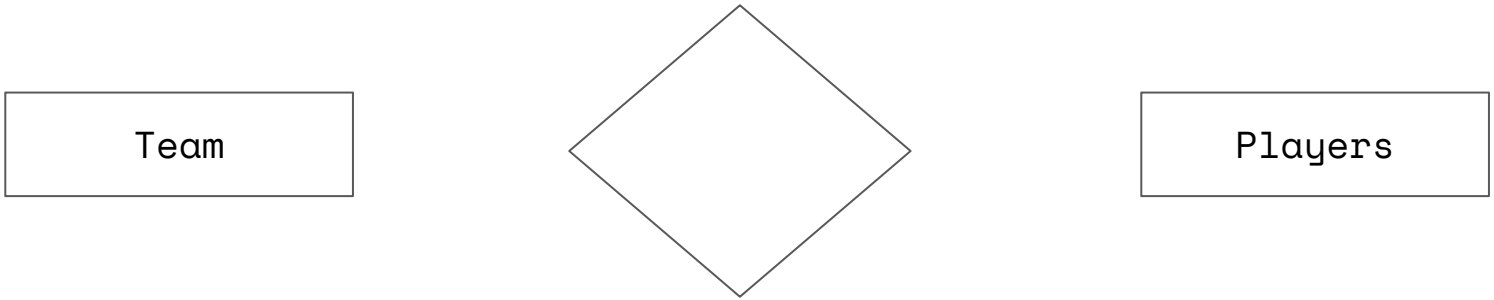
Representing a Relationship



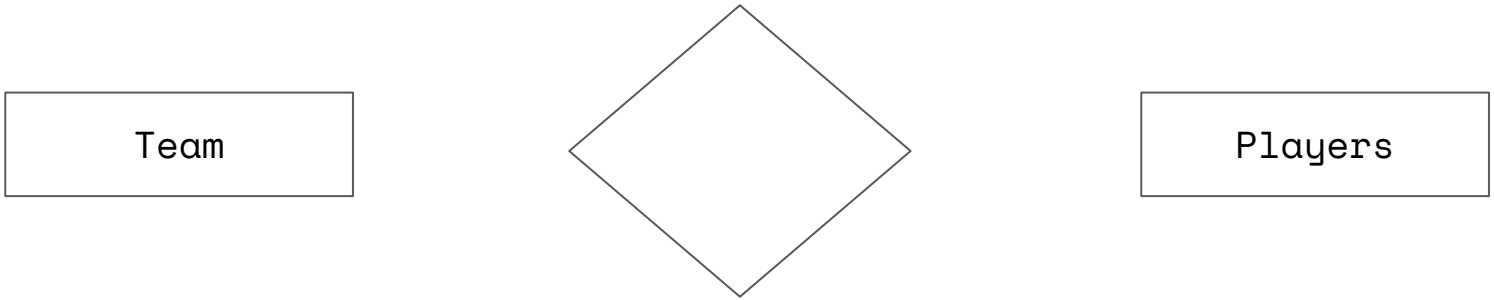
Representing a Relationship



Identify Relationships



Identify Relationships



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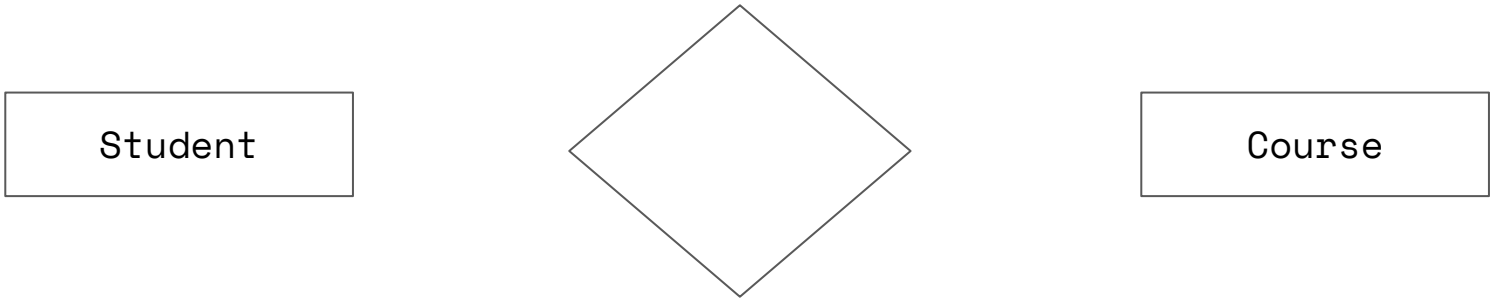

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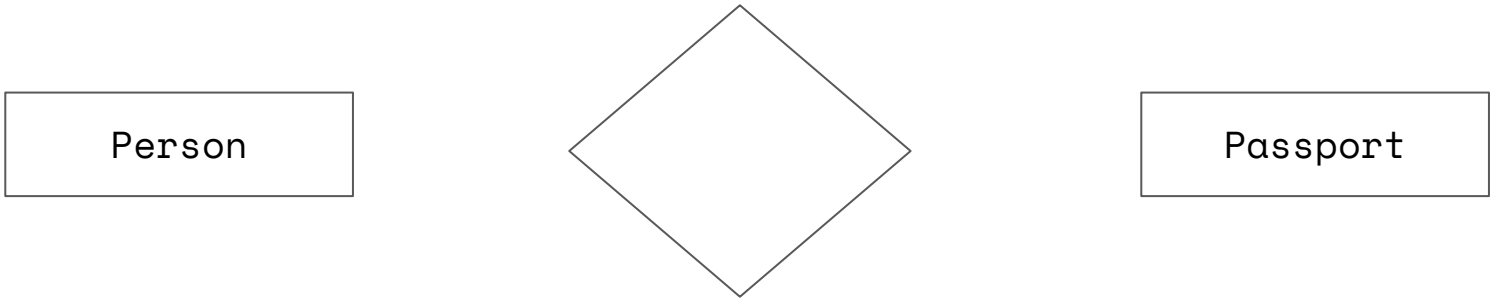

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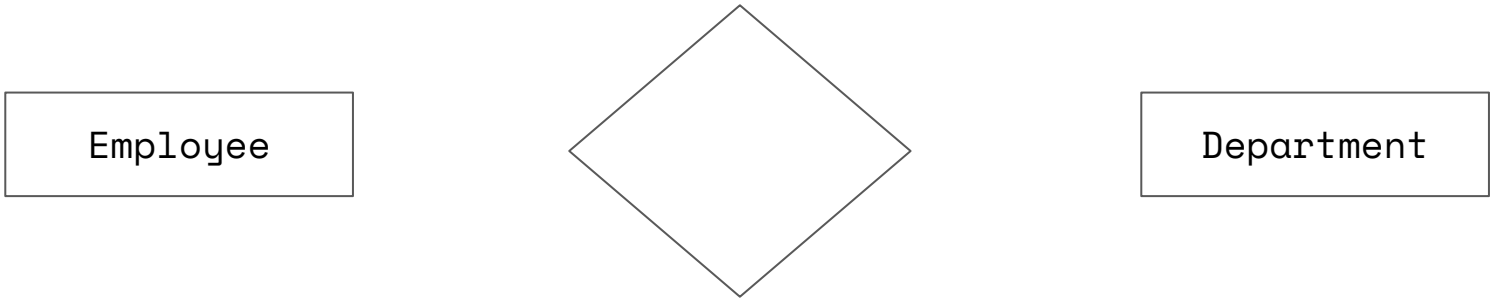

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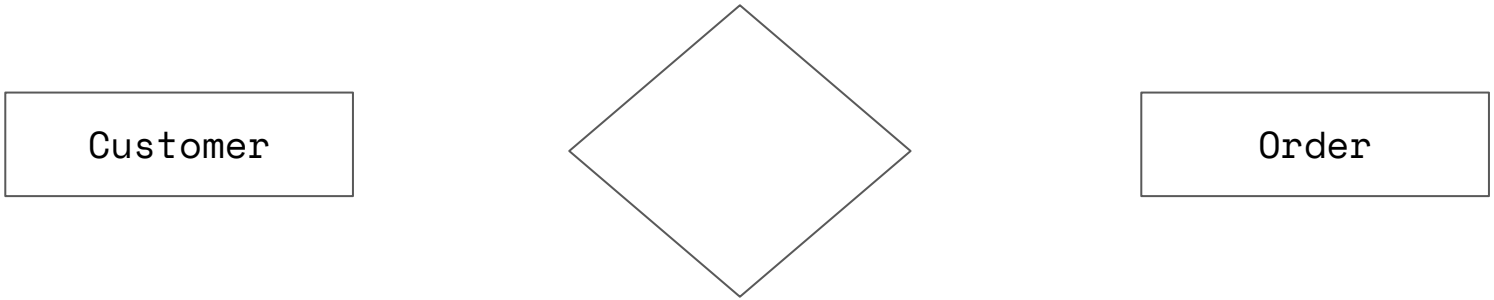


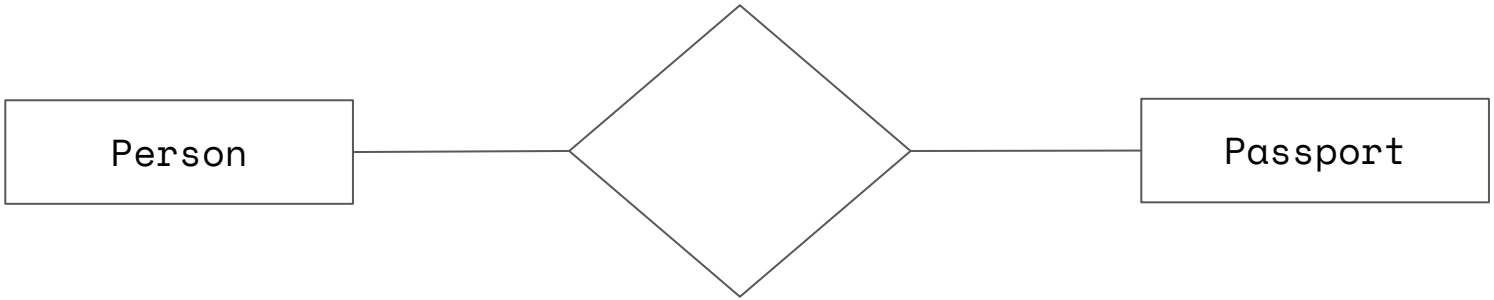
Cardinality

Cardinality defines the possible number of occurrences in one entity which is associated with the number of occurrences in another.

1. Many-to-Many Cardinality (m:n)
2. Many-to-One Cardinality (m:1)
3. One-to-Many Cardinality (1:n)
4. One-to-One Cardinality (1:1)

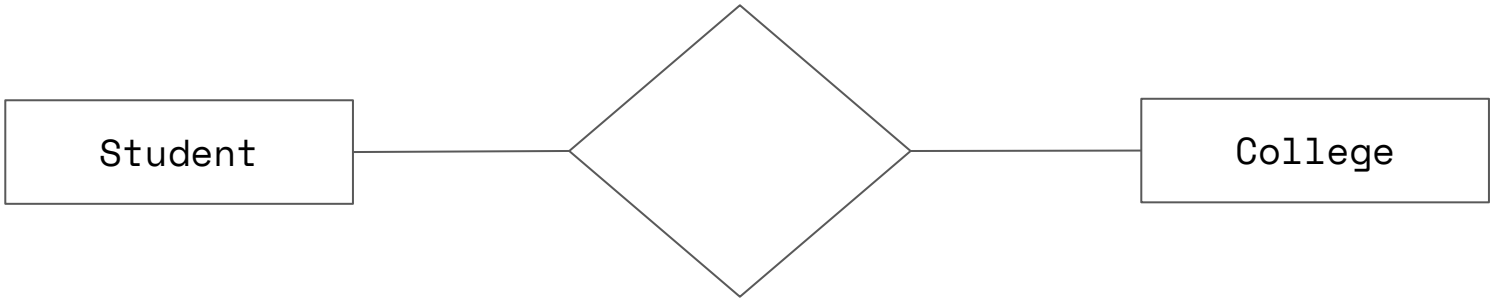
One-One Cardinality

When a single instance of an entity is associated with a single instance of another entity then it is called one to one relationship



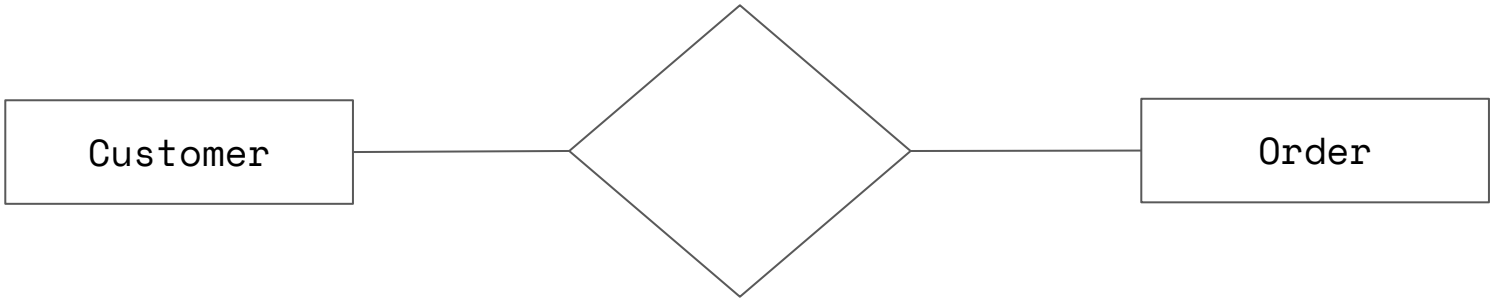
Many-One Cardinality

When more than one instances of an entity is associated with a single instance of another entity then it is called many to one relationship.



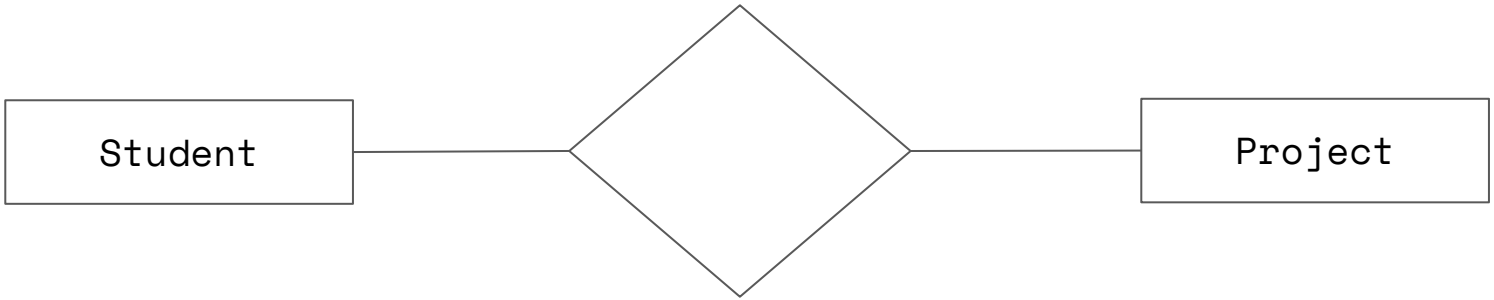
One-Many Cardinality

When a single instance of an entity is associated with more than one instances of another entity then it is called one to many relationship.



Many-Many Cardinality

When more than one instances of an entity is associated with more than one instances of another entity then it is called many to many relationship.



Participation Constraints

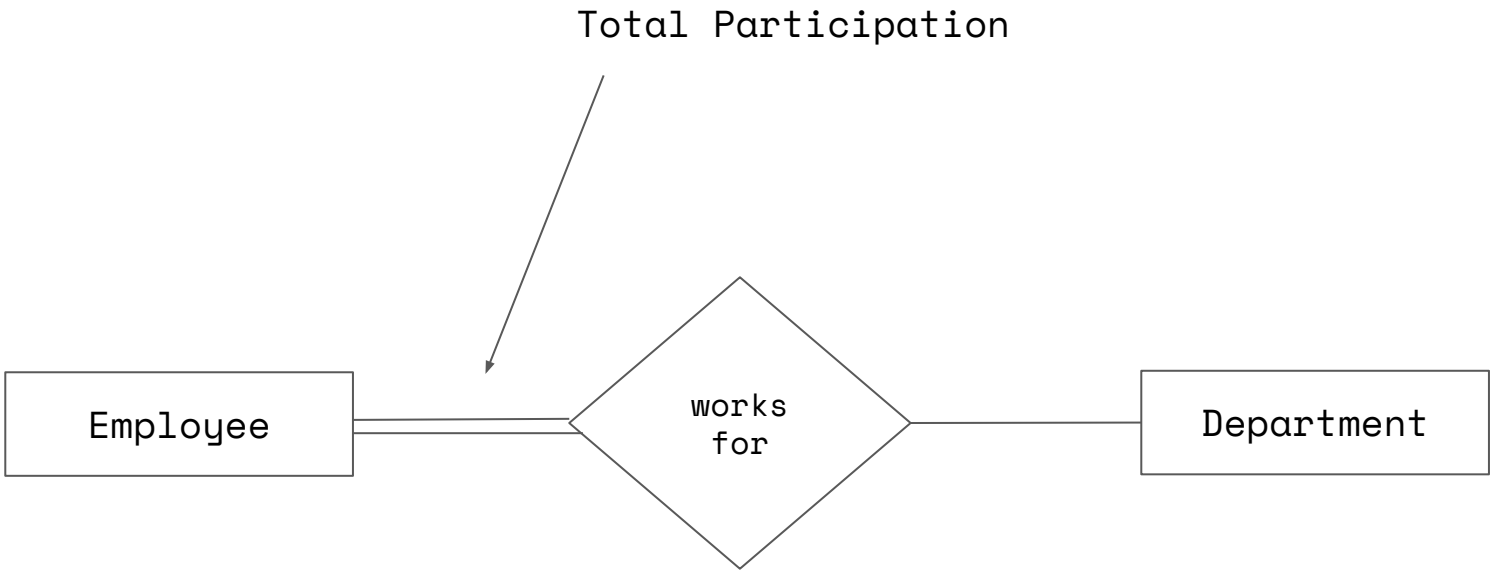
TOTAL PARTICIPATION

Each entity in the entity set is involved in the relationship.

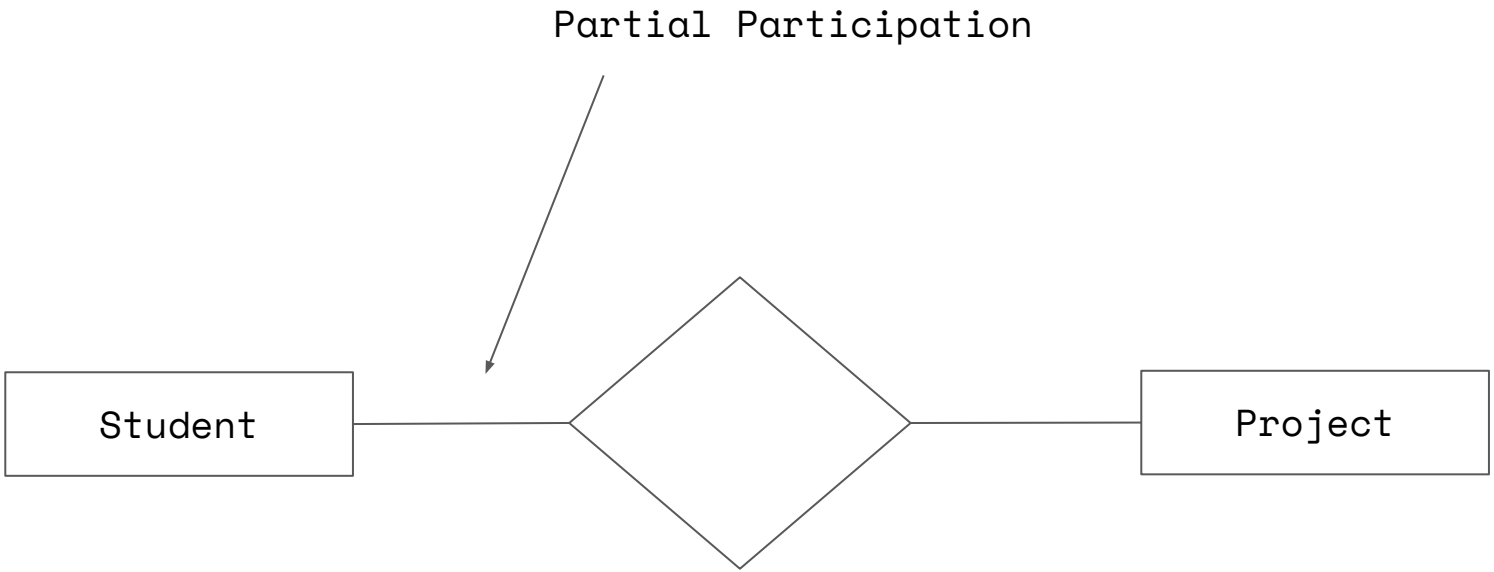
PARTIAL PARTICIPATION

Each entity in the entity set is not necessarily involved in the relationship.

Total Participation - ER



Partial Participation-ER



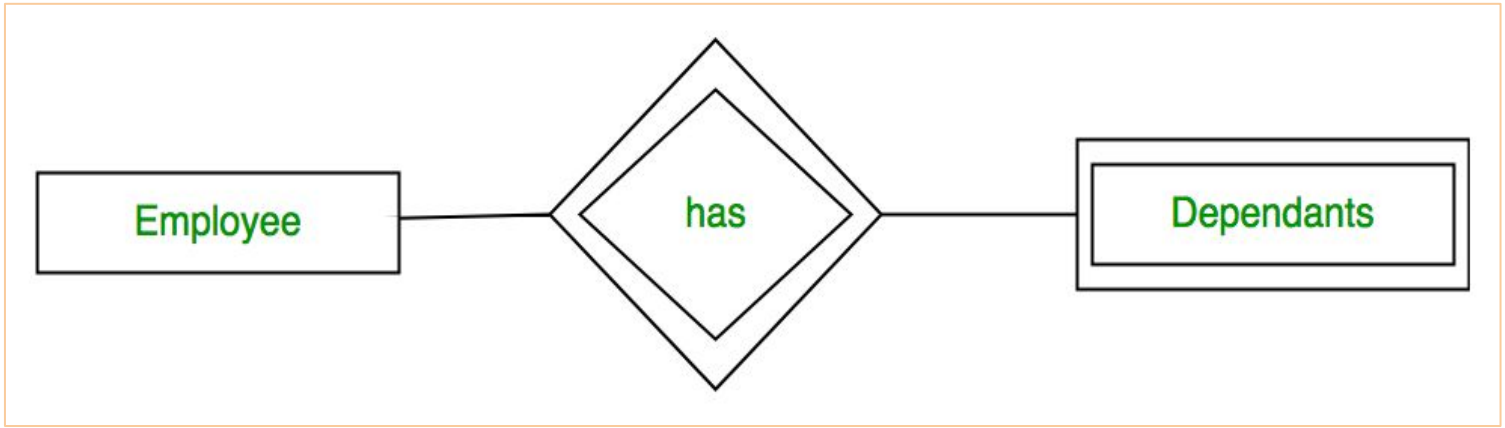
Weak Entity & Strong Entity

The entity sets which do not have sufficient attributes to form a primary key are known as **weak entity sets.**

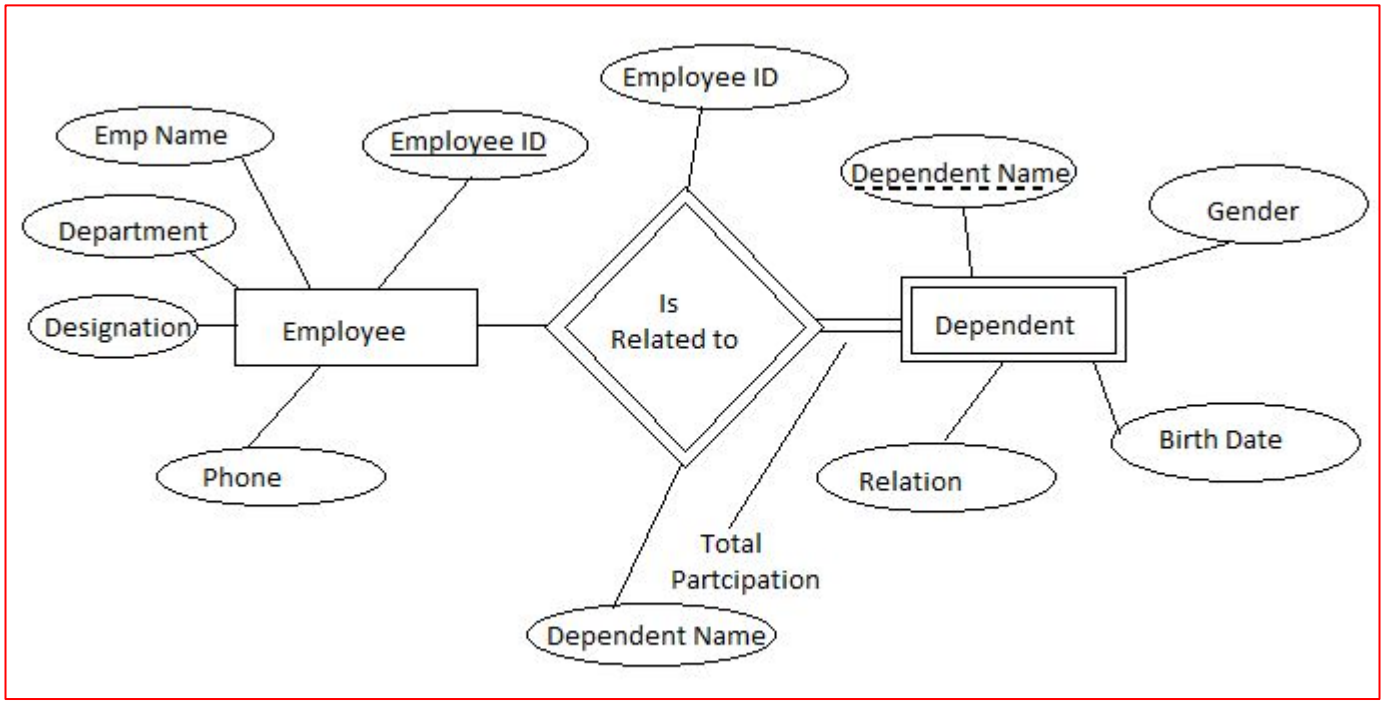
The entity sets which have a primary key are known as strong entity sets.

Weak entities are represented with double rectangular box in the ER Diagram and the identifying relationships are represented with double diamond.

Weak Entity & Weak Relations



Weak Entity & Weak Relations



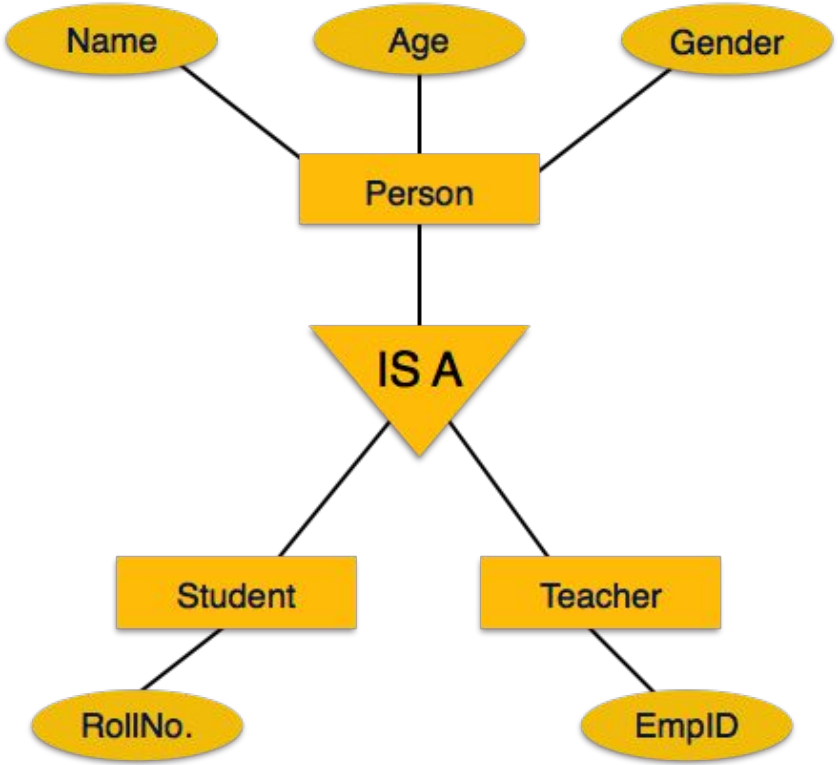
Source: https://csveda.com/database-management-system/strong-and-weak-entity-types/

Generalization

Generalization is the process of extracting common properties from a set of entities and create a generalized entity from it.

It is a bottom-up approach in which two or more entities can be generalized to a higher level entity if they have some attributes in common.

Generalization



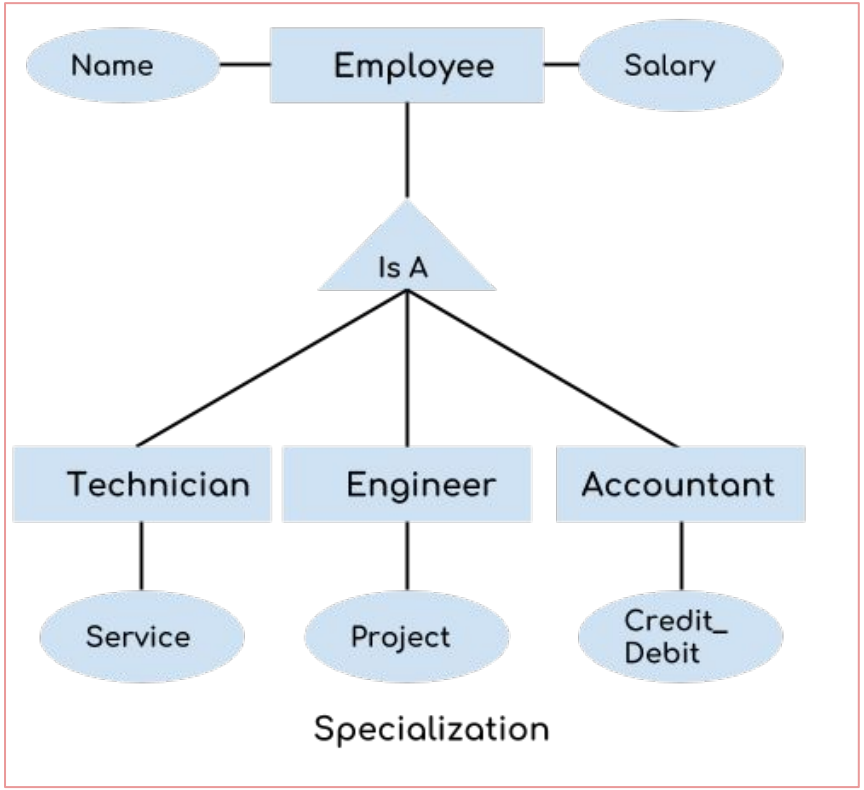
Source : https://www.tutorialspoint.com/dbms/dbms_generalization_aggregation.htm

Specialization

In specialization, an entity is divided into sub-entities based on their characteristics.

It is a top-down approach where higher level entity is specialized into two or more lower level entities.

Specialization



Source: https://beginnersbook.com/2018/11/dbms-specialization/

Practice Problem 1

Construct an E-R diagram for a car-insurance company whose customers own one or more cars each. Each car has associated with it zero to any number of recorded accidents.

Practice Problem 1- Solution

Practice Problem -2

Suppose that you are designing a schema to record information about reality shows on TV. Your database needs to record the following information:

_ For each reality show, its name, genre, basic_info and participants name. Any reality show has at least two or more participants.

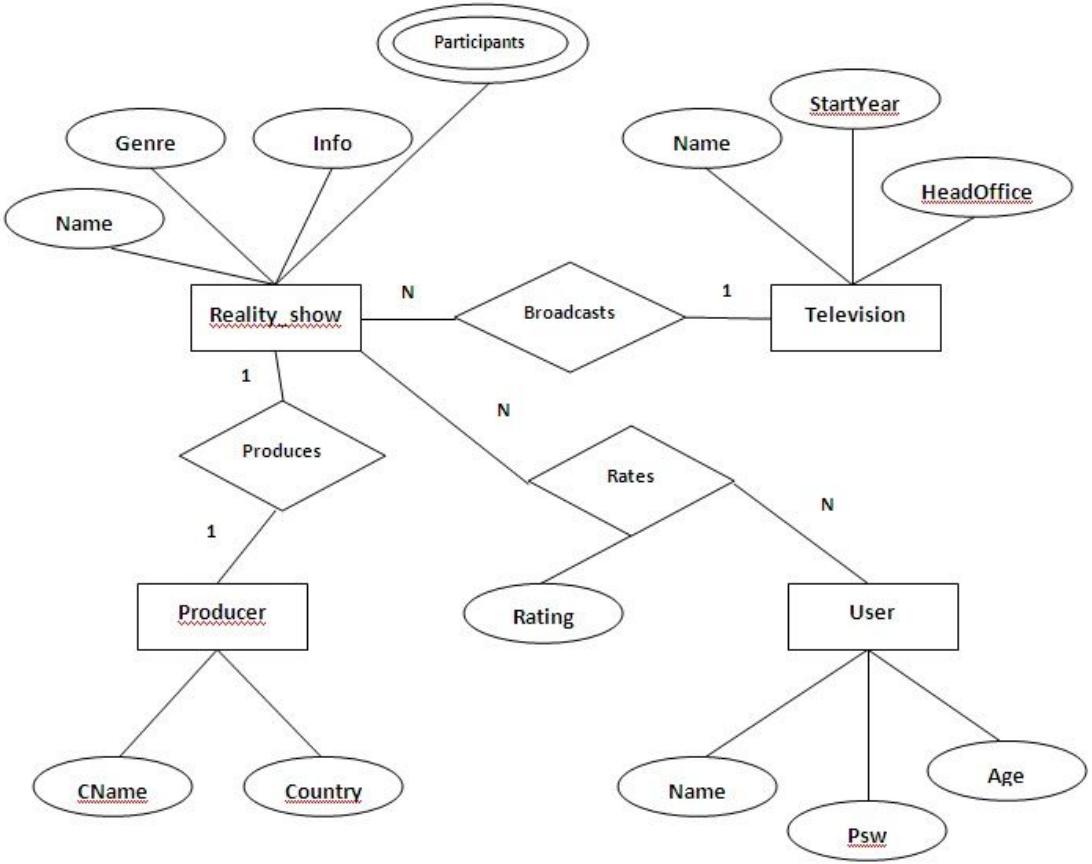
_ For each producer, the company name, company country. A show is produced by exactly one producer. And one producer produces exactly one show.

_ For each television, its name, start year, head office. A television may broadcasts multiple shows. Each show is broadcasted by exactly one television.

_ For each user, his/her username, password, and age. A user may rate multiple shows, and a show may be rated by multiple users. Each rating has a score of 0 to 10.

Draw an entity relationship diagram for this database.

Practice Problem 2- Solution



Source : https://www.exploredatabase.com/2018/01/draw-entity-relationship-diagram-for-given-scenario.html?m=0

ERD to Relational Schema

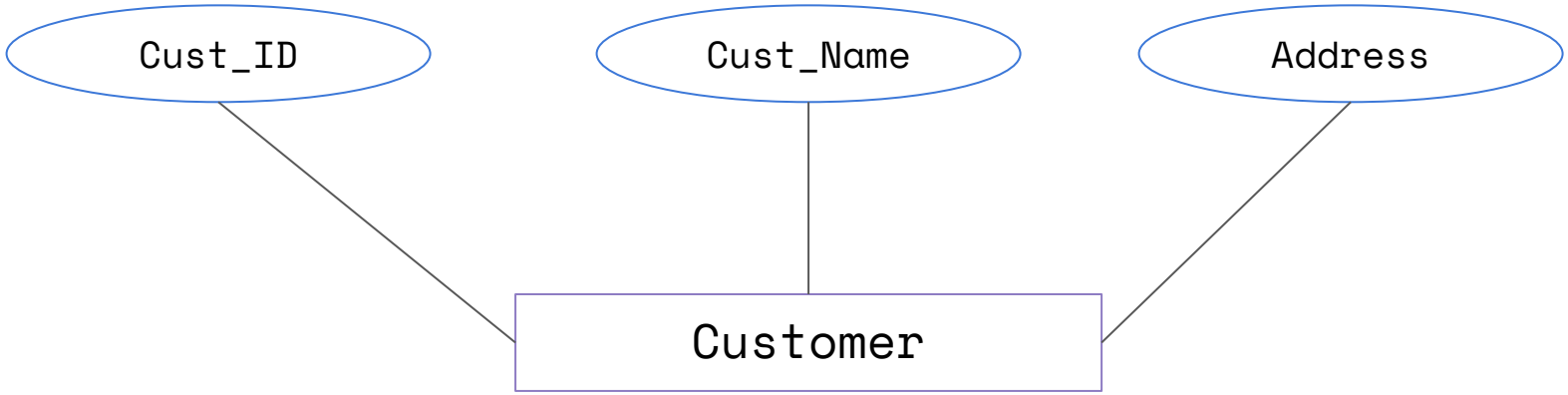
Mapping Regular Entities & Attributes

For each regular (strong) entity type E in the ER schema, create a relation R that includes all the simple attributes of E.

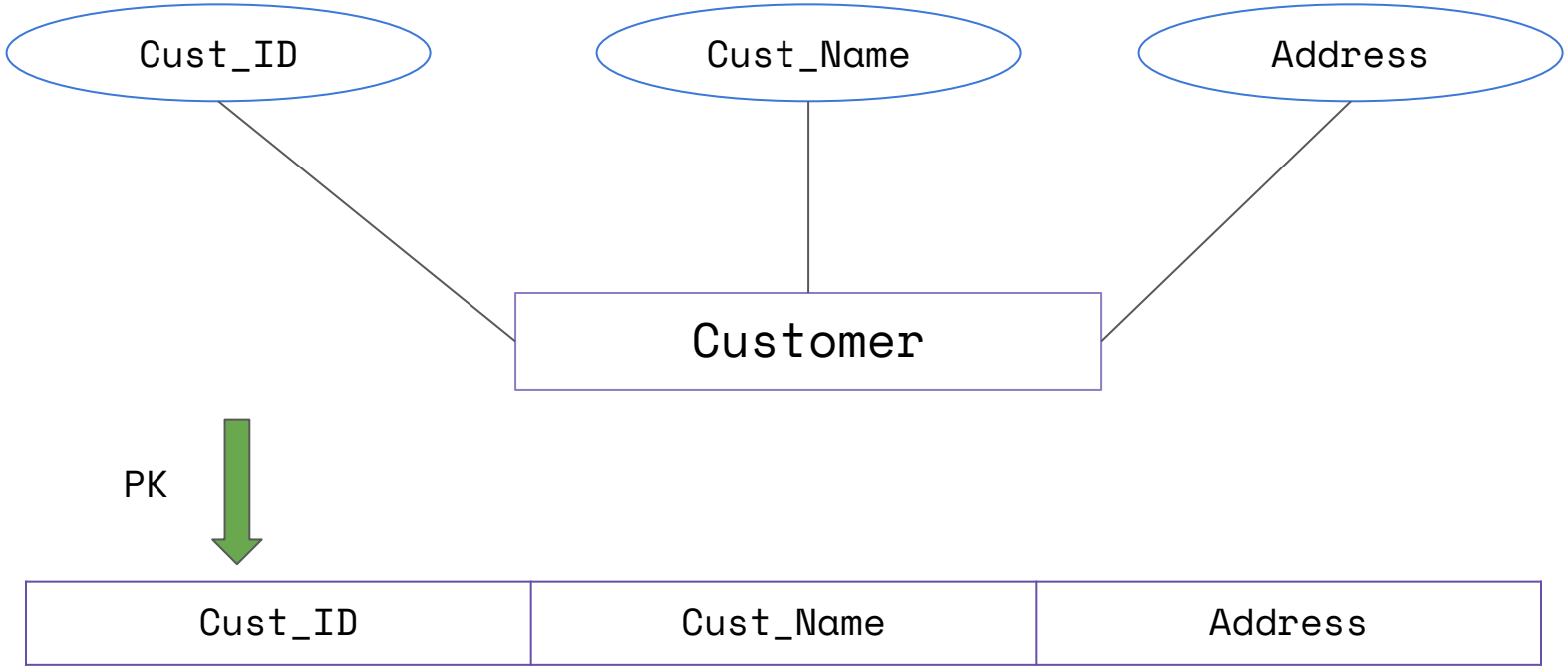
Choose one of the key attributes of E as the primary key for R.

For composite attributes, include only the simple attributes it consists of, to the relation R

Mapping Regular Entities & Simple Attributes

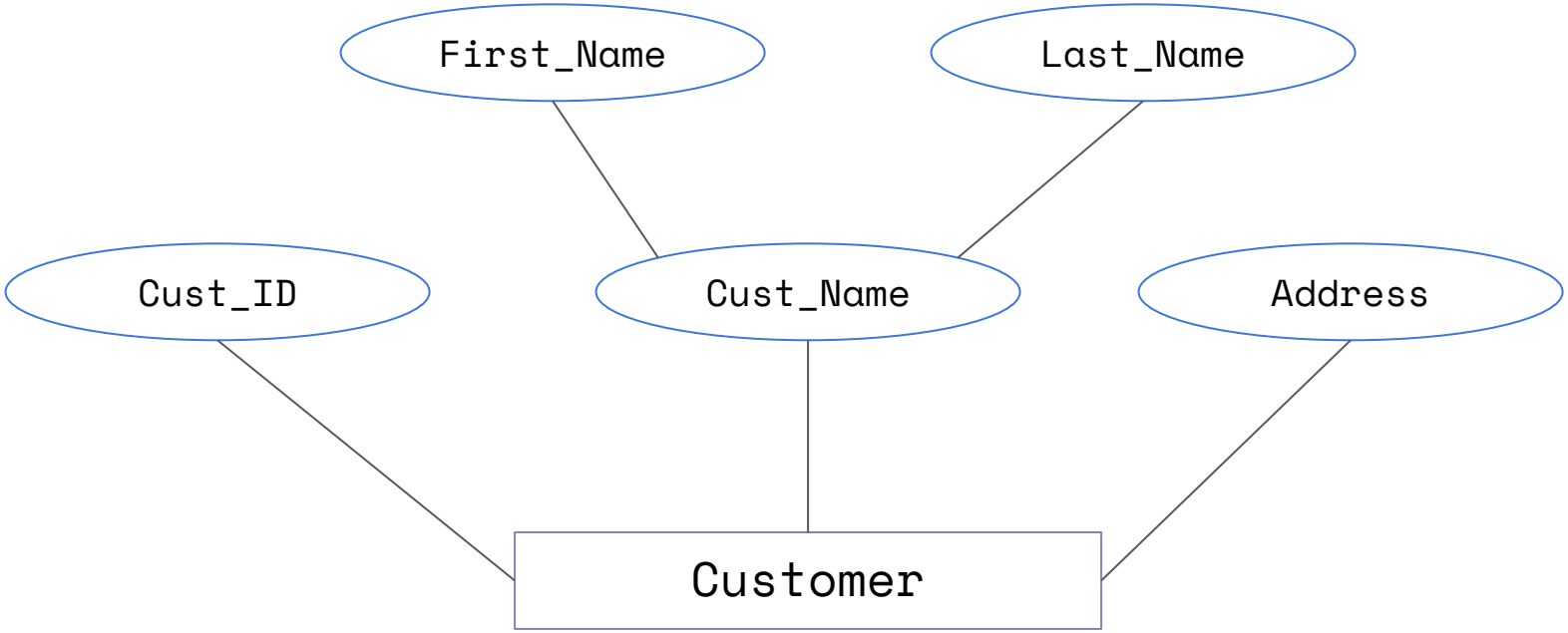


Mapping Regular Entities & Simple Attributes

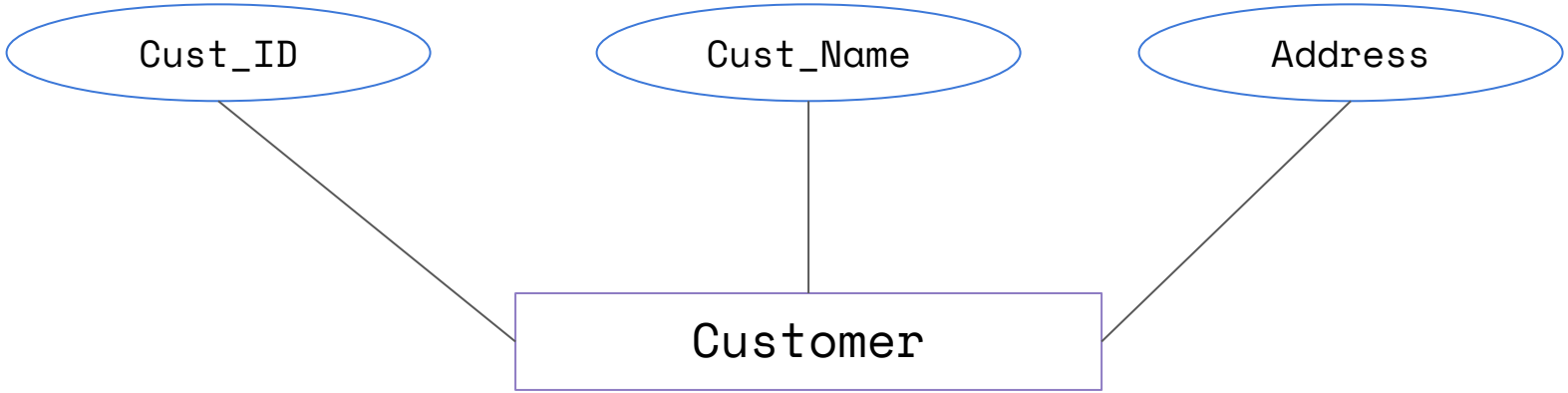


Customer Table

Mapping Regular Entities & Composite Attributes



Mapping Regular Entities & Composite Attributes



PK

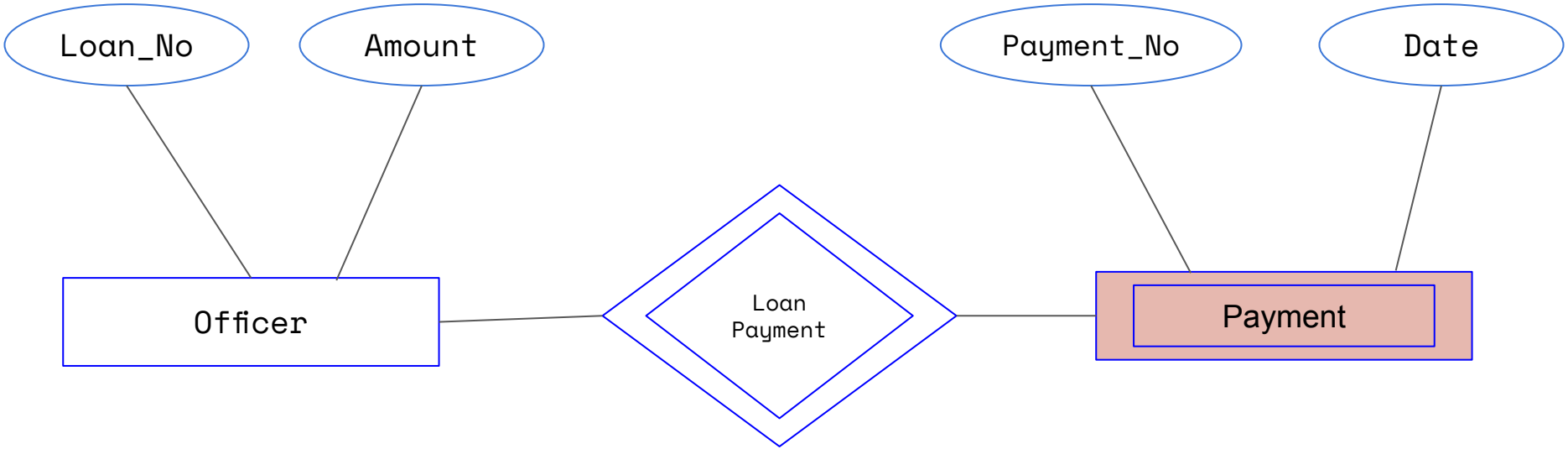
Cust_ID	First_Name	Last_Name	Address

Customer Table

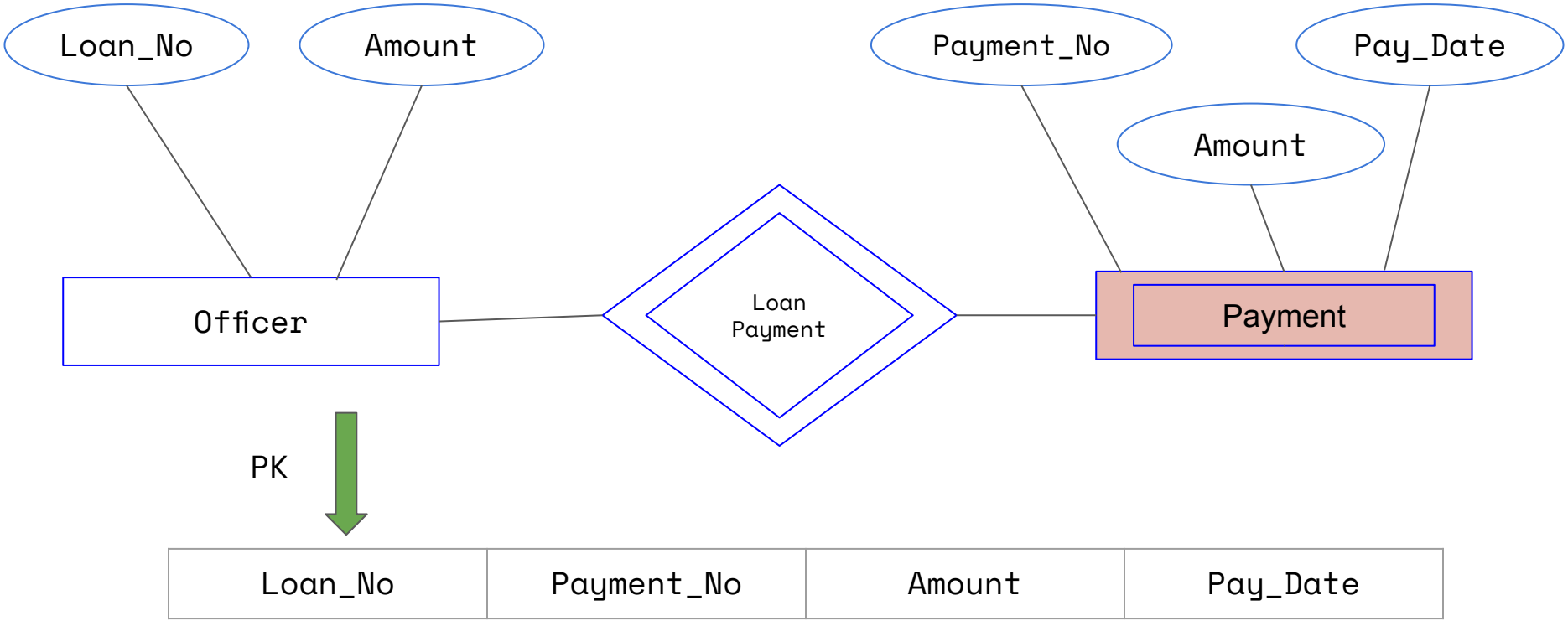
Representing Weak Entities

Include the primary key of the linked strong entity set and all the attributes of the weak entity set.

Representing Weak Entities



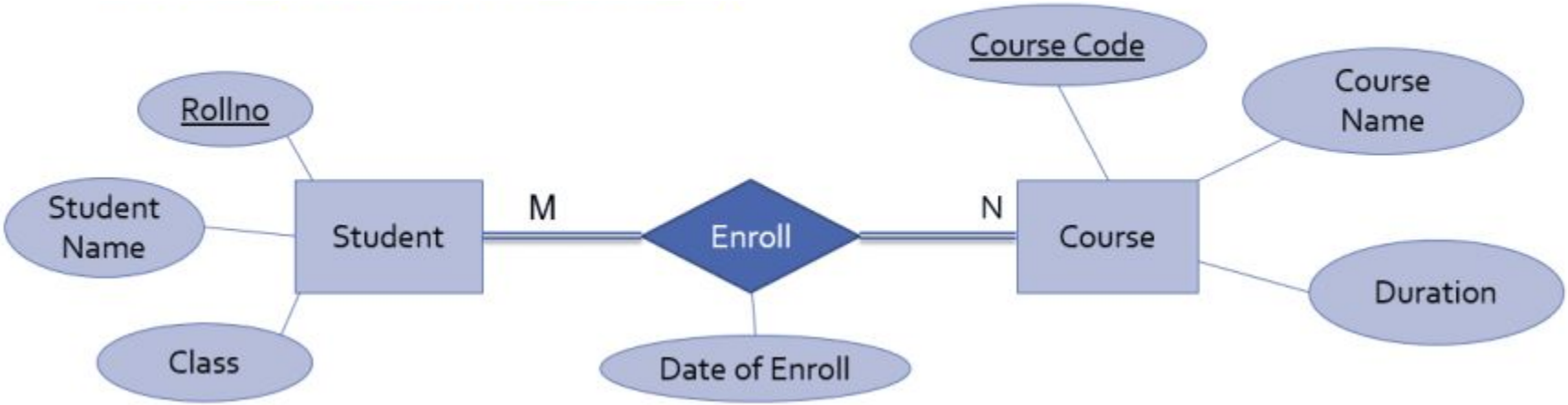
Representing Weak Entities



Mapping M:N Binary Relations

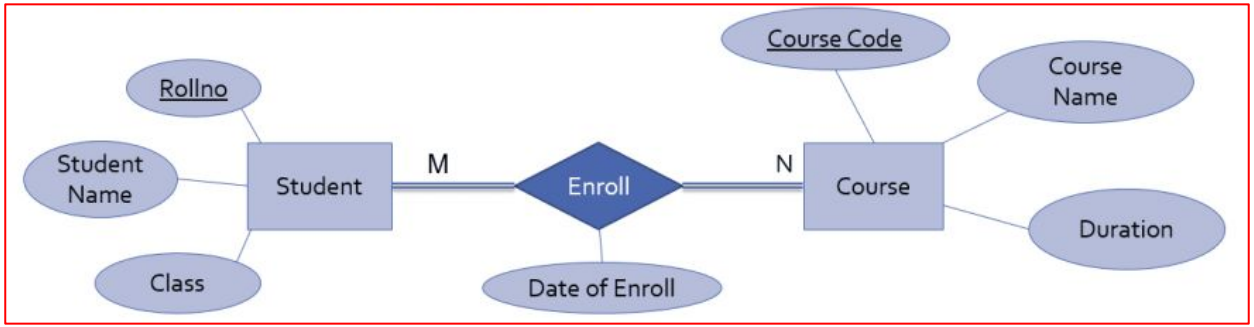
1. Relationship set is mapped as separate relation
2. Key attributes of participating entity sets are mapped as primary key for that relation
3. Attribute of relationship set becomes simple attributes for that relation
4. And separate relation is created for other participating entities

Mapping M:N Binary Relations



Source: https://dev.to/ketan_patil/er-diagram-to-relational-model-conversion-49ip

Mapping M:N Binary Relations



Student Table

Roll_No	Student_Name	Class

CourseTable

Course_Code	Course_Name	Duration

Enroll Table

Roll_No	Course_Code	Date_of_Enroll

Mapping 1:M Binary Relations

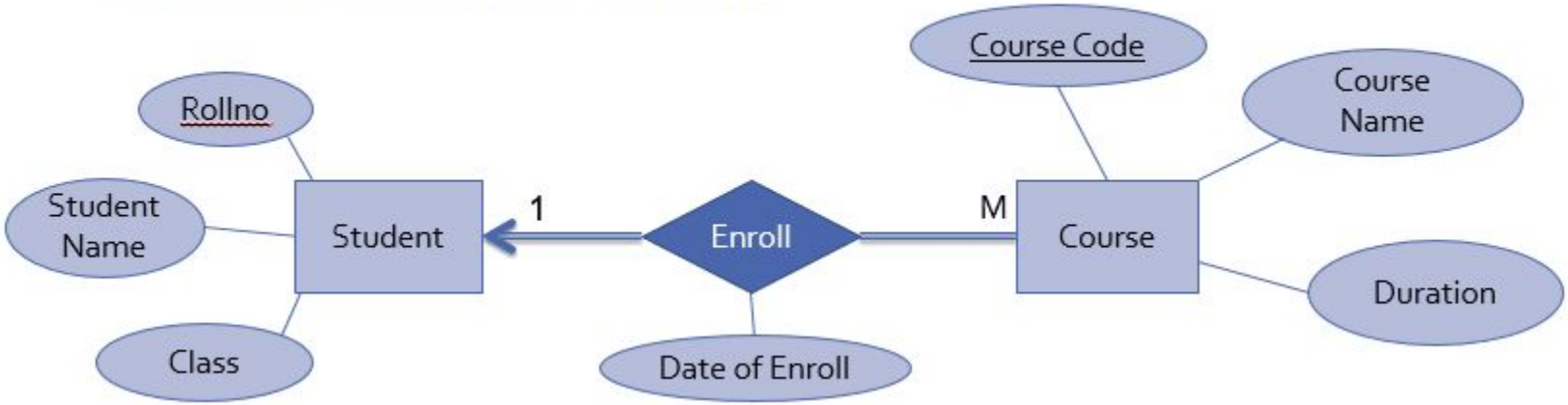
1.Separate relation is created for all participating entity sets.

2.Key attribute of Many's side entity set is mapped as foreign key in one's side relation.

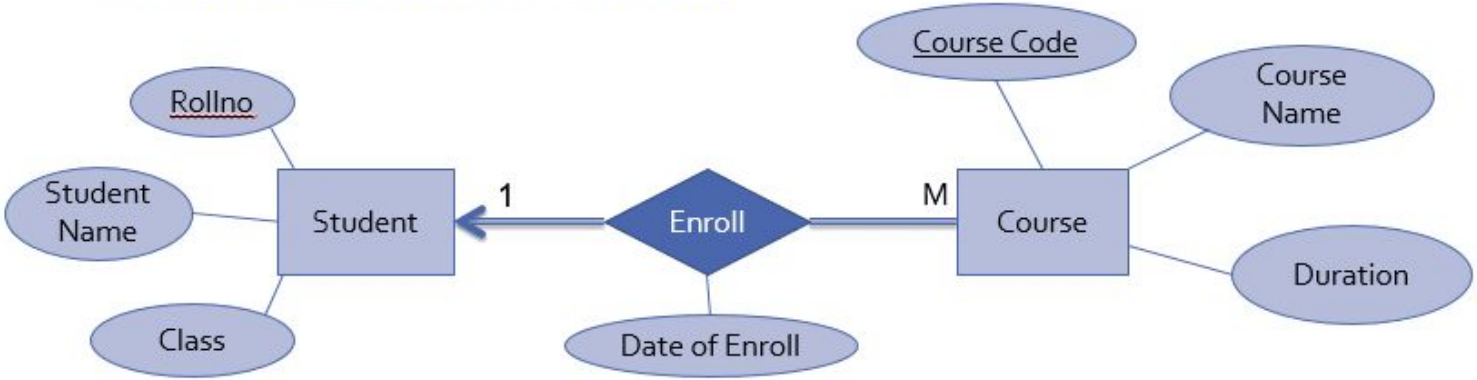
3.All attributes of relationship set are mapped as attributes for relation of one's side entity set.

Source: https://dev.to/ketan_patil/er-diagram-to-relational-model-conversion-49ip

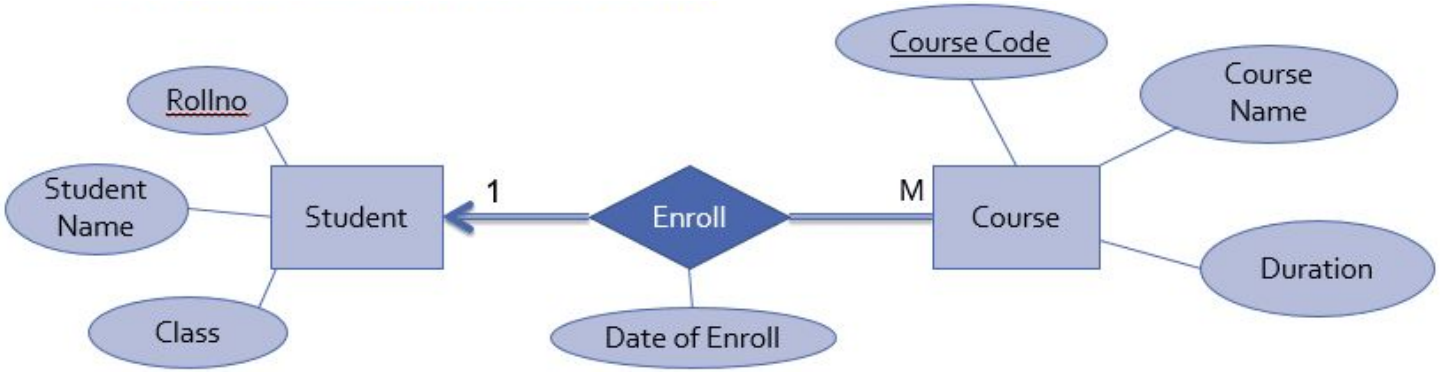
Mapping 1:M Binary Relations



Mapping 1:M Binary Relations



Mapping 1:M Binary Relations



Student Table

Roll_No	Student_Name	Class	Course_Code	Date_of_Enroll

CourseTable

Course_Code	Course_Name	Duration

Mapping M:1 Binary Relations

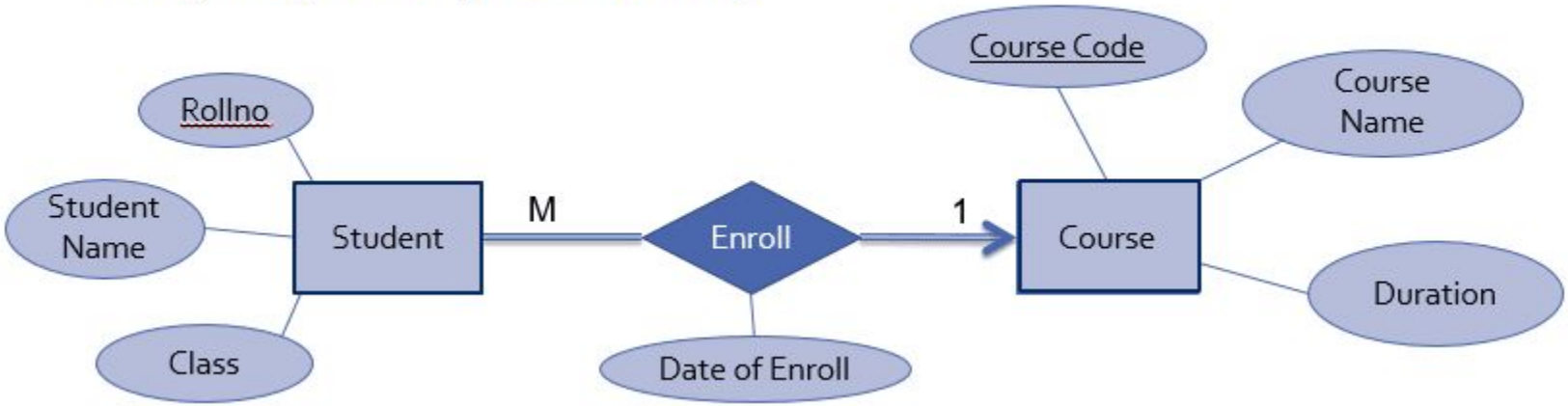
1.Separate relation is created for all participating entity sets.

2.Key attribute of Many's Side Entity Set is mapped as foreign key in one's side relation

3.All attributes of relationship set are mapped as attributes for one's side relation course.

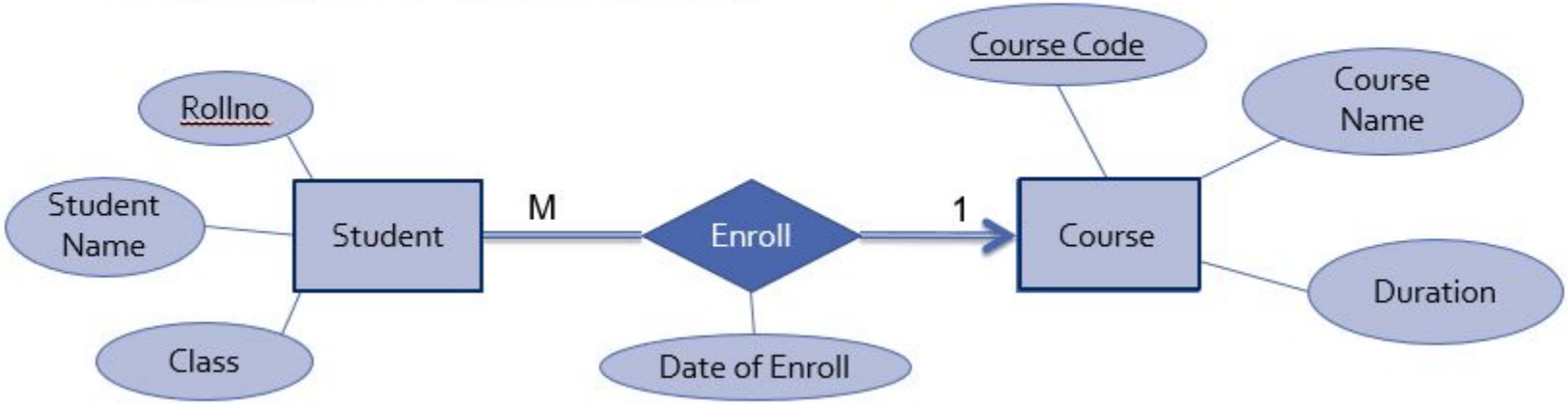
Source: https://dev.to/ketan_patil/er-diagram-to-relational-model-conversion-49ip

Mapping M:1 Binary Relations



Source: https://dev.to/ketan_patil/er-diagram-to-relational-model-conversion-49ip

Mapping M:1 Binary Relations



Student Table

Roll_No	Student_Name	Class

CourseTable

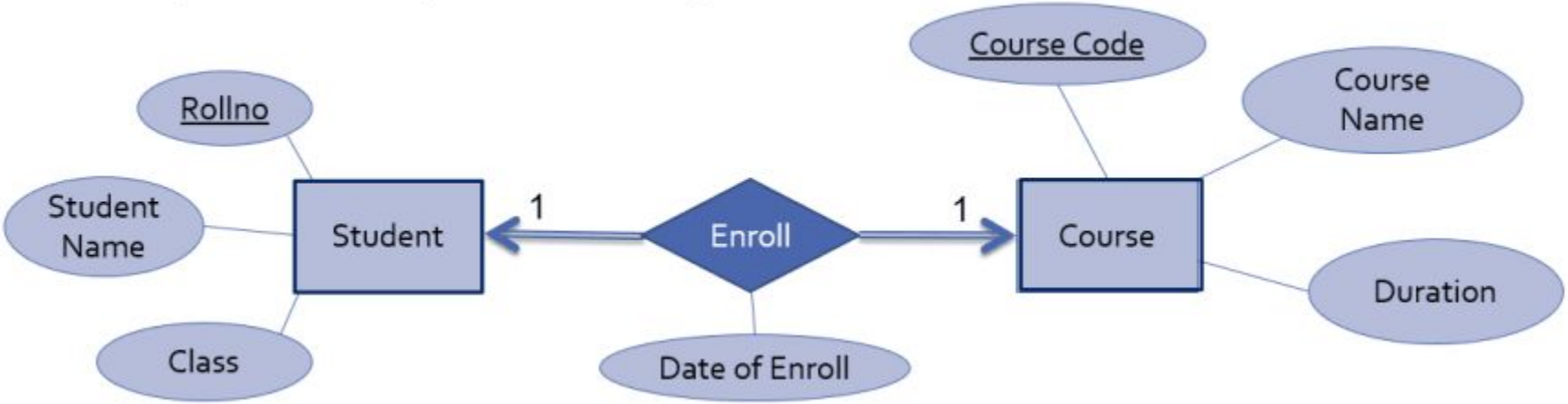
Course_Code	Course_Name	Duration	Roll_No	Date_of_Enroll

1:1 Binary Relations

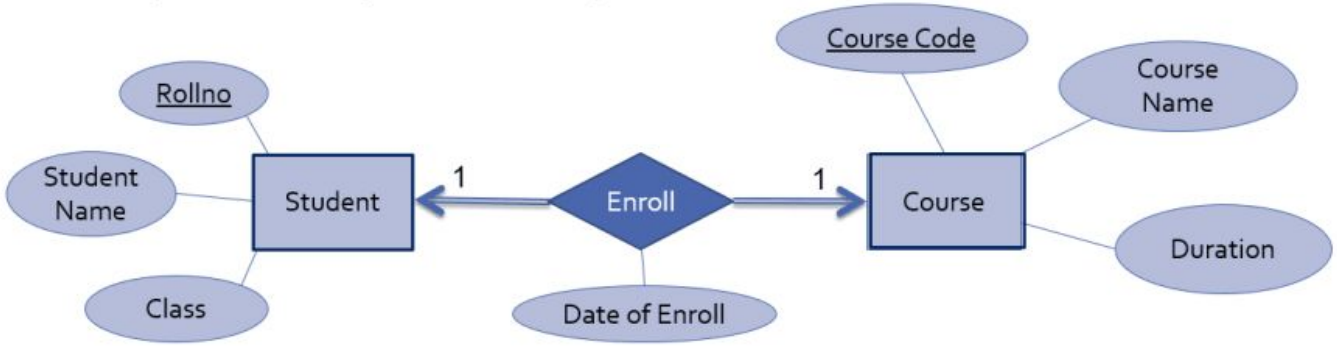
1.Separate relation is created for all participating entity sets.

2. Primary Key of Relation Student can be act as foreign key for relation Course OR Primary Key of Relation Course act as foreign key for relation Student.

1:1 Binary Relations



1:1 Binary Relations



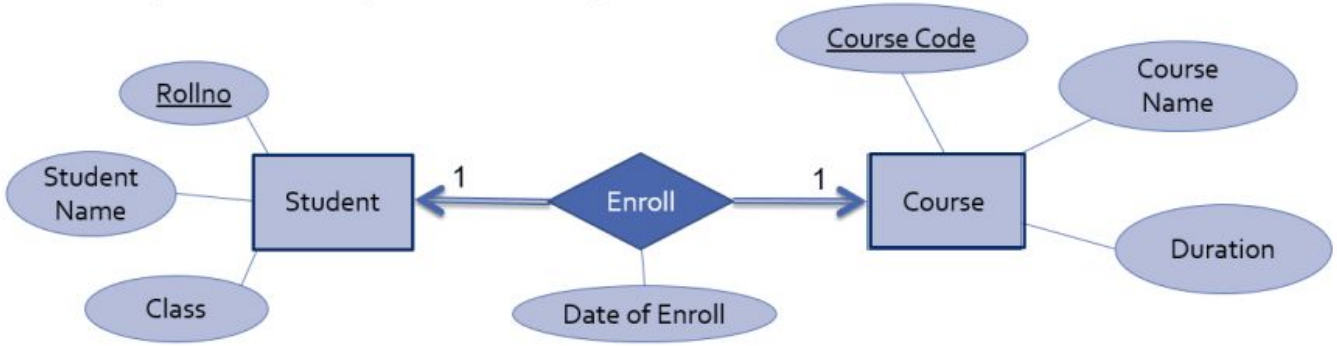
Student Table

Roll_No	Student_Name	Class

CourseTable

Course_Code	Course_Name	Duration	Roll_No

1:1 Binary Relations



Student Table

Roll_No	Student_Name	Class	Course_Code

CourseTable

Course_Code	Course_Name	Duration

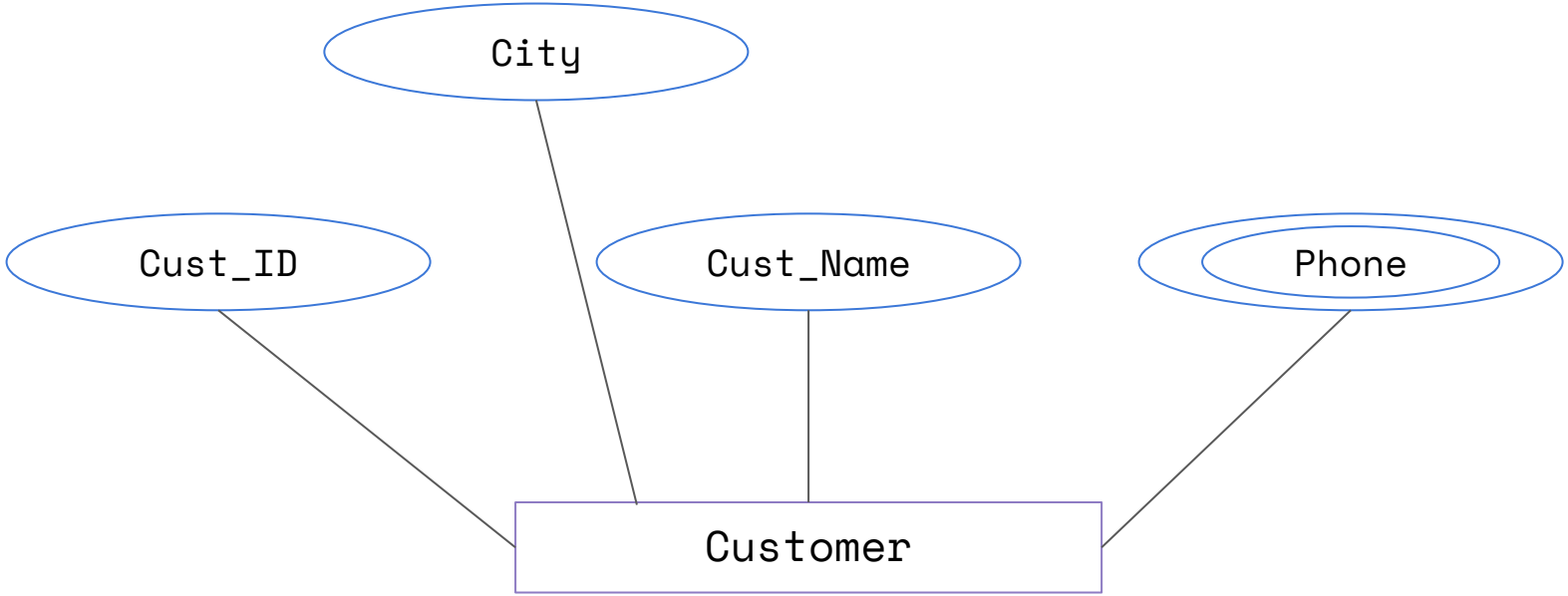
Entities with Multi-Valued Attributes

1.Create a new relation for the multi-valued attribute.

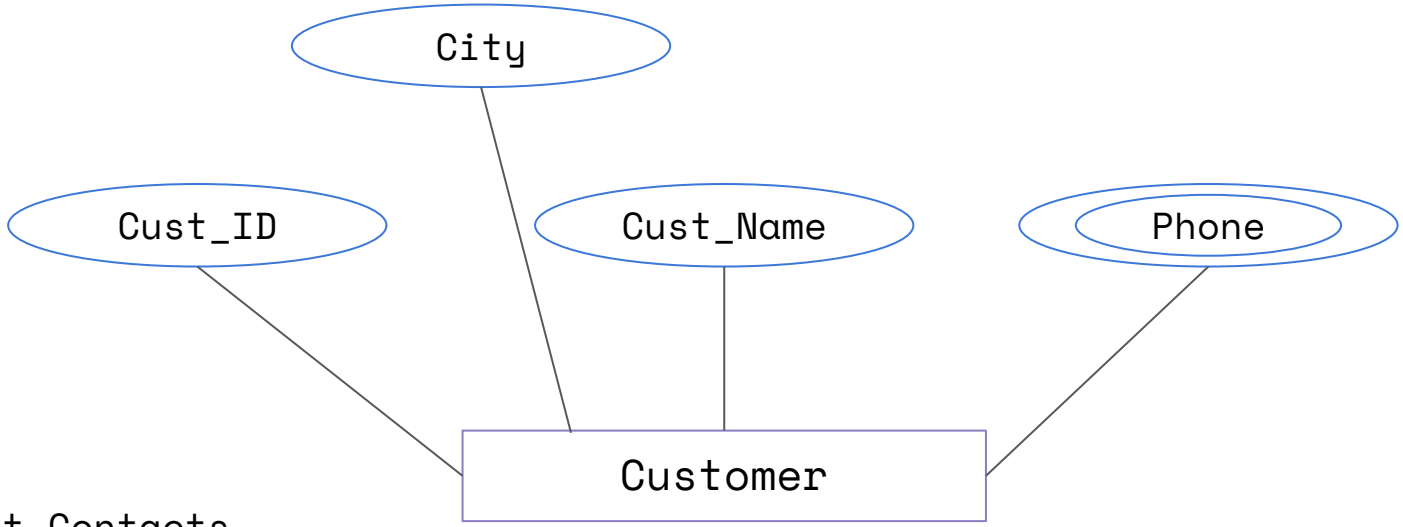
2.Key attribute and multivalued attribute of entity set becomes primary key of the new relation.

3. Separate relation is created with remaining attributes.

Entities with Multi-Valued Attributes



Entities with Multi-Valued Attributes



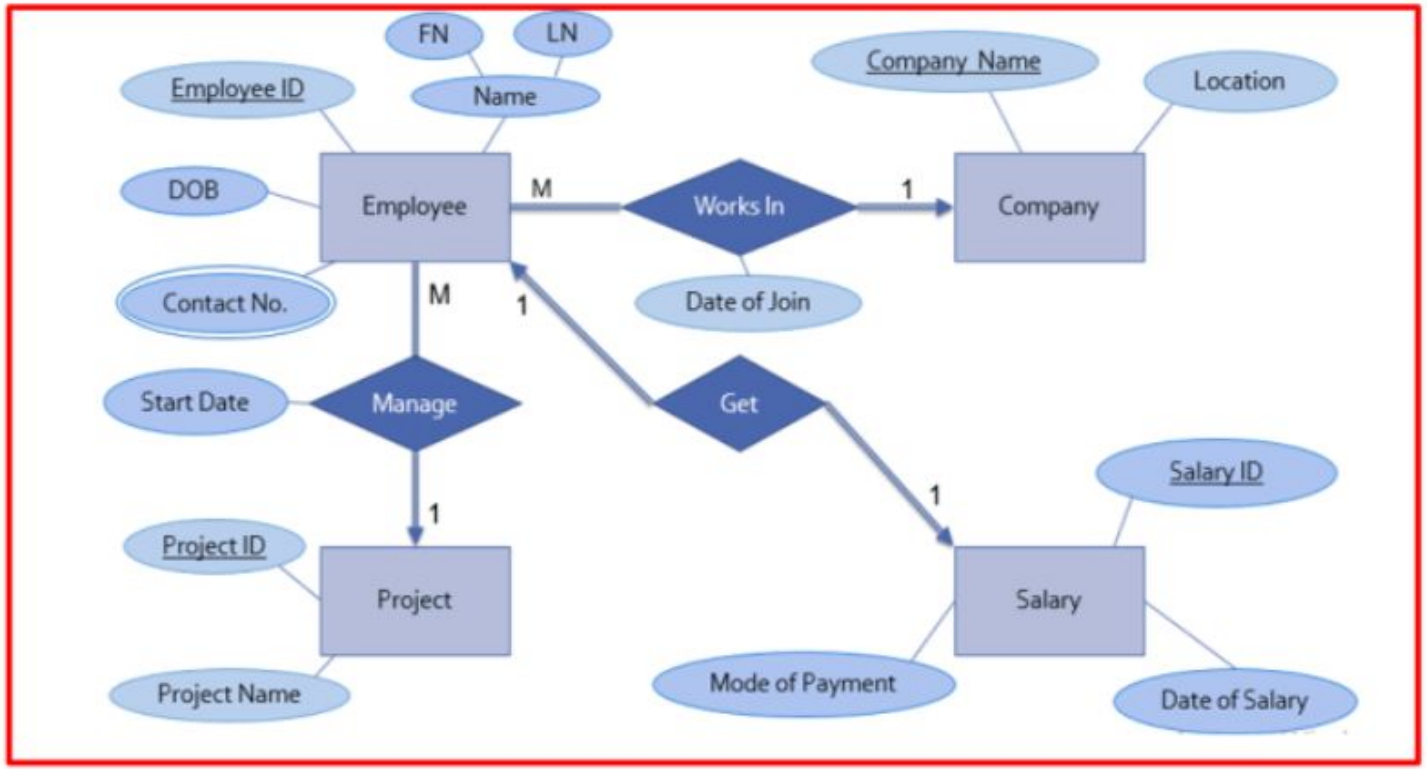
Cust_Contacts

Cust_ID	Phone

Cust_Table

Cust_ID	Cust_Name	City

Practice Problem



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