



Topic B

RELATIONAL DATA MODEL

RELATIONAL DATA MODEL

CONTENT

- The basic concepts of a database
- The relational terminologies
- The properties of a relation
- Entity Relationship Diagram (ERD)
- Transform ERD to Database
- Normalization

Basic Concepts of Database

- What is a database?
 - A collection of **inter-related data**
- Inter-related data
 - This means **data are linked together** by some mechanism
- What is a database management system
 - A collection of programs to manage(update, insert, delete, select), protect and control access to the database

The Relational Terminologies – A relation

Your personal information

Title ☐ Mr. ☐ Ms.

First name

Last name

E-mail

Password (5 characters min.)

Date of Birth - -

Customer

Title	First_name	Last_name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

A relation is a 2 dimensional table. The intersection between a row and column is called a cell.

The Relational Terminologies – Record/Tuple

Title	First_name	Last_name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

Customer

Each row in the table is a record which represents an individual object in the relation.
Record of a table is also called tuple.

The Relational Terminologies – Attributes

Your personal information

Title ☐ Mr. ☐ Ms.

First name

Last name

E-mail

Password (5 characters min.)

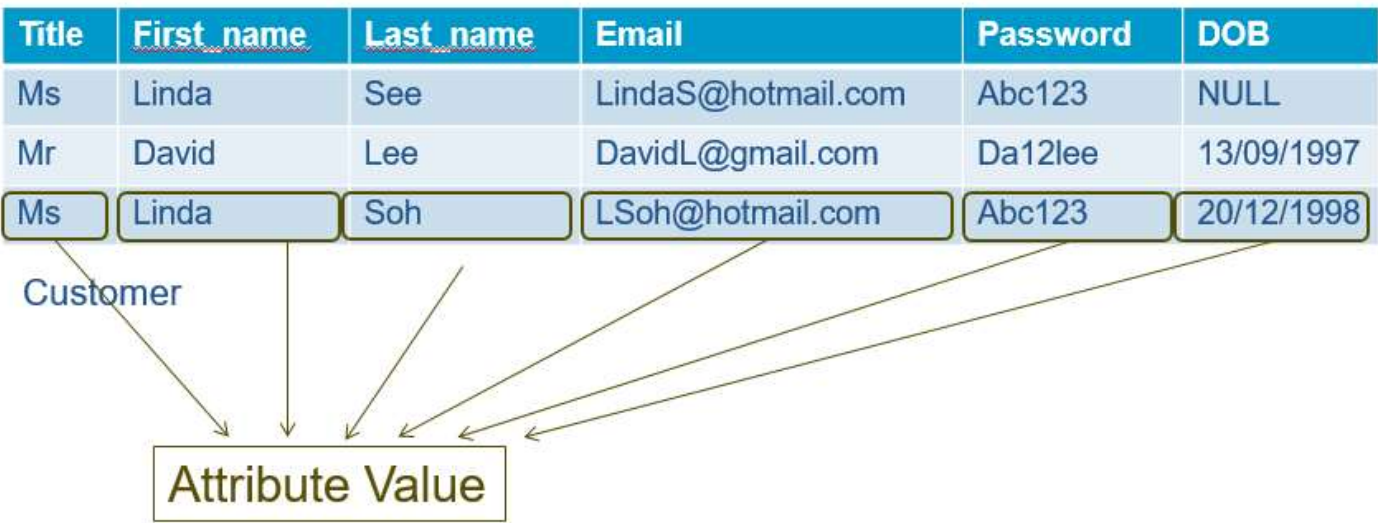
Date of Birth - -

Title	First_name	Last_name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

Customer

Attributes are column names of a table to define the characteristics of the object.

The Relational Terminologies – Attribute Values



- Concept of **NULL** Attribute Value –
- NULL is a special value allowed in a relational database
 - NULL means the value is UNKNOWN or NOT APPLICABLE

The Relational Terminologies – Attribute Domain

You are only allowed to select Mr. or Ms. for the Title field

Your personal information

Title

☐ Mr. ☐ Ms.

First name

Last name

E-mail

abc@hotmail.com

Password

(5 characters min.)

Date of Birth

-

-

-

Title	First name	Last name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	01/02/2000
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

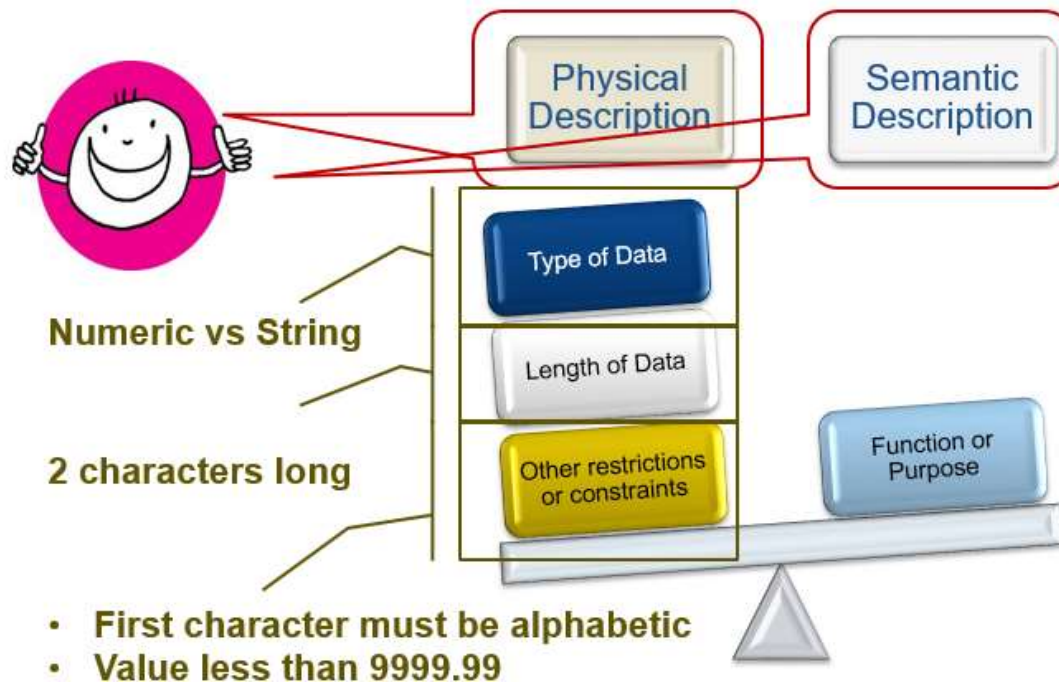
Customer

Attribute Domain –
The set of allowable values of that attribute (Example Ms, Mr)
A description of the possible values for that attribute

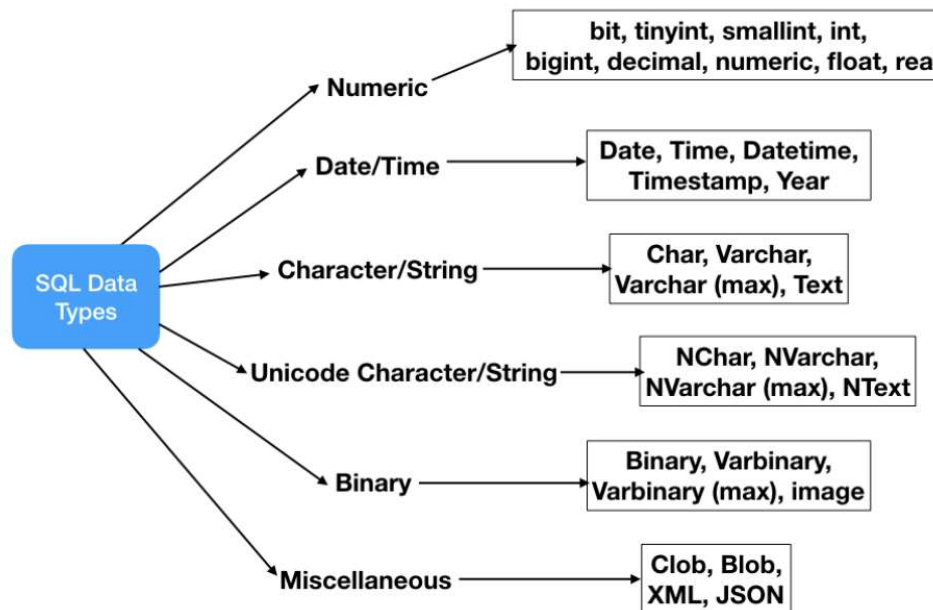
- Physical Description
- Semantic Description

The Relational Terminologies – Attribute Domain

- **Domain of Title attribute is set of letters consists of {'Ms', 'Mr'} where Ms represents Miss while Mr represents Mister.**



The Relational Terminologies – Attribute DataType / SQL Date Type



What is the difference between Char and Varchar?

Not all data types are supported by every relational database management systems.

Source: <https://www.journaldev.com/16774/sql-data-types>, 29 Feb 2020

The Relational Terminologies – Relational Database



A collection of inter-related proper form relations

Customer

Title	First_name	Last_name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	Lsoh@hotmail.com	Abc123	20/12/1998

Cart

Email	Product_code	Cart_ID	Qty
DavidL@gmail.com	HG4872	C10001	1
DavidL@gmail.com	HG5879	C10002	1

Properties Of A Relation

A table must satisfy the SIX properties of a relation.

#1: Name of Relation is unique in a database

You cannot create another relation/table in the same database by the same name

#2: Every cell must be single-valued

You cannot have multi-valued cell

#3: Attribute name in a relation must be unique

You cannot have two attributes by the same name

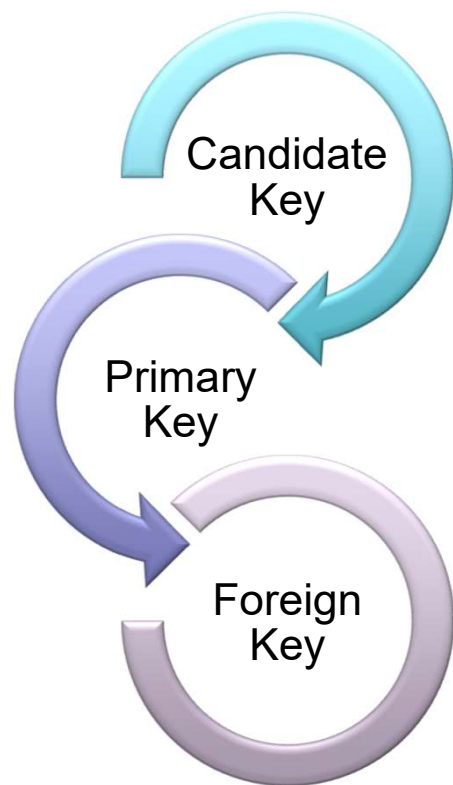
#4: Values of an attribute are from the same domain

#5: Order of tuples or attributes in a relation does not matter

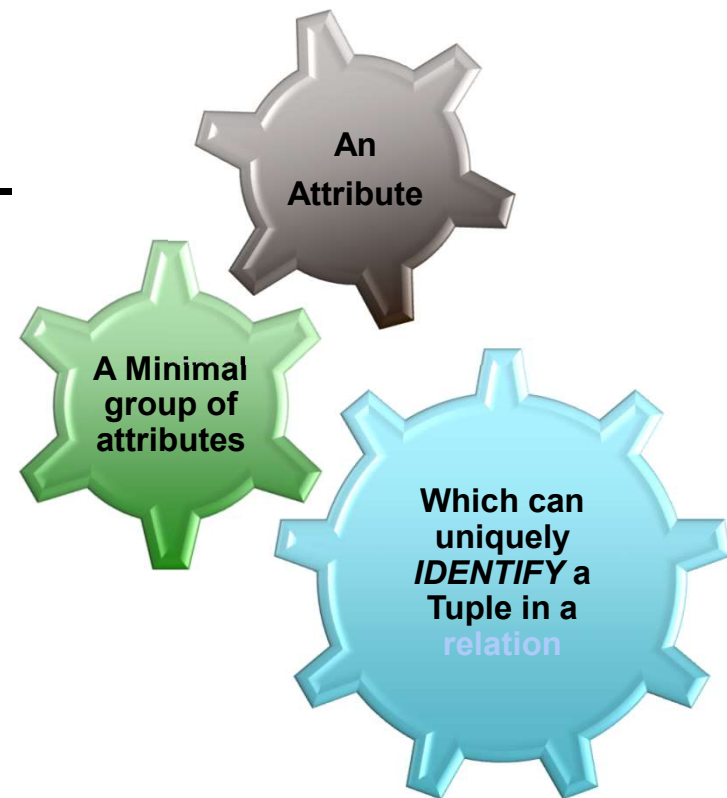
#6: Each tuple in a relation is unique

You cannot have duplicate tuple/row

The Relationship Integrity Rules - Keys



A candidate key is -



The Relationship Integrity Rules – Candidate Keys

Your personal information

Title ☐ Mr. ☐ Ms.

First name

Last name

E-mail

Password (5 characters min.)

Date of Birth

CANDIDATE KEY

Title	First_name	Last_name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

Email (an attribute) can uniquely identify a customer tuple (record) in the Customer relation

Customer

The Relationship Integrity Rules – Candidate Keys

Title	First_name	Last_name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

Customer

A minimal group of attributes
First_name, Last_name, Password

Identify the group of attributes which can uniquely identify a customer based on the tuples

The Relationship Integrity Rules – Primary Key

There are TWO candidate keys of customer relation:

1. Single attribute email
2. Minimal group of attributes
First name, last name, Password

Do we need so many identifiers for a relation ?

NO! We do not need so many identifiers for a relation.

- Choose one of the most suitable candidate key be the official identifier of a relation - **Primary key**

The Relationship Integrity Rules – Foreign Keys

What is the Foreign key?

- An attribute (column)
- OR a group of attributes (2 or more columns) with a relation that matches
- the value of the primary key OR the candidate key
- of the home OR other relation

Dishes

DishID	Name	Description
8	Chef's Salad	The Chef's Salad has...
10	Classic Burger	Our Classic Burger...
14	Family Fiesta Platter	This platter is...
15	Crème Brûlée	Elegantly crafted...
16	Cheesecake	Our New York style...

Customers

CustomerID	FirstName	LastName	...	FavoriteDish
1	Taylor	Jenkins		8
71	Winnah	D'Elia		10
97	Herb	McParland		14
83	Caril	Matejic		15
27	Yves	Dell'Abette		8
76	Dyanna	Fulger		16
95				

the foreign key will be on the many side.

The Relationship Integrity Rules – Foreign Keys

Title	First_name	Last_name	Email	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

Customer

Email	Product_code	Cart_ID	Qty
DavidL@gmail.com	HG4872	C1001	1
DavidL@gmail.com	HG5879	C1001	1

Cart

Email of cart relation is the foreign key referencing the primary key in the customer relation

The Relationship Integrity Rules – Entity Integrity Rule

Applies to primary key

Title	First_name	Last_name	Email (Primary Key)	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998
Mr	Jonanthan	Sim	NULL	JonS098	NULL



Email is the attribute of the Primary key, CANNOT BE NULL

Primary key = attribute or combination of attributes cannot be NULL

The Relationship Integrity Rules – Entity Integrity Rule

Composite Primary Key = Email + Product_code + Cart_ID

Email (PK)	Product_code (PK)	Cart_ID (PK)	Qty
DavidL@gmail.com	HG4872	C1001	1
DavidL@gmail.com	HG4872	C1001	1
NULL	HG4872	C1002	2



No part of a primary key can be duplicated

No part of the primary key can be Null

The Relationship Integrity Rules – Referential Integrity Rule

Applies to foreign key

Title	First_name	Last_name	Email (Primary Key)	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

Customer

Email (Foreign Key)	Product_code	Cart_ID	Qty
DavidL@gmail.com	HG4872	C1001	1
DavidL@gmail.com	HG5879	C1001	1
JuneL@gmail.com	HG4872	C1002	2

Cart

DavidL@gmail.com of cart relation is the foreign key referencing the primary key in the customer relation

The Relationship Integrity Rules – Referential Integrity Rule

Title	First_name	Last_name	Email (Primary Key)	Password	DOB
Ms	Linda	See	LindaS@hotmail.com	Abc123	NULL
Mr	David	Lee	DavidL@gmail.com	Da12lee	13/09/1997
Ms	Linda	Soh	LSoh@hotmail.com	Abc123	20/12/1998

Customer

Email (Foreign Key)	Product_code	Cart_ID	Qty
DavidL@gmail.com	HG4872	C1001	1
DavidL@gmail.com	HG5879	C1001	1
JuneL@gmail.com	HG4872	C1002	2

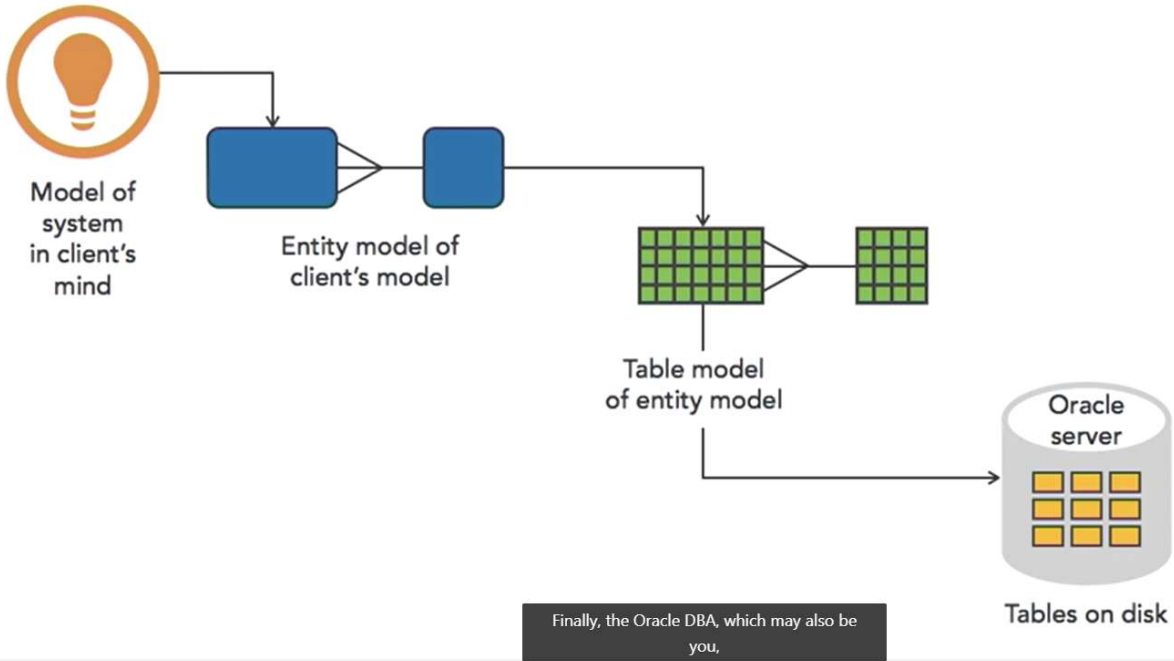
Cart

> JuneL@gmail.com of cart relation is not found in the customer relation

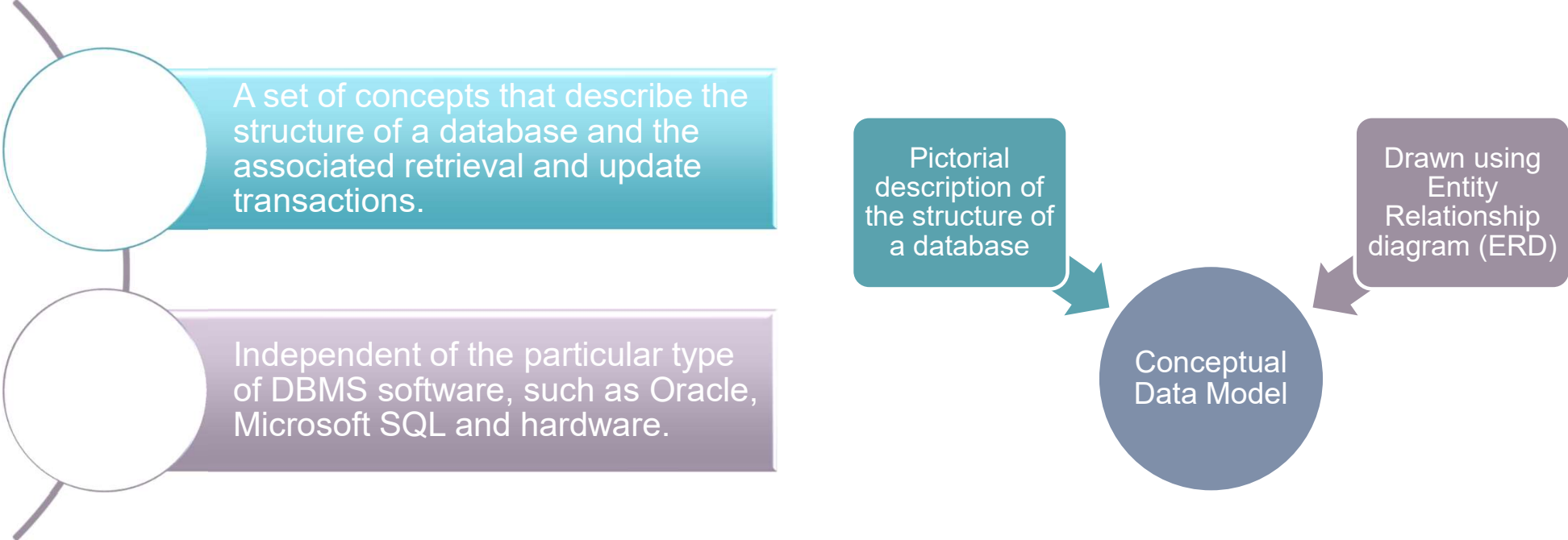
> Can we set the email in 3rd row of cart relation to Null? Is this logical?

Yes we can set part or whole of the foreign key to Null

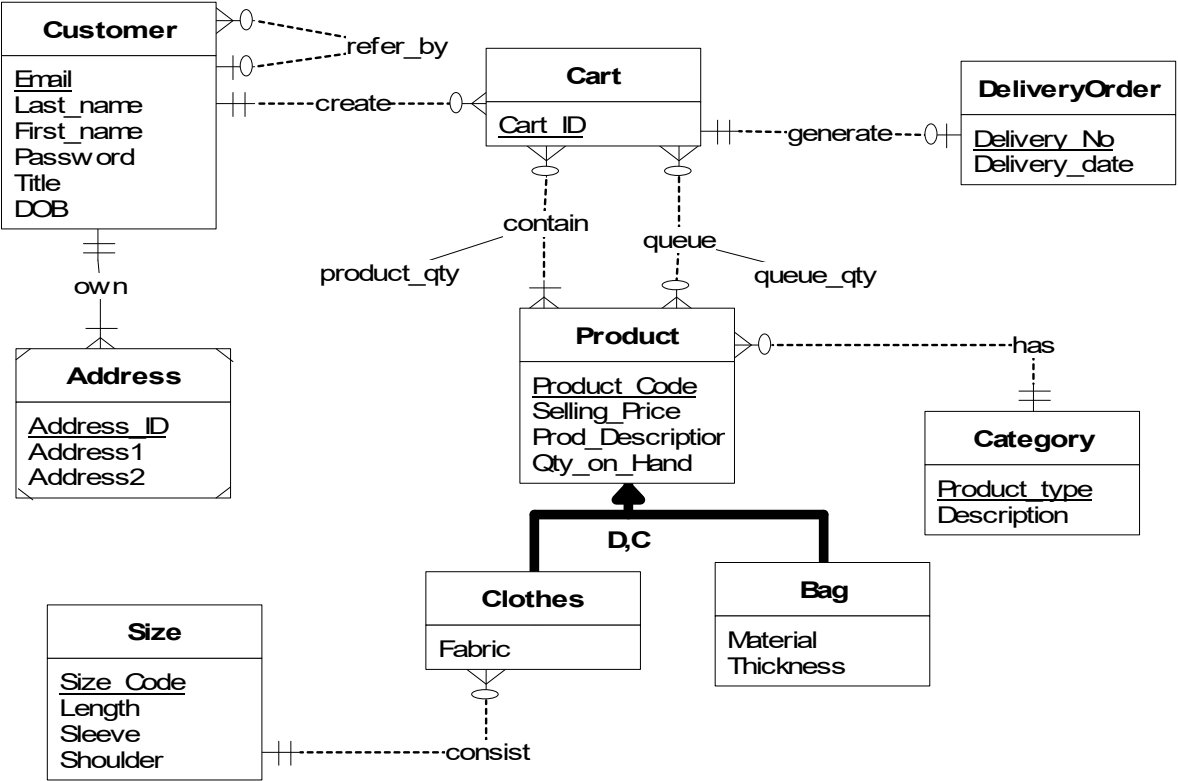
Getting from Idea to Database: Modeling



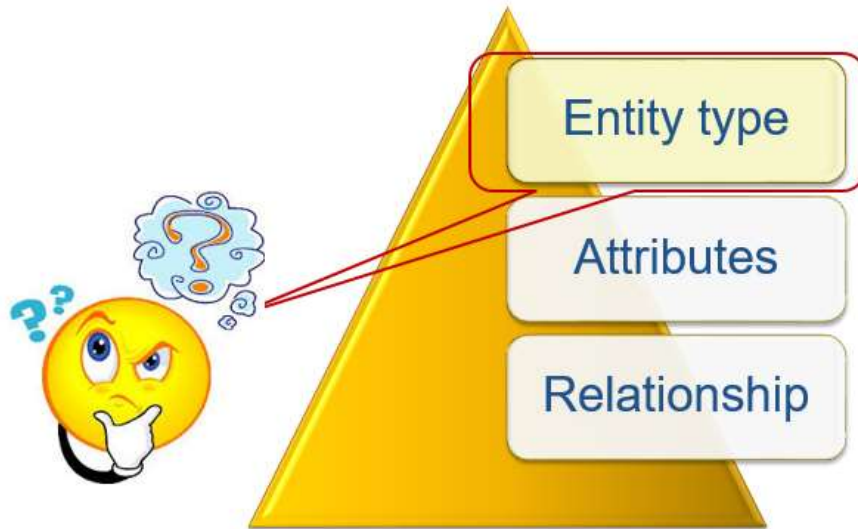
Entity Relationship Diagram - Conceptual Data Model



Entity Relationship Diagram -Conceptual Data Model (ERD)



Entity Relationship Diagram – Entity Type

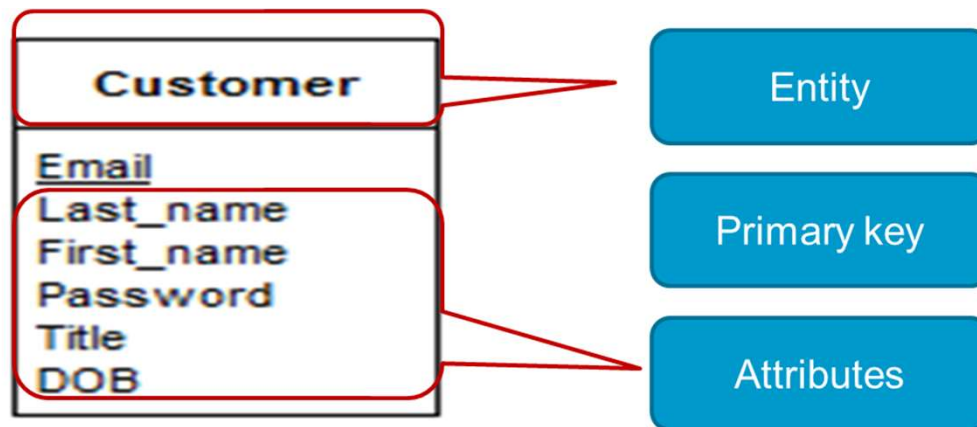


Defined as a **collection of entities** that **has common properties** and are **of interest to an organization**

Examples:

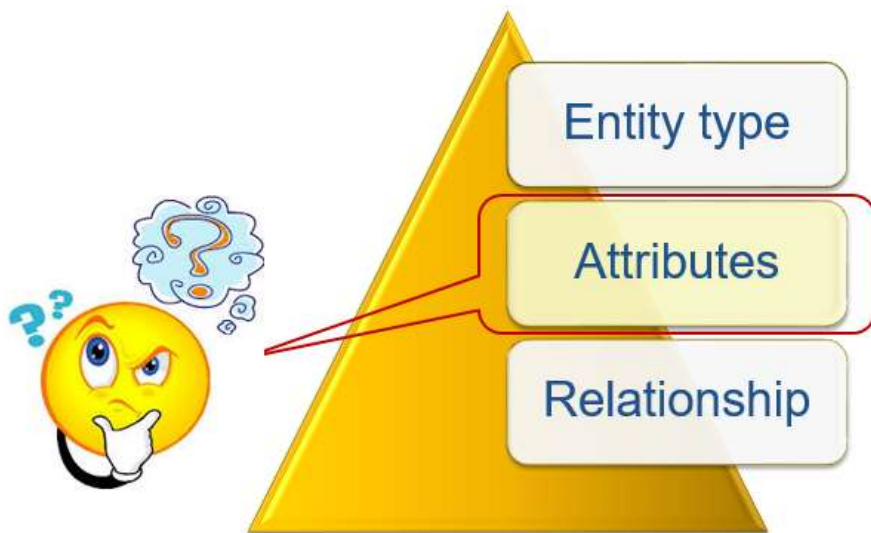
Customer, Address and Cart
Product, Clothes and Bag

Entity Relationship Diagram - Entity Type



Each entity type is identified by a name (singular noun) and a list of attributes.

Entity Relationship Diagram - Attributes



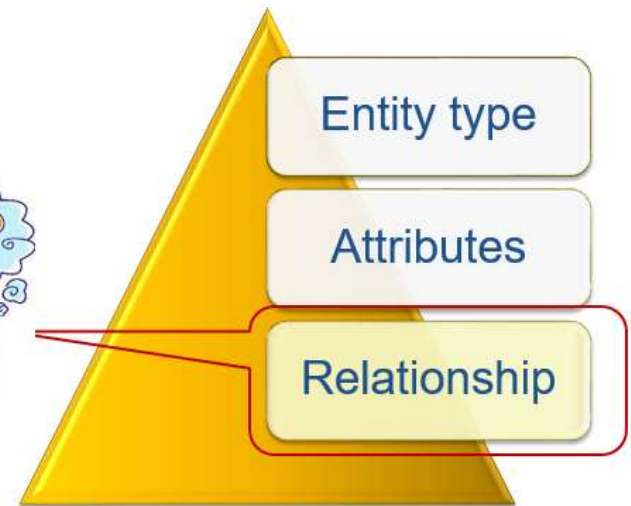
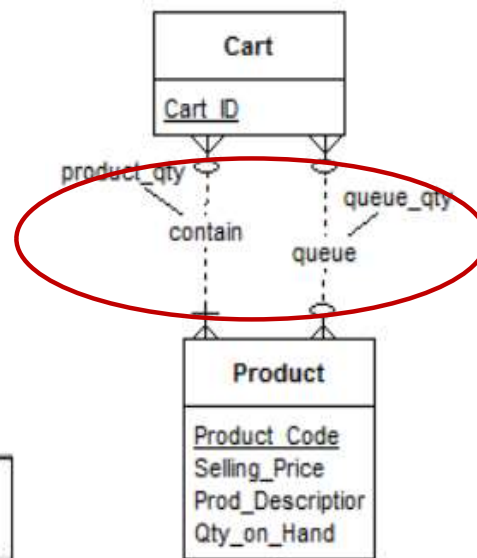
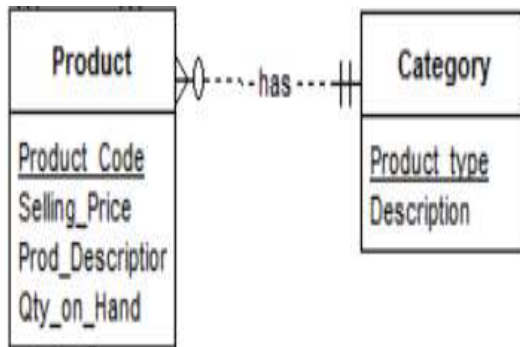
Composite Attribute – an attribute composed of multiple components. E.g. Name and Address

Simple Attribute – an attribute that composed of single component. E.g. Gender, mobile_no, student_no

Derived Attribute – an attribute that derives from a set of attributes. E.g. Age

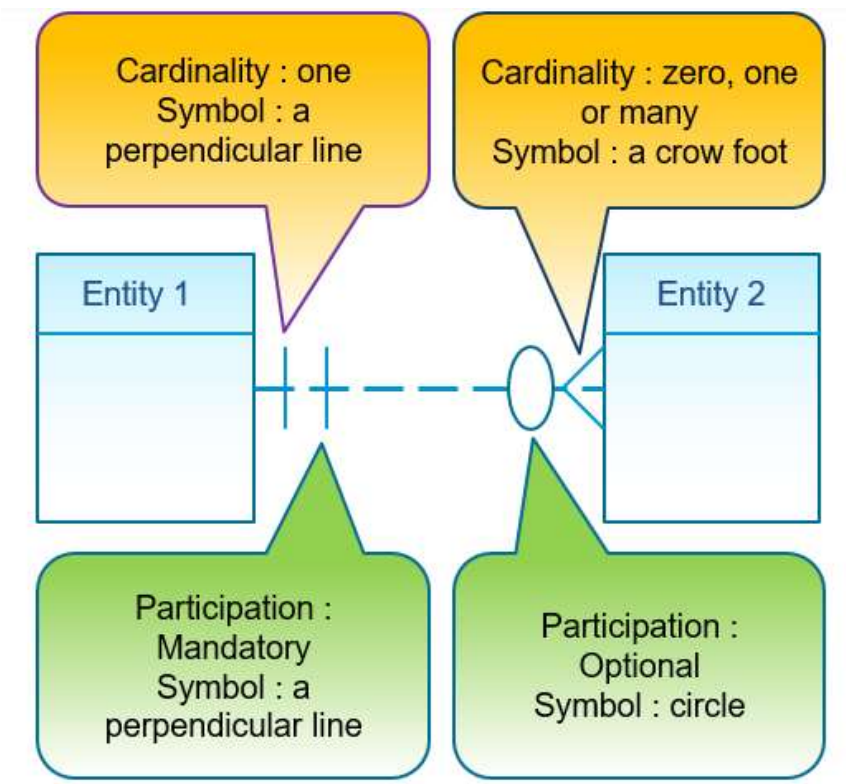
Entity Relationship Diagram – Relationships (single and multiple)

- Relationship is the association between 2 entities.
- Each relationship has a verb-based name.
- E.g. The 'has' relationship between product and product_type enables the user to know that this product is a blouse



- Multiple relationships can be created when the two entities are associated through two distinct relationships.
- (a) The cart must contain one or many products
- (b) The cart may be queuing for one or more products that are out-of-stock.

Entity Relationship Diagram – Structural Constraints



Reflect business rules set by the organization



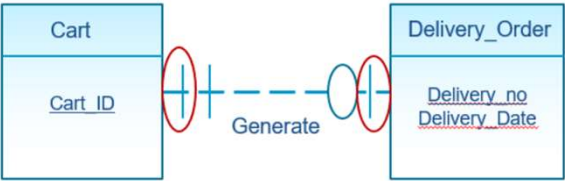
Entity Relationship Diagram – Cardinality Constraints

Describe the number of entity instances that participate in a relationship

Cardinality Ratios	Read as
1 : 1	One-to-one
1 : M	One-to-many
M : N	Many-to-many

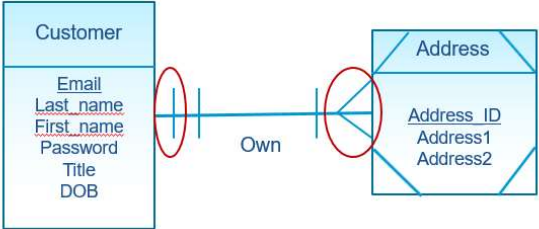
Entity Relationship Diagram – Cardinality Constraints

* 1 : 1 Relationship



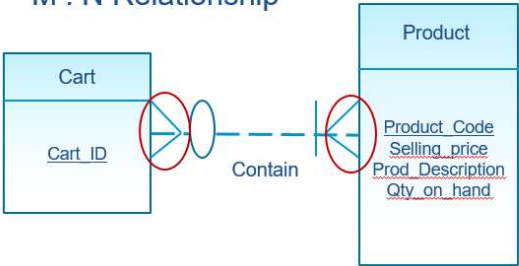
A cart generates one Delivery_order once the customer checkout the bag. And every Delivery_order belongs to one cart.

* 1 : M Relationship



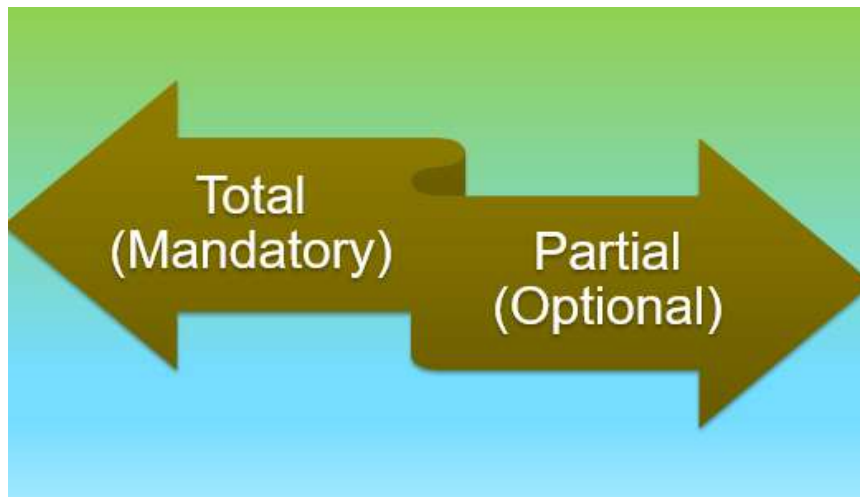
A customer has one or many addresses and each address belongs to only one customer.

* M : N Relationship



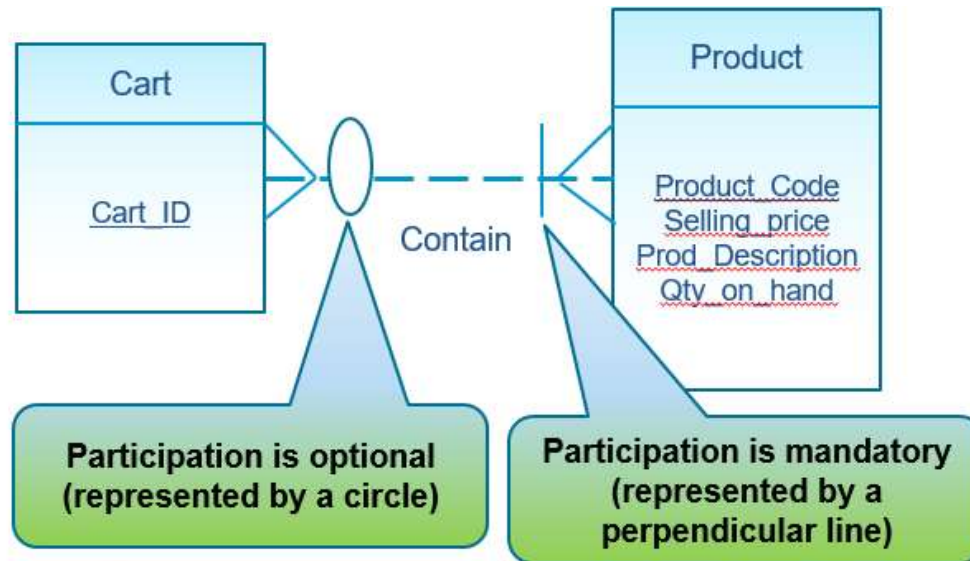
A cart contains one or many products.
A product can be added in zero, one or many carts.

Entity Relationship Diagram – Participation Constraints



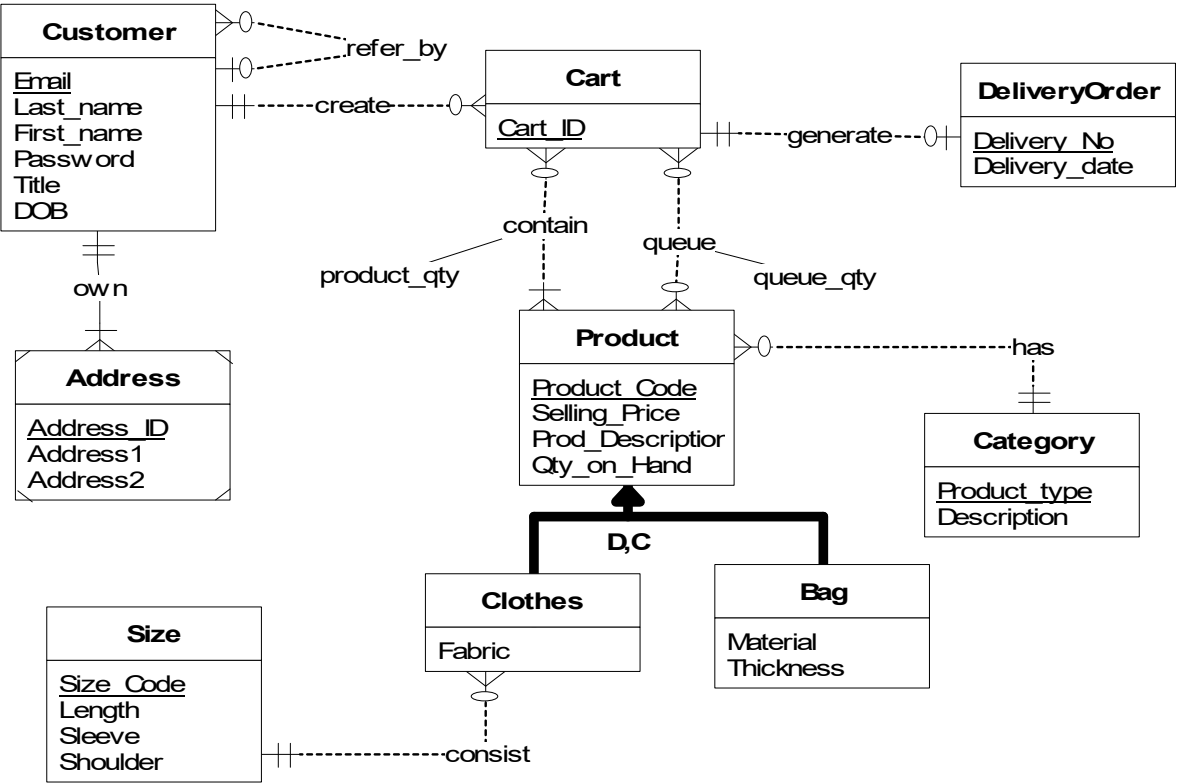
Determines if the existence of an entity type depends on another entity type

Entity Relationship Diagram – Participation Constraints



- Each cart must have one or more product.
- A product may not be added to a cart.

How to transform an Entity Relation Diagram to Database?



- 1. Database tables does not have M:N Relation?
- 2. How to systematically transform an ERD to Database?

How to transform an Entity Relation Diagram to Database?

Cart (CartID, Email)

Product (ProductCode, SellingPrice, ProductDescription, Qty, ProductType)

Category (ProductType, Description)

Cart_Product(CardID, ProductCode, Product_Qty)

Customer(Email, Last_Name, First_Name, Password, Title, DOB)

DeliveryOrder (Delivery_No, DeliveryDate, CartID)

1. Database tables does not have M:N Relation?
2. How to systematically transform an ERD to Database?

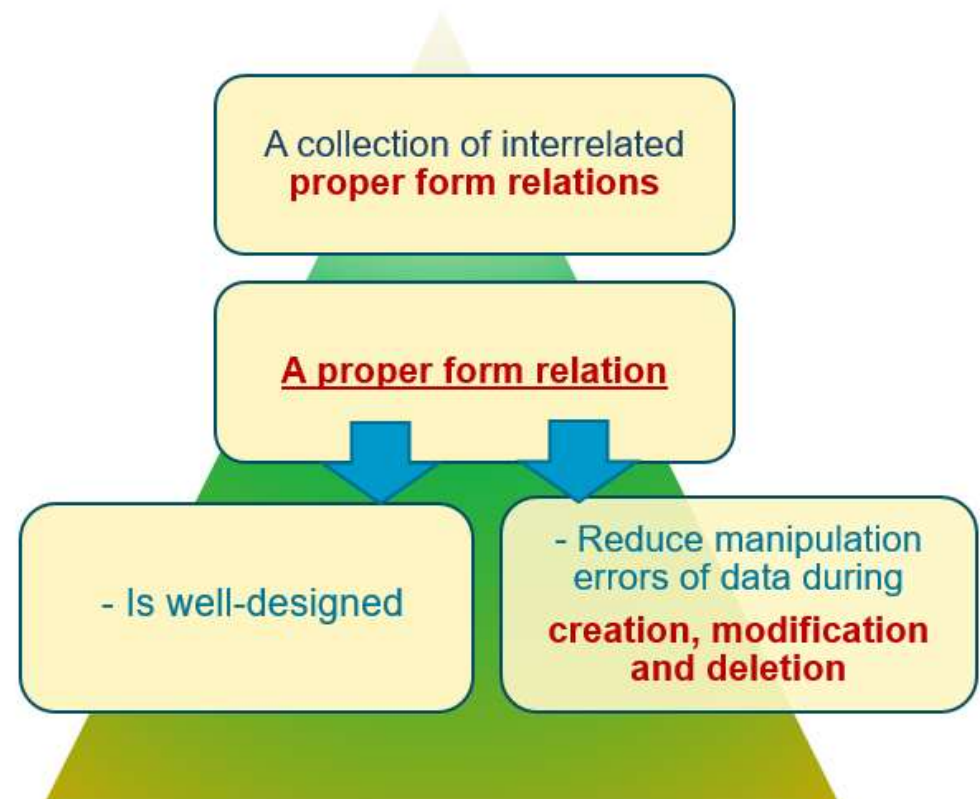
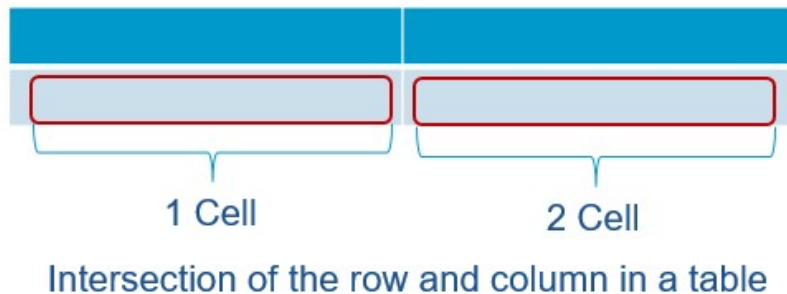


Entity Relationship Diagram and Database

Definition		Example	
ERD	Database	ERD	Database
Entity type	Relation / Table	Customer Entity type	Customer Relation / Table
Entity	Tuple / Row	Customer Entity	Customer Tuple / Row
Attribute	Attribute / Column	Email Attribute	Email Attribute / Column
Relationship	Foreign key referencing Primary key	Relationship Own	Email_addr (Foreign key) referencing Email (Primary key)
Primary key	Primary key	Primary key (Email)	Primary key (Email)

Normalization – Proper Form Relation

- ❑ No more than one value in each cell of a relation
- ❑ Each cell must be **single value**
- ❑ Each cell must not be multi-value



Normalization – Un-normalized Form (0NF/UNF)

The table is called an Un-normalized (UNF) table



- ❖ A table with multi-valued cells
- ❖ A table with repeating group

Customer_Product_Supplier

<u>First_name</u>	<u>Email</u>	<u>Prod_Co</u> <u>de</u>	<u>Prod_Desc</u>	<u>Unit_px</u>	<u>Supplier</u> <u>_ID</u>	<u>Supplier Name</u>	<u>Qty</u>	<u>Ttl_Amt</u>
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
		HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60
		RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40
Linda	LSoh@hotmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte ltd	1	15.90
		HG6159	Sale Dress Pink	15.40	S1003	Best Clothing Pte Ltd	4	61.60

Single-valued cell

Multi-valued cell

Normalization – How To Represent a 0NF/UNF?

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
		HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60
		RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40
Linda	LSoh@hotmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	1	15.90
		HG6159	Sale Dress Pink	15.40	S1003	Best Clothing Pte Ltd	4	61.60

Relational Heading Format	Syntax
Customer_Product_Supplier (First_name, Email, { Prod_Code, Prod_Desc, Unit_px, Supplier_ID, Supplier_Name, Qty, Ttl_Amt })	<Relation> (Single-valued columns,.. { Multi-valued columns })

Normalization – Transform 0NF to 1NF

Normal Form	Description	Problem	Solution
UNF/0NF	Table with multi-valued cells	Violate the properties of relation	Form new row for each multi-valued cell to remove repeating group.

We therefore cannot make use of this improper form relation. We need to transform it to first normal form.

First Normal Form (1NF)

Customer_Product_Supplier

First_name	<u>Email</u>	<u>Prod_Code</u>	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60
David	DavidL@gmail.com	RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40
Linda	LSoh@hotmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	1	15.90
Linda	LSoh@hotmail.com	HG6159	Sale Dress Pink	15.40	S1003	Best Clothing Pte Ltd	4	61.60

Step	Description

Normalization – First Normal Form (1NF)

<u>First_name</u>	<u>Email</u>	<u>Prod_Code</u>	<u>Prod_Desc</u>	<u>Unit_px</u>	<u>Supplier_ID</u>	<u>Supplier_Name</u>	<u>Qty</u>	<u>Ttl_Amt</u>
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60
David	DavidL@gmail.com	RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40
Linda	LSoh@hotmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	1	15.90
Linda	LSoh@hotmail.com	HG6159	Sale Dress Pink	15.40	S1003	Best Clothing Pte Ltd	4	61.60

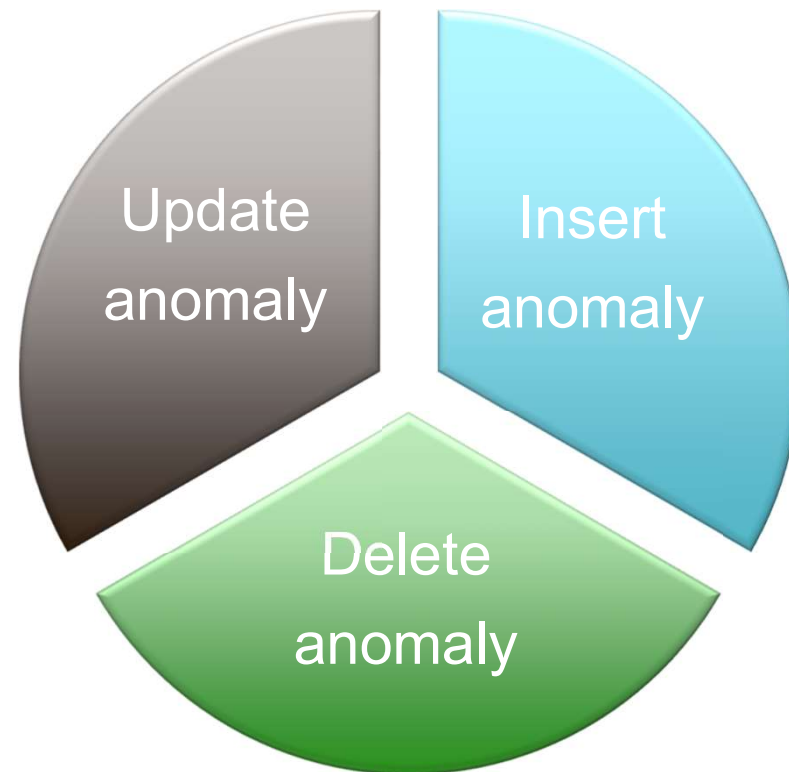
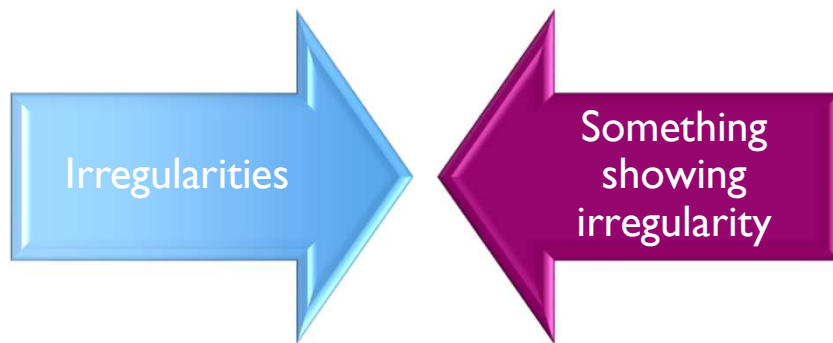
There is **NO REPEATING GROUP** in a First Normal Form table



- ❖ No Repeating groups of data
- ❖ Identify the primary key

Normalization - Anomalies

What are anomalies?



Normalization-1NF : Insert anomaly

Customer_Product_Supplier Primary Key

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60
David	DavidL@gmail.com	RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40
Linda	LSoh@hotmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	1	15.90
Linda	LSoh@hotmail.com	HG6159	Sale Dress Pink	15.40	S1003	Best Clothing Pte Ltd	4	61.60

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
Rachel	Rachel@gmail.com	?	?	?	?	?	?	?

Cannot insert a row when a particular customer (email) does not buy any product

Normalization-1NF : Insert anomaly

Customer_Product_Supplier Primary Key

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60
David	DavidL@gmail.com	RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40
Linda	LSoh@hotmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	1	15.90
Linda	LSoh@hotmail.com	HG6159	Sale Dress Pink	15.40	S1003	Best Clothing Pte Ltd	4	61.60

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
?	?	HX1021	Red Dress	10.10	ST1001	King Dress Pte Ltd	?	?

Cannot insert a row when the new product does not have any new customer

Normalization – 1NF : Insert anomaly

- Which rule does Insert anomaly violates?
 - ☐ Entity Integrity Rule
 - ☒ Referential Integrity Rule
 - ☐ Both
 - ☐ None of the above

Normalization - 1NF: Update anomaly


Customer_Product_Supplier

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Dress Pure White	15.90	S1001	King Kong Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Kong Dress Pte Ltd	2	39.60
David	DavidL@gmail.com	RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40
Linda	LSoh@hotmail.com	HG7160	Dress Pure White	15.90	S1001	King Kong Dress Pte Ltd	1	15.90
Linda	LSoh@hotmail.com	HG6159	Sale Dress Pink	15.40	S1003	Best Clothing Pte Ltd	4	61.60

- a. Change the supplier name from King Dress Pte Ltd to King Kong Dress Pte Ltd
- b. Change the product description of HG7160 to Dress Pure White

Change of supplier name and product description requires updates in several rows

Normalization – 1NF : Update anomaly

- What happen during Update anomaly?
 - ☐ Multi-value cells created
 - ☐ Data inconsistency due to data redundancy 
 - ☐ Violate Entity Integrity Rule
 - ☐ All the above

Normalization - 1NF : Delete anomaly

Customer_Product_Supplier

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60
David	DavidL@gmail.com	RQ0207	Dress White	18.60	S1002	Ladies Green Pte Ltd	4	74.40

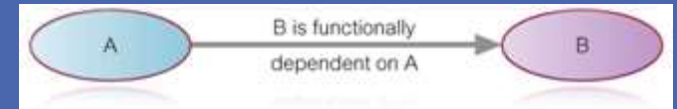
Delete Linda will result in removing product such as HG6159 that is only bought by Linda

Loss of information when rows are deleted from the relation

Normalization – Anomaly Summary

Anomaly	Description / Examples	Violation / Problem
Insert Anomaly	<p>Primary key (email, product_code)</p> <p>Cannot insert a row when a particular customer (email) does not buy any product</p> <p>Cannot insert a row when the new product does not have any new customer</p>	Entity Integrity Rule
Update Anomaly	<p>Changes of supplier name and product description requires updates in several rows</p> <p>Resulting in <u>data inconsistencies if care is not taken to update all relevant data.</u></p>	Data inconsistencies due to data redundancy
Delete Anomaly	Delete Linda will result in removing product such as HG6159 that is only bought by Linda	Lost of information when rows are deleted from the relation

Normalization – Functional Dependency



- ❖ A functional dependency is a constraint about two or more columns of a table
- ❖ Occurs when the value of an attribute is fully dependent upon another attribute's value
- ❖ A relation is said to be in Second Normal Form if all non-key attributes are fully dependent on whole of its primary key

Attribute on the **left hand side** of a functional dependency (FD) is known as LHS or determinant.

Attribute B's value is functionally dependent upon attribute A's value. i.e. if there exists at most one value of B for every value of A.

Normalization – Functional Dependency

Examples of functional dependency

Supplier_ID \rightarrow Supplier_Name

Supplier_ID \rightarrow Supplier_Phone

Supplier_ID \rightarrow Supplier_Address

Supplier_ID \rightarrow Supplier_Name, Supplier_Phone, Supplier_Address

Normalization – Transform 1NF to 2NF

Normal Form	Description	Problem	Solution
1NF	Table with anomalies	Violate the properties of relation	Transform further to second normal form.

As there are anomalies in 1NF , we therefore need to transform it second normal form.

Normalization – Second Normal Form (2NF)

Customer_Product_Supplier

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60

Partial keys	Whole key
Email	Email, Prod_Code
Prod_Code	

Step I – Identify keys

Normalization – Second Normal Form

Customer_Product_Supplier

First_name	Email	Prod_Code	Prod_Desc	Unit_px	Supplier_ID	Supplier_Name	Qty	Ttl_Amt
David	DavidL@gmail.com	HG7160	Sale Dress White	15.90	S1001	King Dress Pte Ltd	3	47.70
David	DavidL@gmail.com	HG9298	Sale Top + Skirt Red	19.80	S1001	King Dress Pte Ltd	2	39.60

<u>Partial Functional Dependencies</u> (One or more non-key attributes functionally dependent on <u>part (but not all)</u> of the primary key)	<u>Functional Dependencies with Whole key</u> (Non-key attributes functionally dependent upon <u>whole of primary key</u>)
Email -> First_Name	Email, Prod_Code -> Qty, Ttl_Amt
Prod_Code -> Prod_Desc, Unit_Px, Supplier_ID, Supplier_Name	

Always identify the FD with all the partial keys first, follow by whole key

Step 2 – List functional dependencies with keys

Normalization – Second Normal Form

Functional Dependencies	Relations (Relational Header Format)
Email -> First_Name	Customer (<u>Email</u> , First_Name)
Prod_Code -> Prod_Desc, Unit_Px, Supplier_ID, Supplier_Name	Product (<u>Prod_Code</u> , Prod_Desc, Unit_Px, Supplier_ID, Supplier_Name)
Email, Prod_Code -> Qty, Ttl_Amt	Customer_Product_Supplier (<u>Email</u> , <u>Prod_Code</u> , Qty, Ttl_Amt)

For each of the partial dependencies identified, create a relation and name them appropriately. Check there are no anomalies in each of the relations.

Step 2 – Derive relations from functional dependencies

Normalization – Transitive Dependency

- ❖ Transitive Dependency is a functional dependency between two (or more) non-key attributes in a relation
- ❖ A relation is said to be in Third Normal Form if there is no functional dependencies among non-key attributes

Normalization - Transform 2NF to 3NF

Relations (Relational Header Format)	3NF?	Transformation
Customer (<u>Email</u> , First_Name)	Yes	
Product (<u>Prod_Code</u> , Prod_Desc, Unit_Px, Supplier_ID, Supplier_Name)	No	Supplier (<u>Supplier_ID</u>, Supplier_Name) NB: Supplier_ID becomes foreign key ref Supplier Product (<u>Prod_Code</u>, Prod_Desc, Unit_Px, Supplier_ID)
Customer_Product_Supplier (<u>Email</u> , <u>Prod_Code</u> , Qty, Ttl_Amt)	Yes	

Normalization – From 0NF To 3NF

Customer (Email, First_Name)

Supplier (Supplier_ID, Supplier_Name)

Product (Prod_Code, Prod_Desc, Unix_Px, *Supplier_ID*)

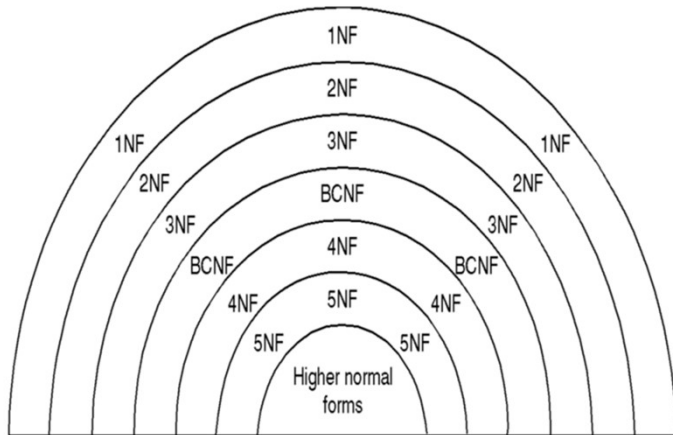
Customer_Product_Supplier (Email, Prod_Code, Qty, Ttl_Amt)

We started with one table and after the 3rd normalization, we have four tables.

Normalization – Summary

Normal Form	Definition	Problem	Solution
UNF/0NF	A table with multi-valued cells or repeating groups	Violate the properties of relation	Form new row for each multi-valued cell to remove repeating group.
1NF	A table without any repeating groups of data	Contain 3 types of anomalies: a. Insert anomaly b. Update anomaly c. Delete anomaly	Remove partial dependencies. Determination of primary key
2NF	A relation that is in the 1NF, and, every non-key attribute is functionally dependent on the whole of its primary key	Functional dependency among the non-key attributes	Create new relation(s). The primary key of the new relation will be served as the foreign key in the existing relation.
3NF	A relation that is in 2NF, and, there is no functional dependency among non-key attributes		

Normalization – Relationships Between Normal Forms

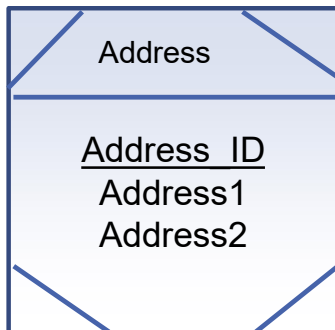


- ❖ Normalisation process splits the information across several relations
- ❖ Aims to establish relations that are more efficient when we perform insert, update and delete records operations on the relation
- ❖ A process of grouping attributes into well-structured relations that allow users to insert, delete and modify rows in these relations without errors or inconsistencies resulting from these operations.

THE END

Optional Discussion

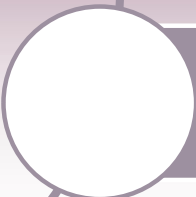
Entity Relationship Diagram – Weak Entity and Identification Dependency



Weak entity or Child entity

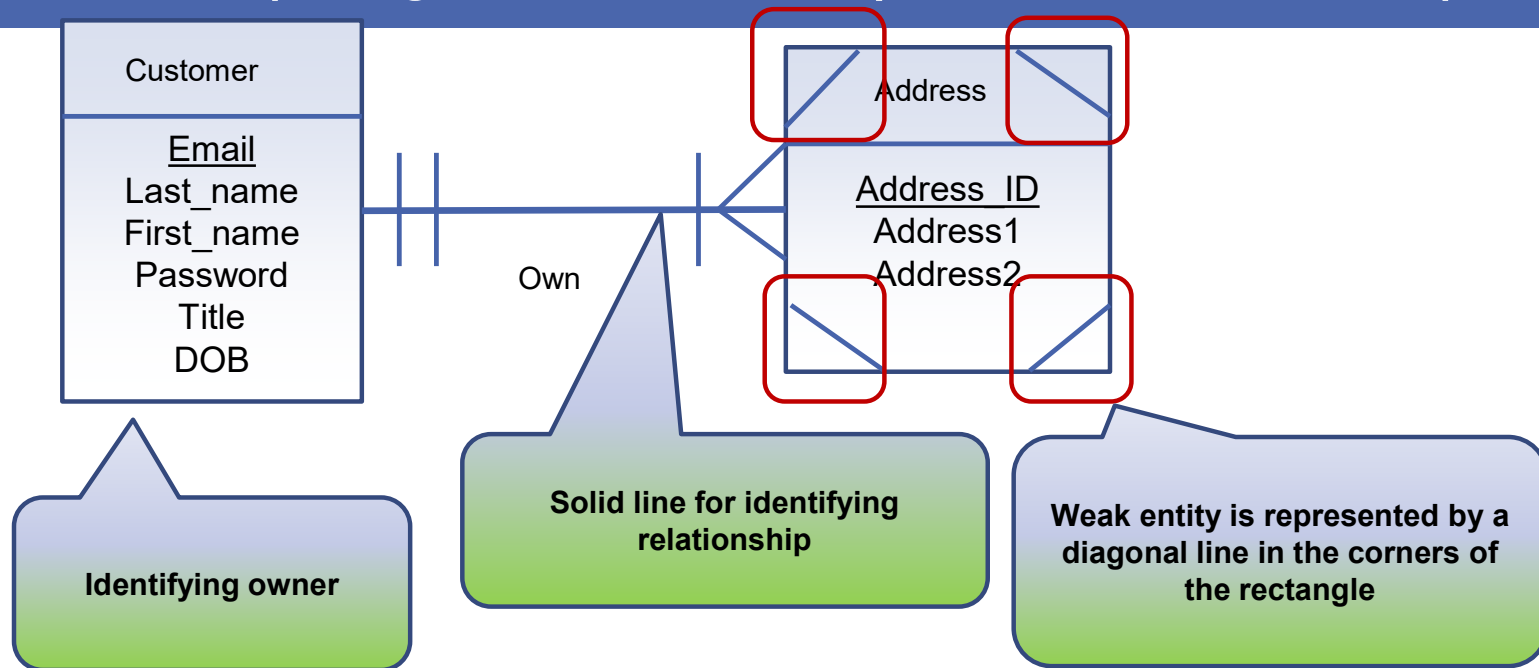


Dependent on parent/owner
entity for existence



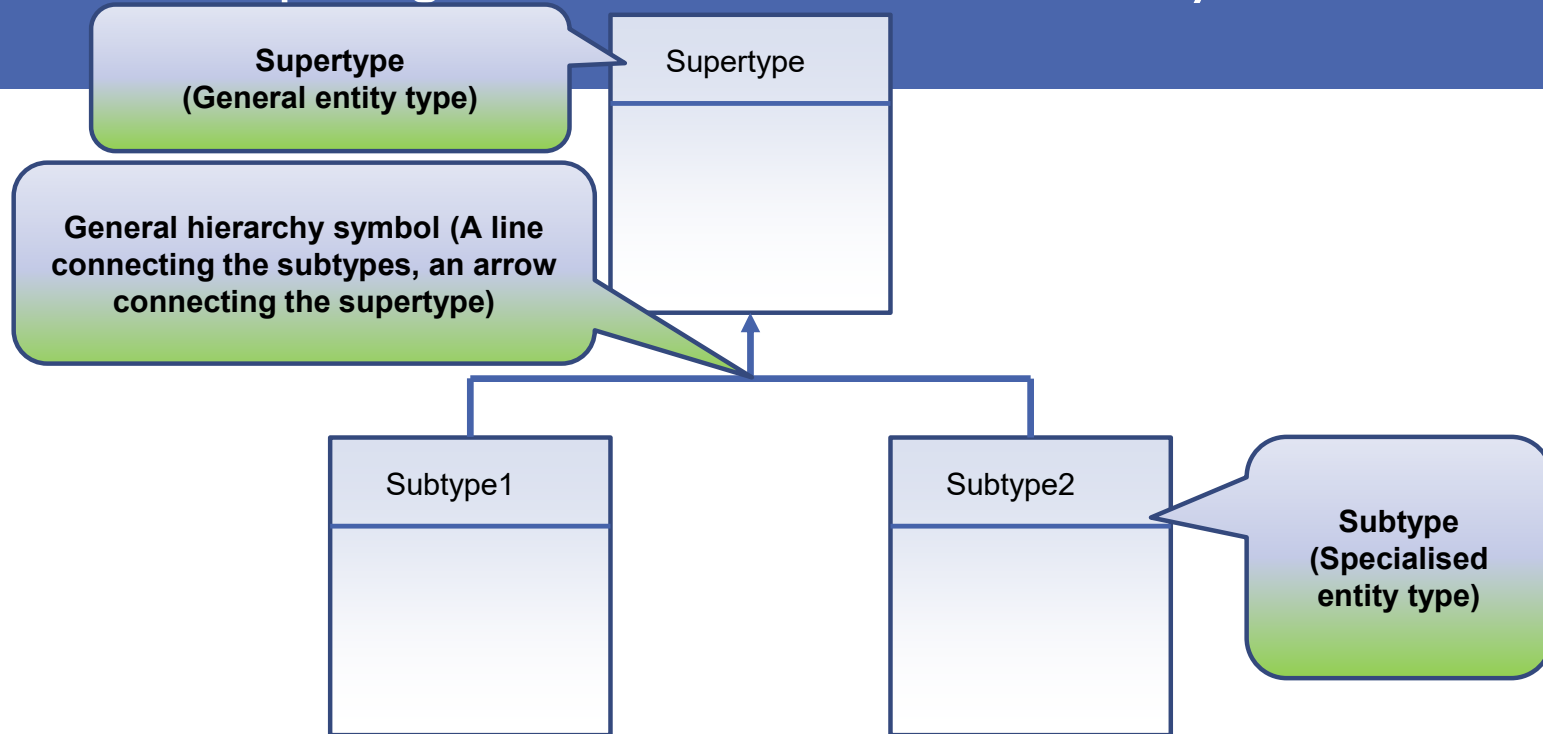
Cannot be identified using
its own attributes only

Entity Relationship Diagram – Weak Entity and Identification Dependency



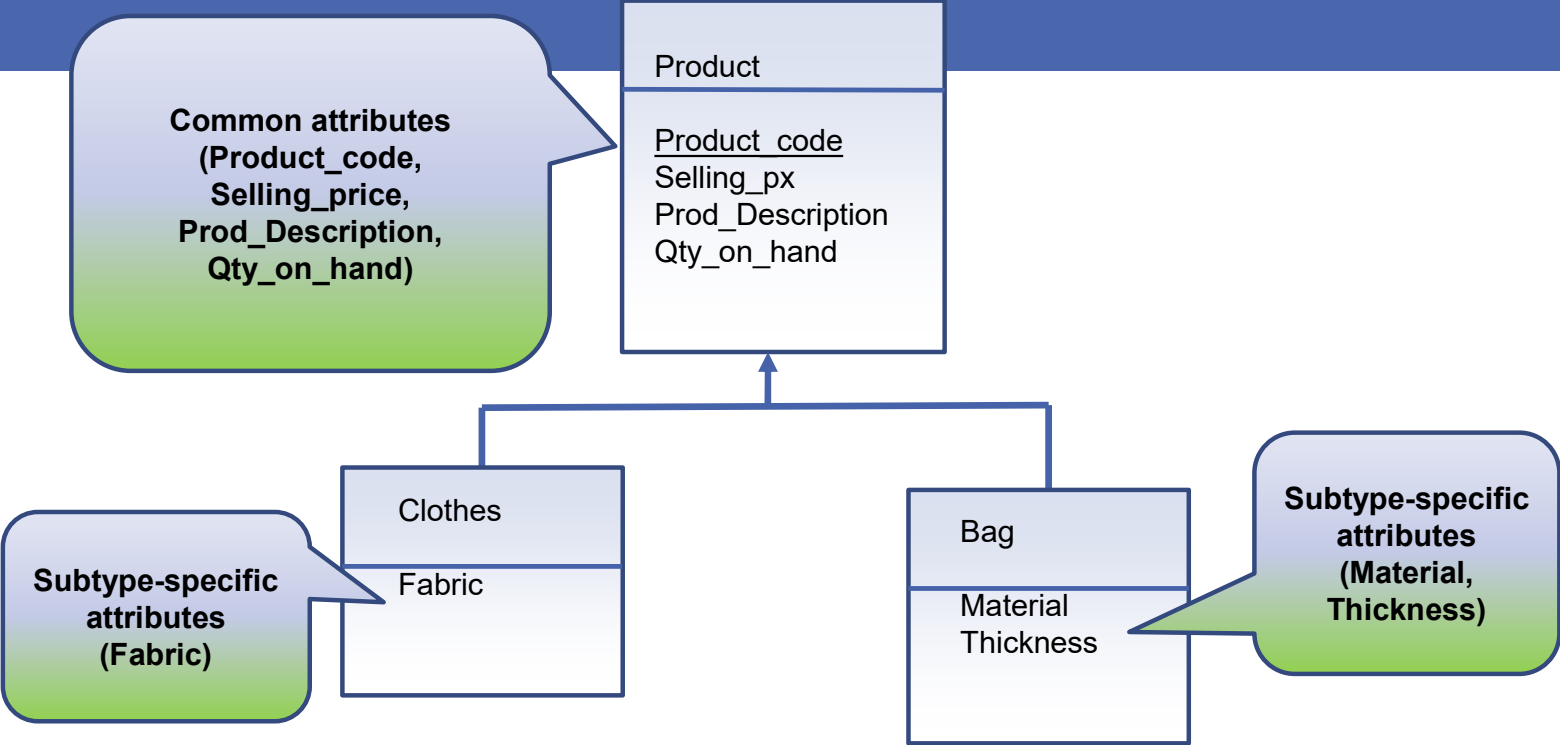
- The **Address** entity is dependent on customer entity for existence.
- Address_ID needs to combine with Email to form the full-identifier.
 - Address_ID + Email = Primary Key.

Entity Relationship Diagram - Generalization Hierarchy



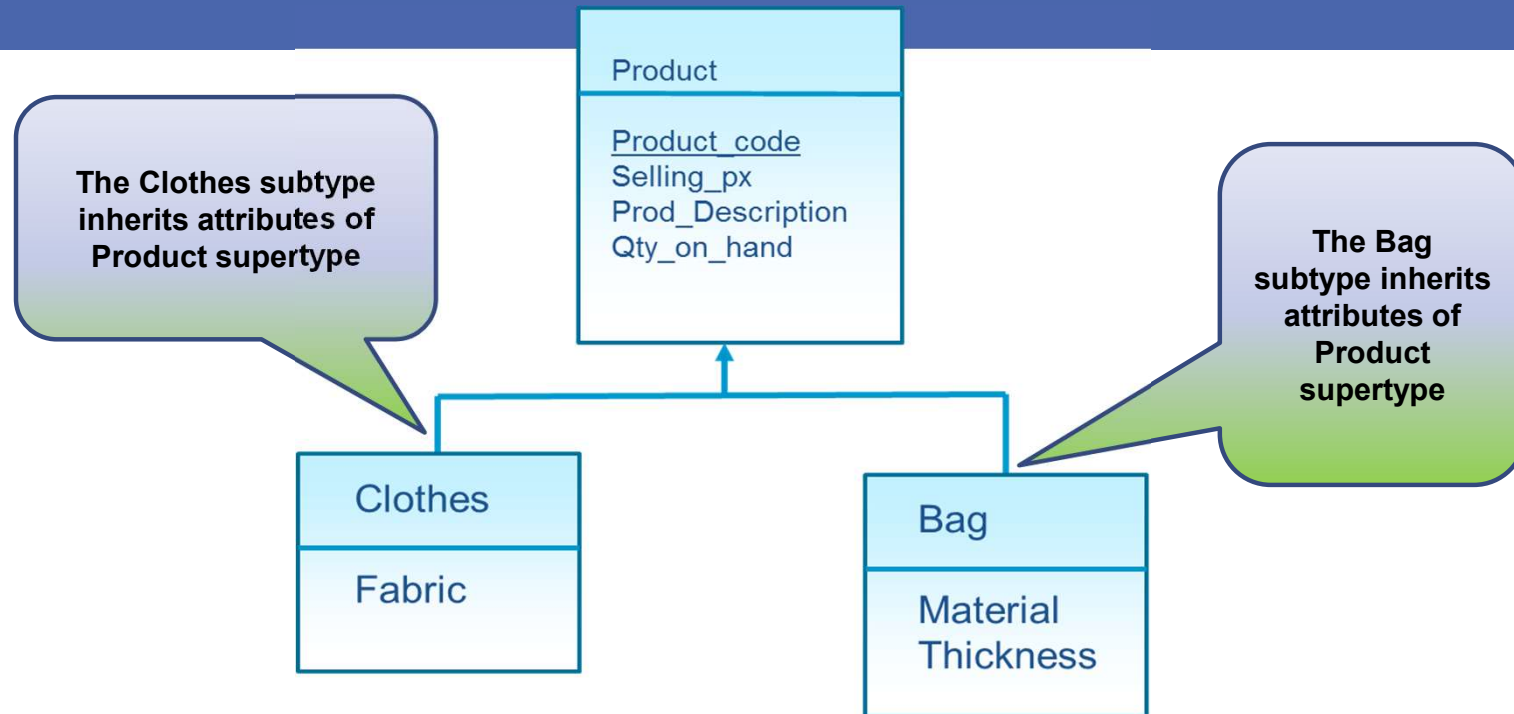
- Also known as IS-A relationship.
- Collection of entity types arrange in hierarchy structure.

Entity Relationship Diagram - Generalization Hierarchy



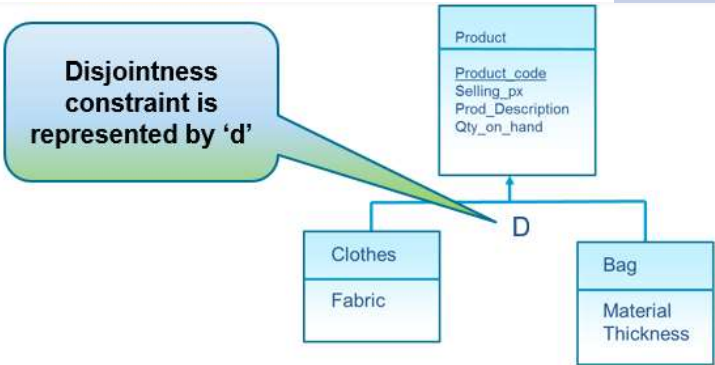
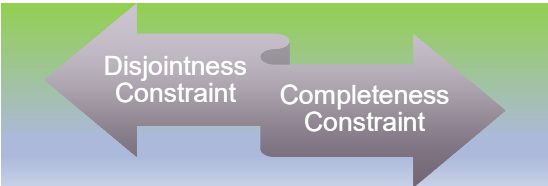
- Attributes that are common to all entities are associated with the Supertype.
- Attributes that are unique to a particular subtype are associated with that subtype.

Entity Relationship Diagram - Generalization Hierarchy

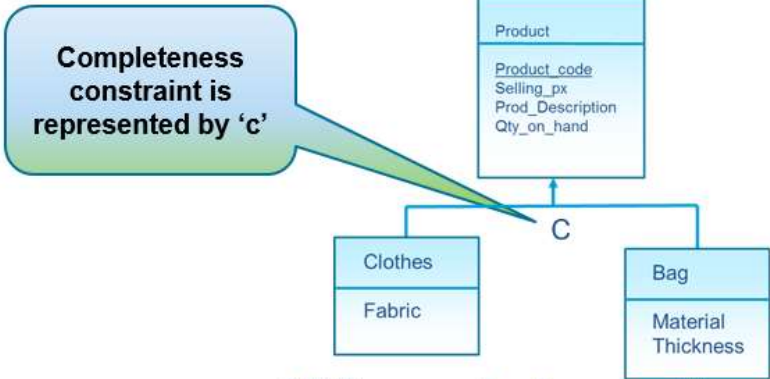


- Subtype entities inherit attributes of the supertype.
- Subtype possesses subtype-specific attributes as well as those associated with supertype attributes.

Entity Relationship Diagram - Generalization Hierarchy



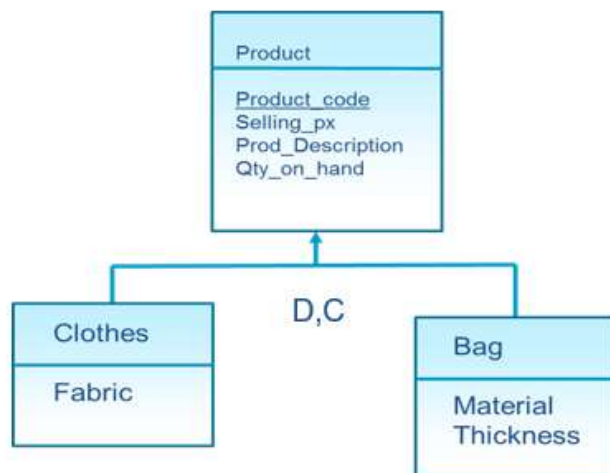
A product is either a clothing or a bag



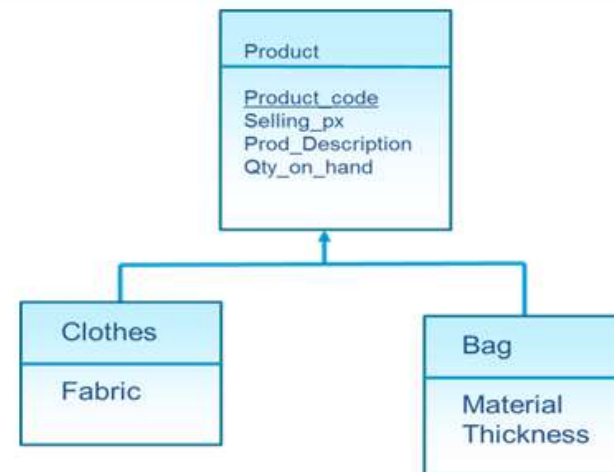
All the products are either clothing or bag

- Specifies that a Supertype can only be a member of one subtype; it cannot be simultaneously be a member of both.
- Specifies all the subtypes that make up a supertype entity.

Entity Relationship Diagram - Generalization Hierarchy



The Disjointness constraint shows that the product is either a clothing or a bag. The Completeness constraint shows that there are only 2 types of products: Clothes or Bag.



The omission of Disjoint constraint implies that a product can be both an article of clothing and a bag at the same time.

The omission of the Completeness constraint implies there are other types of products besides clothes and bags eg. shoes.