



systems

ENTITIES, RELATIONSHIPS, AND CARDINALITY CONSTRAINTS

DATABASE DESIGN

202 – Introduction to Database Systems

Week 1 / Day 2

LEARNING OBJECTIVES & AGENDA

Learning Objectives:

- Map entities and relationships to real-world contexts.
- Understand cardinality & participation.
- Design and interpret entity relationship diagrams.

Agenda / Sub-Topics:

- Entities & Relationships.
- Cardinality Constraints.
- ER Diagrams.

ENTITIES & RELATIONSHIPS

MAPPING ENTITIES & RELATIONS

- **Entities** are objects whose data will be stored.
 - Tuples (rows / records) in a database's table.
 - E.g. person, place, thing.
- **Attributes** are characteristic values belonging to an entity that need to be stored.
 - Attributes / fields of a database's table.
 - E.g. a person's name, gender, age, CNIC, etc.
- **Relationships** show how entities are related to one another.
 - E.g. a worker 'works for' employer.

ENTITIES VS ATTRIBUTES

	Attribute	Attribute	Attribute	Attribute	Attribute
Entity					
Entity					
Entity					
Entity					
Entity	DATABASE				
Entity					
Entity					
Entity					
Entity					
Entity					
Entity					

KEYS TO ACCESS TUPLES (RECORDS)

- Attributes (one or more) that **uniquely** identify a tuple, should **never change**, and can **never be completely NULL**.
- Types:
 - **Super Key:** Unique & not NULL.
 - **Composite Key:** Multi-Attribute Key.
 - **Minimal Super-key:** Irreducible key.
 - **Candidate Keys:** Key in the set of minimal super-keys.
 - **Primary Key:** Default attribute(s) to be used as key.
 - **Alternate Key:** All candidate keys other than primary key.
 - **Foreign Key:** Attributes that take values from another table only.

EXAMPLE – E-COMMERCE DATABASE

Customer	
Key	Customer_ID
	FirstName
	LastName
	Street
	City
	Zip
Key	Phone

Order	
PK	Order_number
	Customer_ID
	Customer_name
	To_street
	To_city
	To-state
	To-zip
	Ship_date

Product	
Key	Product_ID
	Quantity
	Product_type

Attributes

YOUR TURN

- Identify any entities, attributes and relations in each case:
 - Author / book
 - Business / employees / departments.
 - Doctor / patient / treatment.
 - Bank / card owner / bank card.

CARDINALITY CONSTRAINTS

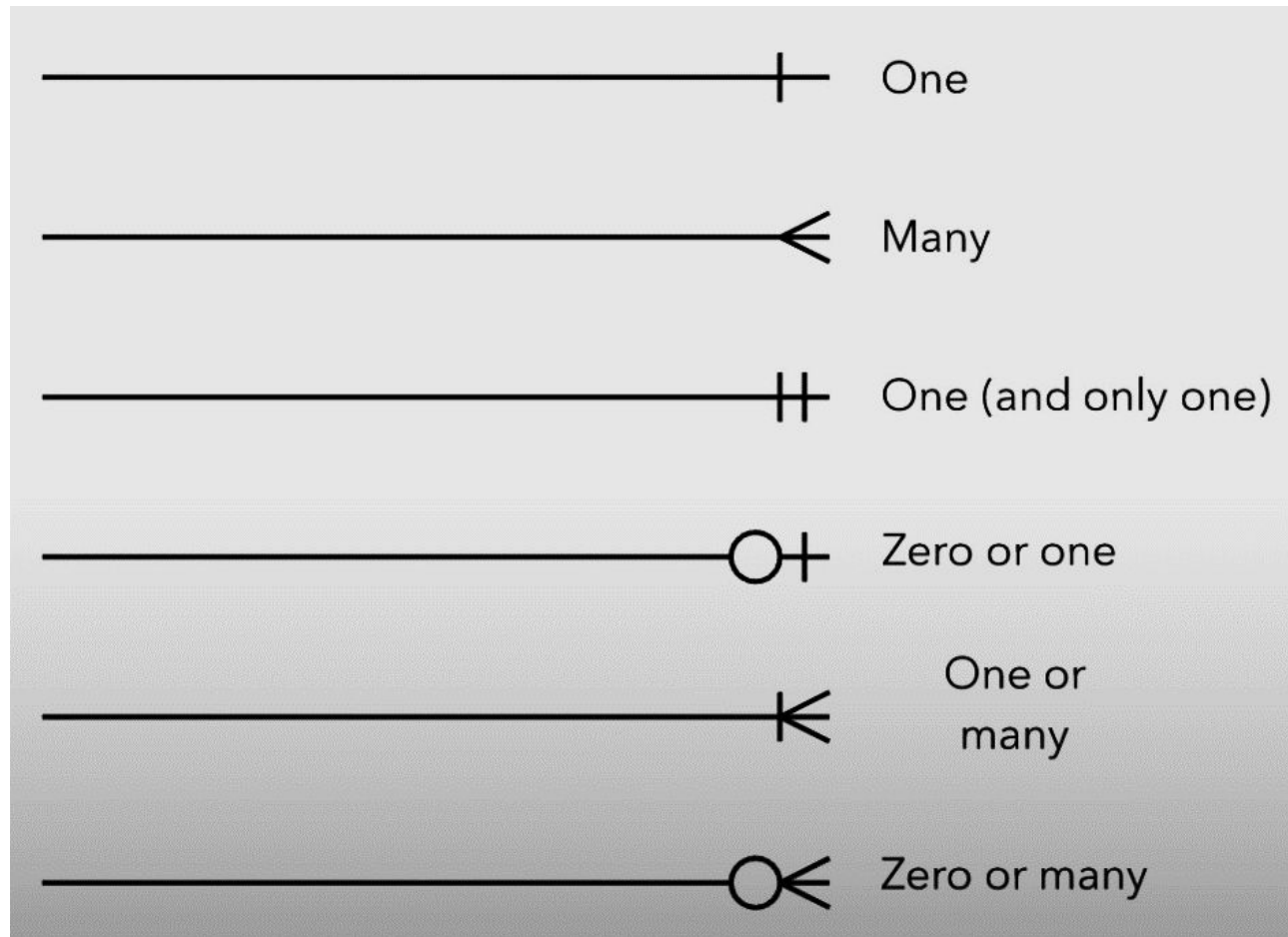
SETTING MIN / MAX LIMITS TO ENTITY RELATIONS

- Max cardinality tells the maximum number of connected entities a single entity may have.
 - E.g. A customer entity may have **one to many** orders.
 - E.g. An order must be placed by **one and only one** customer.

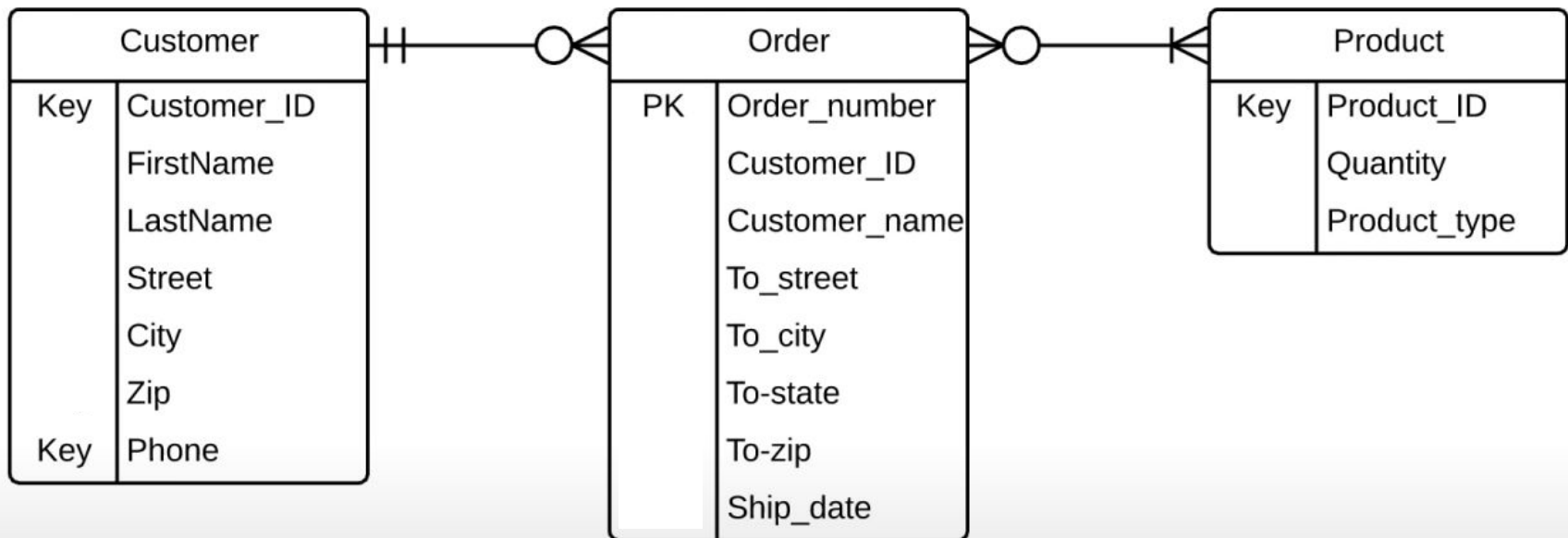
SETTING MIN / MAX LIMITS TO ENTITY RELATIONS

- Cardinality participation tells the minimum number of connected entities a single entity may have.
 - E.g. A customer entity may have **one to many** orders.
 - E.g. An order must be placed by **one and only one** customer.

CROW'S FOOT NOTATION



EXAMPLE – E-COMMERCE DATABASE



ER DIAGRAMS

FLOW-CHARTS TO VISUALIZE THE DATABASE SCHEMA

- A graphical flow-chart to visualize all entities, their attributes and how they are related to each other in the data model.
- Allows designers to **design, debug and share** schema plans.

DESIGN BEFORE IMPLEMENTING!

WHY NOT BUILD DIRECTLY?

ER DIAGRAM SYMBOLS & NOTATIONS



Entity



Attribute



Relationship



**Weak
Entity**



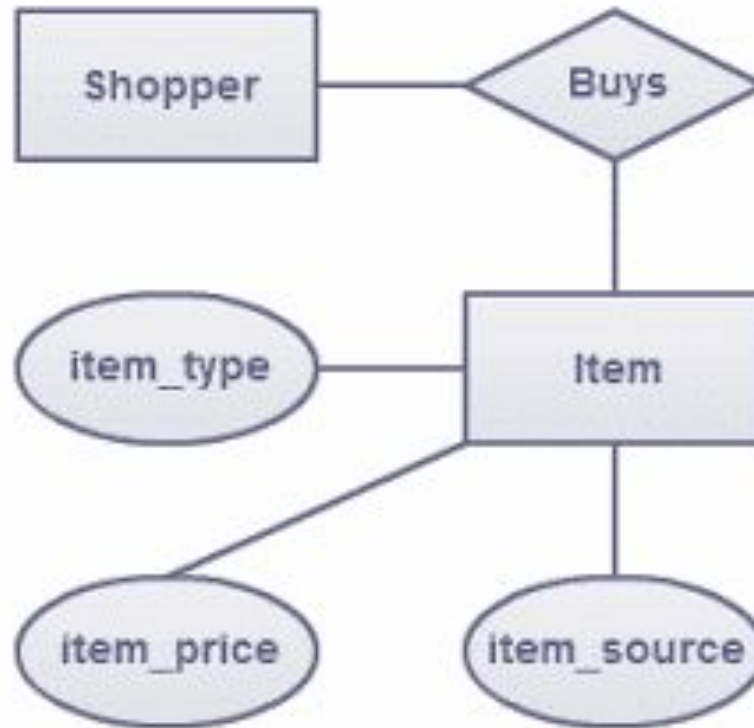
**Multivalued
Attribute**



**Weak
Relationship**

EXAMPLE – E-COMMERCE DATABASE

- Complete the diagram below:



YOUR TURN

- Create ER diagrams for each of the following cases:
 - Author / book
 - Business / employees / departments.
 - Doctor / patient / treatment.
 - Bank / card owner / bank card.