

## ❖ What is an Entity Relationship Diagram (ERD)?

- After gathering the requirements, we start converting these lines into a diagram.
- Way of modelling
- While you read the requirement lines, try to identify the **main components**.
- ✓ **Entities:** Any important objects inside the system that I need to store data about it , it could be:
  - **person/role:** (e.g. Student, employee, Doctor, Teacher)
  - **object:** (e.g. Invoice, Product, Vehicle, Book)
  - **concept:** abstract ideas or categories important to a system (e.g. Profile or account) → (username, password). (e.g. Permission) → Represents access rights or privileges granted to users in a system (Attributes could include permission type (read, write, delete), description, and associated roles).
  - **Event:** (e.g. Transaction) → transaction ID, amount, date. (e.g. Appointment, Login Attempt, Payment, booking, Registration, sale)
- ✓ **Attributes:** column, an attribute is a property or characteristic of the entity that holds it, **THERE IS NO ENTITY WITH NO ATTRIBUTES!!!**
- ✓ **Relationship:** Links between the entities (**Between ENTITY and Another**) **PK -FK , THERE IS NO RELATION BETWEEN ATTRIBUTES OR BETWEEN ATTRIBUTES AND ENTITY 😊 !!!**
- ✓ **In ERD there is no data and FK ( this will see on DB Mapping).**



**Entity Name**

**Entity**

Person, place, object, event or concept about which data is to be maintained

**Example:** Car, Student



**Attribute Name**

**Attribute**

Property or characteristic of an entity

**Example:** Color of car Entity Name of Student Entity

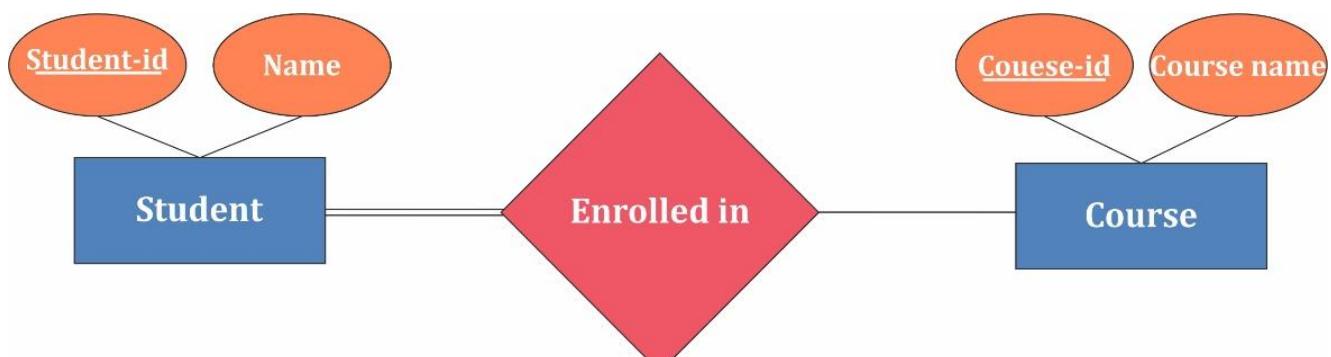


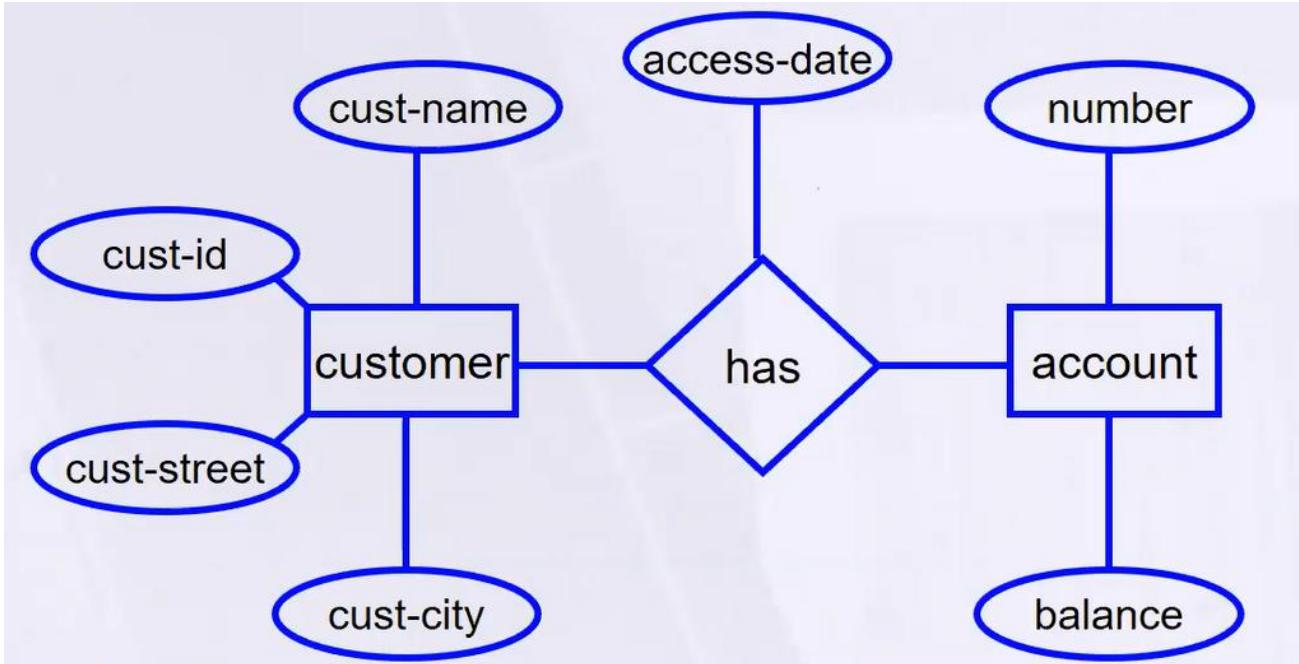
**Relation**



Association between the instances of one or more entity types

**Example:** Blue Car Belongs to Student Jack





We say that attribute is a property or characteristic of the entity, I can see in this diagram that we have attribute on the relationship!!

Do not ask where I can put this attribute later in database??!

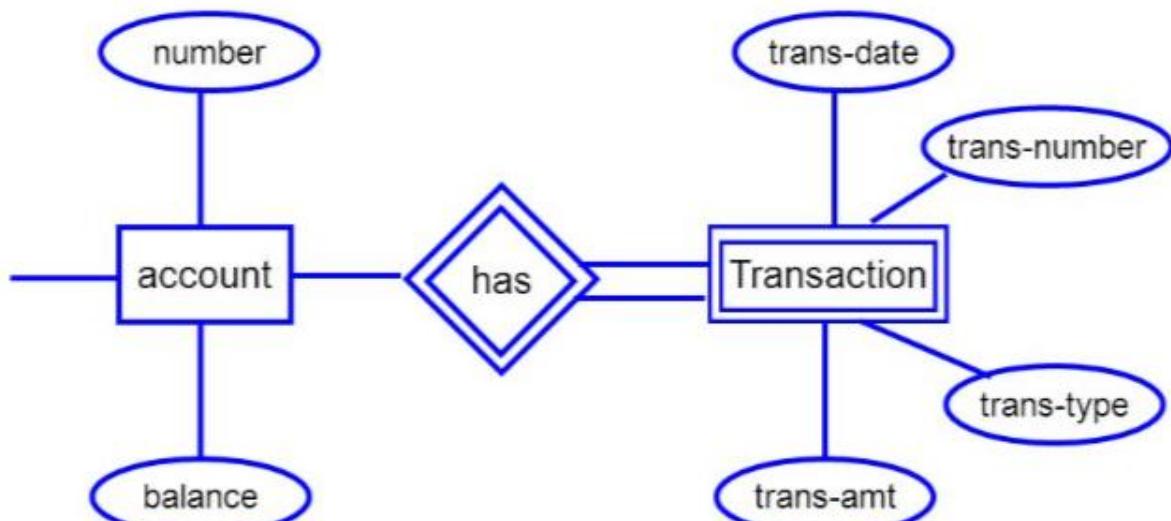
- This attribute is shared among them.
- Same as (Student and Course) → where can I put the grade of the student? its shared between them so we will write it on the relationship.
- Number of hours the employee worked on a specific project ( Employee and Project) → number of hours is attribute on the relationship.

## ❖ Let's learn more about a Strong entity VS Weak Entity



- ✓ we have this example here, "If an employee is dismissed from a specific department, will that department be closed?" No !
- ✓ "Or vice versa, "if I close a specific department, does that mean I am dismissing the employees?" No !
- ✓ Yes, there is a relationship, but it hasn't reached the level where deleting a row from one table would affect the other table. So this is **Strong entity (Employee, Department).**

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- ✓ **Weak Entities:** It is the Entity which existence in the system can disappear with the disappearance of another entity.
  - ✓ ممكن تختفي بسبب اختفاء وحدة ثانية



- ✓ **For example:** (شخص يستخدم بطاقة للسحب والإيداع) A person with their credit card uses it to withdraw and deposit money. *If they go to the bank to cancel the credit card, is there a need to store the transactions that were made with the credit card?* No! So, **Transaction is weak entity**
- ✓ **If the account disappears → Transaction will disappear also.**
- ✓ **Another example:** Courses and the labs, if the courses disappeared the labs will automatically disappear.
- ✓ **Another example:** The employee's insurance is cancelled if the employee resigns
- ✓ Every strong entity has → PK
- ✓ Weak entity has → Partial key (البراهيمي كي يطلق عليه partial) → مفتاح جزئي لأنه بعدين ما يصير يكون مفتاح أساسى لأنها ضعيفة

Strong entity	Weak Entity
Strong entity set always has a primary key.	It does not have enough attributes to build a primary key.
It is represented by a rectangle symbol.	It is represented by a double rectangle symbol.
It contains a Primary key represented by the underline symbol.	<p>It contains a Partial Key which is represented by a dashed underline symbol.</p> <p>In a weak entity set, it is a combination of primary key (account number) and partial key (transaction number).</p>

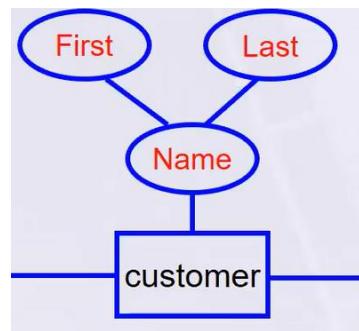
## ❖ Types of Attributes 😊

There are different types of attributes as discussed below:

- **Composite Attribute**
  - **Multi-Valued Attribute**
  - **Derived Attribute**
  - **Complex Attribute**
  - **Simple Attribute**
- 

- **Simple Attribute**

If this attribute is ***not divisible, not calculated at runtime, not repeated*** for the same person. E.g. → city (muscat) → ينبع  
الجزء المسلط؟!

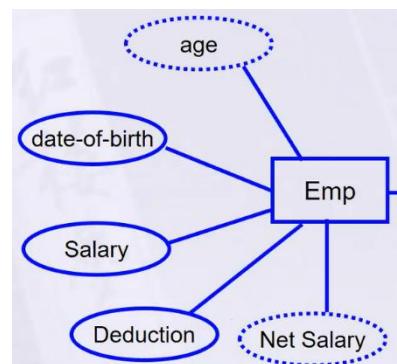


- **Example:** City, roll number of a student, the ID number of an employee, gender, name) Is it possible to create an equation to calculate the name?) , but if mention (First, Last name)→  
**Composite Attribute**

- **Derived Attribute**

Something ***calculated at runtime***, something I can derive from another thing. And it is represented by dotted oval shape.

**Example:** We have **birthday**→ I can calculate **age**, **Total and average marks** of a student, **age** of an employee that is derived from date of birth.

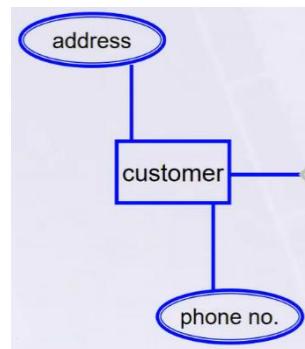


- **Multi-Valued Attribute**

Something that is **repeated** for the same person.

And it is represented by **double oval shape**.

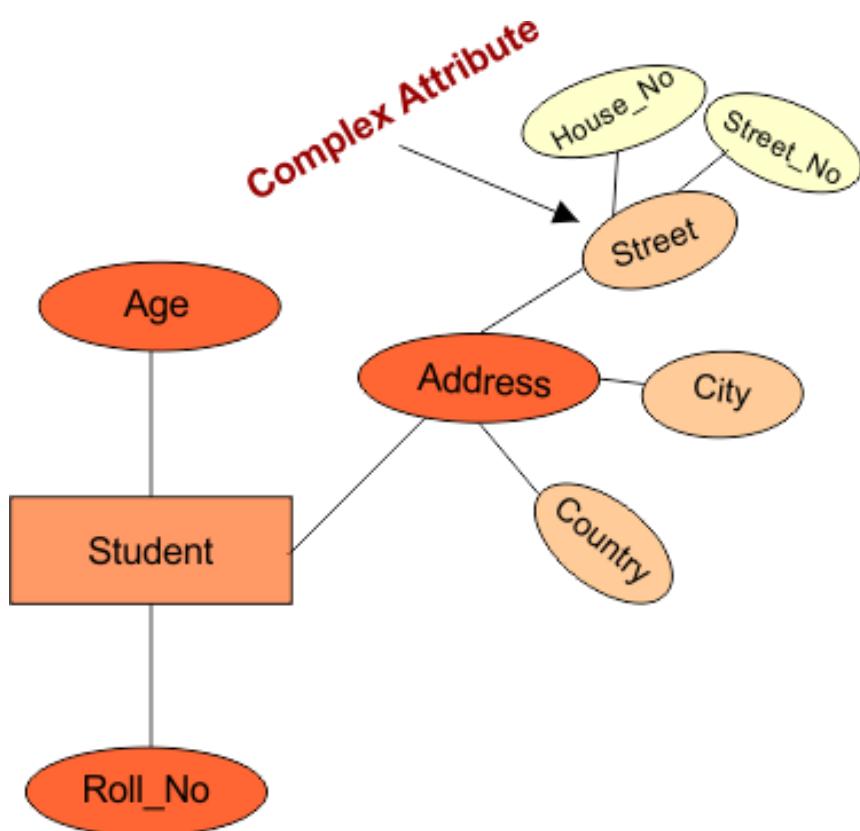
**Example:** Phone number more than one, Address, programmer know more than one lang.



- **Complex Attribute**

Multi-Valued + Composite

**Example:** Address because address contain composite value like street, city, state, PIN code and multivalued because one people has more than one house address.

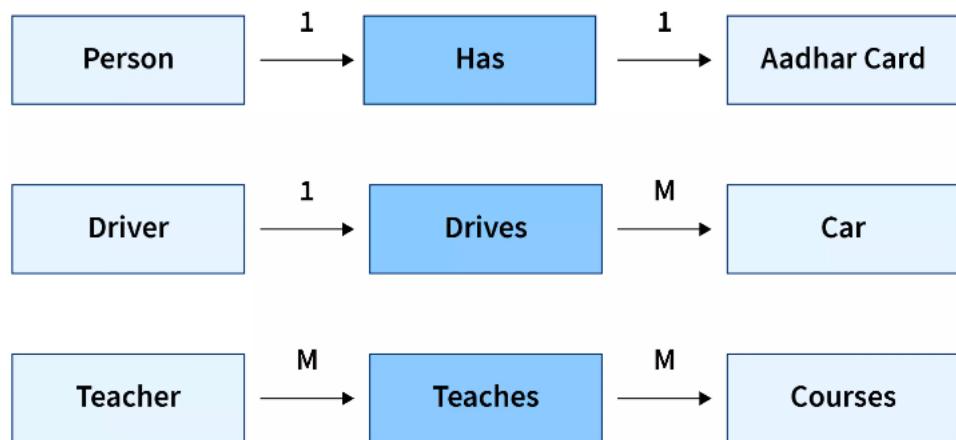


## ❖ What Is Relationship?

When we read the requirements document, we find nouns and verbs

**Nouns:** could be entity or attribute → Student, Course, id, name, grade

**Verbs:** Relationship → own, borrow, has, have, assign, mange, work



## ❖ What are the types Of Relationships? 😊

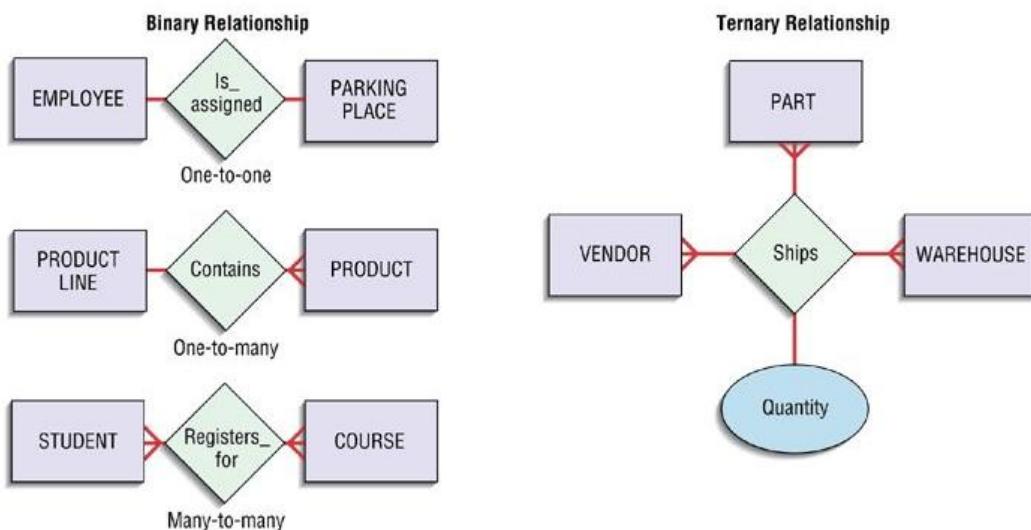
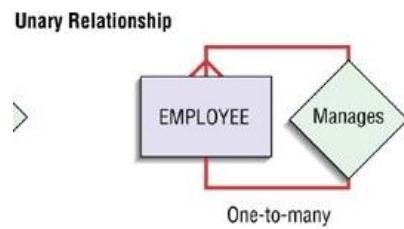
- ✓ Degree of relationship
- ✓ Cardinality constraint
- ✓ Participation constraint

## ➤ Degree of relationship:

**Degree:** number of entity types that participate in relationship.

- **Unary, Self, Recursive:** between 2 instances of one entity type (e.g. shared attribute Employee (id, name) mange Manger (id, name) → employee could be manger also! So later, we can have one entity. Called (*Employee*)).
- **Binary:** between the instance of 2 entity type *the most common in databases*, no attribute is shared. (e.g. Employee and department, Students and courses, Employees and projects, Department and instructors, nurse and patient).
- **Ternary:** among the instance of 3,4 or 5 entities type.

There is a specific attribute that combine three entities. (e.g. Course teaches by number of teacher (Fatma and Karim 😊), Teacher, Student) → here Grade will appear but if we said that the course is teach by one teacher → this will be binary.

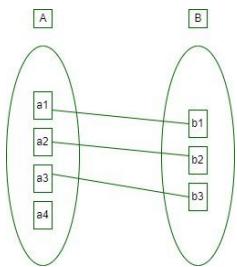


## ➤ Cardinality constraint:

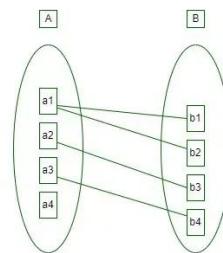
Each row in the first entity is linked to how many rows in the second entity.

كل صف من (الجدول الأول) مرتبط بكم صف من (الجدول الثاني)

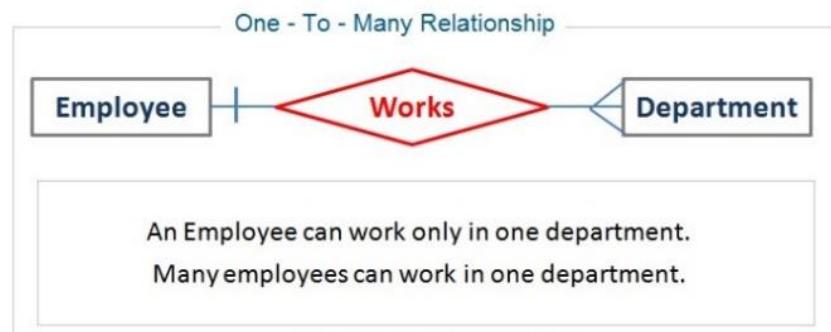
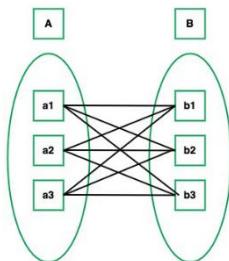
### One-to-One



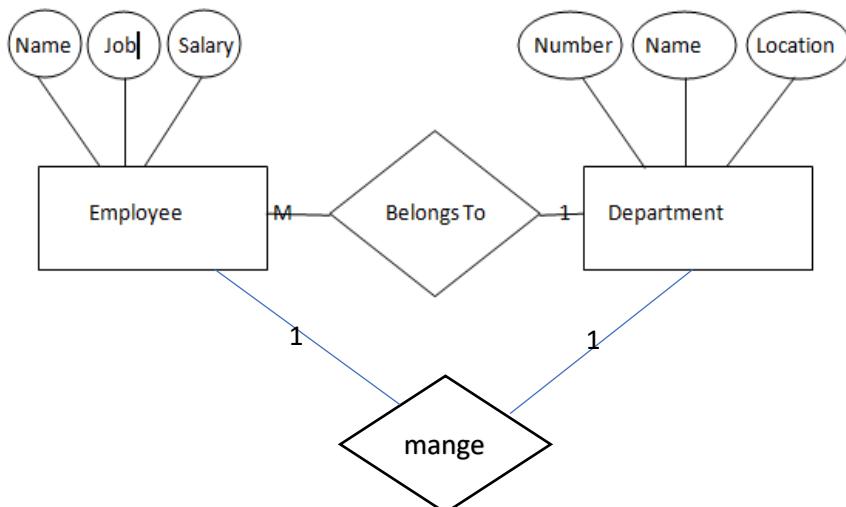
### One-to-Many

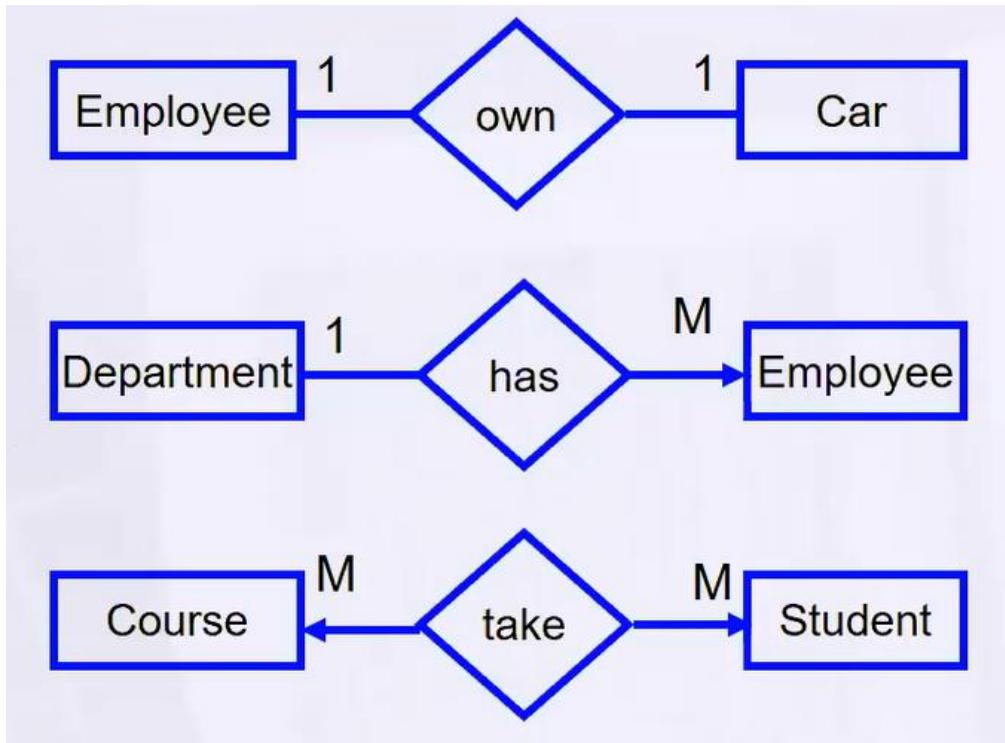


### Many-to-Many



ينفع يكون في علاقتين مع بعض





**Note:** All the cardinality depends on the **business requirement**. If it does not appear in the requirement, ask the System analyst → we can ask our **specialist Kaim 😊** Do not assume the logic by yourself!

**Participation constraint:** يمثل المشاركة من عدمها

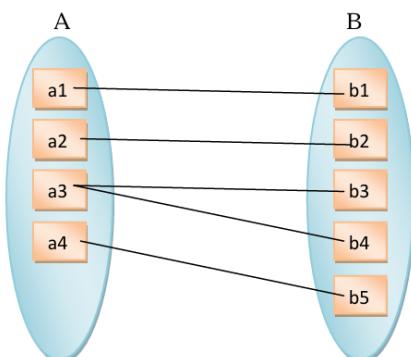
هل كل الصفوف داخله في العلاقة او لا؟!

- ✓ Are all the rows involved in the relationship or not?
- ✓ **For example:** Do all employees must to have a department? If :
- ✓ Optional (*may, some*) → one line
- ✓ Mandatory (*must*) → 2 lines

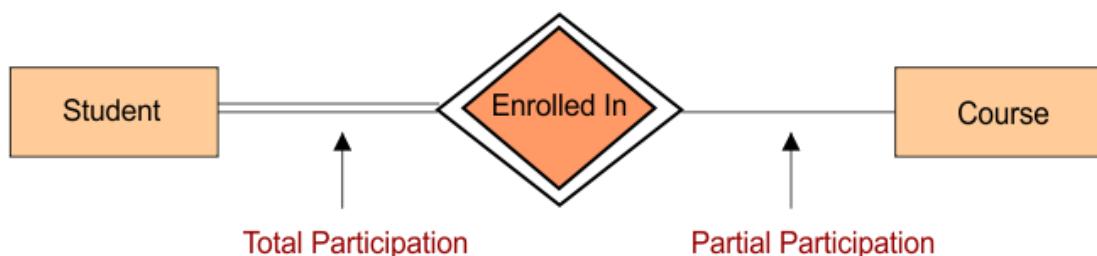
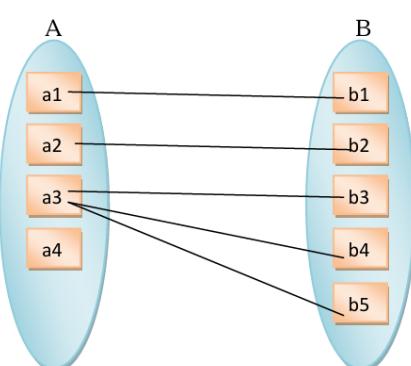
## What is the difference between cardinality and participation?

- In cardinality I will take one row and compare it
- In participation I will take all rows and look if it is inside the relationship or not → لا دخله في العلاقة او لا
- One to many between department and employee → لما اسأل هل القسم ممکن يكون فاضي او لا هذه هي نسميتها المشاركة من عدمها

### Total Participation



### Partial Participation



### ❖ Keys:

- ✓ Primary Key
- ✓ Candidate Key
- ✓ Foreign Key (we will explain it later 😊)
- ✓ Composite Key
- ✓ Partial Key => for the weak entity
- ✓ Super Key
- ✓ Alternate Key
- ✓ Artificial Key ... your job is to search about it there are more than this! 😊

- There are many attributes, and you want to choose the PK, before you choose the PK you must first **determine candidate Key**.
- **What is the candidate key?** The one that could be PK you choose the suitable one.
- **ID → PK** with underline.
- Assume that I don't have ID, so we will go with composite PK (name, address together) اعمل تبادل وتوافق بينهم للاختيار 😊
- If all the composite is not suitable then we set one PK.

## SUMMARY OF ER-DIAGRAM NOTATION FOR ER SCHEMAS

<u>Symbol</u>	<u>Meaning</u>
	ENTITY TYPE
	WEAK ENTITY TYPE
	RELATIONSHIP TYPE
	IDENTIFYING RELATIONSHIP TYPE
	ATTRIBUTE
	KEY ATTRIBUTE
	MULTIVALUED ATTRIBUTE
	COMPOSITE ATTRIBUTE
	DERIVED ATTRIBUTE
	TOTAL PARTICIPATION OF E <sub>2</sub> IN R
	CARDINALITY RATIO 1:N FOR E <sub>1</sub> :E <sub>2</sub> IN R
	STRUCTURAL CONSTRAINT (min, max) ON PARTICIPATION OF E IN R