

Database Design – ER Modeling

Entity Relationship Diagrams (ERD)

An Entity Relationship Diagram (ERD) is a graphical representation of an organization's data storage requirements.

ERD's are used to:

- Identify the data that must be captured, stored and retrieved in order to support the business activities performed by an organization.
- Identify the data required to derive and report on the performance measures that an organization should be monitoring.
- Show the relationships which exist between the entities in a relational database.

ER modeling is based on artifacts, which can be either a representation of physical artifacts, such as Product or Employee, or a representation of a transaction between artifacts, such as Order or Delivery. Each artifact contains information about itself. ER modeling also focuses on relationships between artifacts. These relationships can be either binary, connecting two artifacts, or ternary, among several artifacts.

The four essential elements of ER modeling are;

1. Entities
2. Attributes of Entities
3. Relationships
4. Attributes of Relationships

Entities

An entity is a set of artifacts with the same structure and independent existence within the enterprise. Examples of entities would be Employee or Product.

Attributes

The structure of an entity is defined with attributes. An attribute can be seen as a property of an entity. Attributes of an Employee might be Name, Address, D.O.B. etc.

Relationships

While entities describe independent artifacts, relationships describe meaningful association between entities. It is important to understand that although we defined a relationship, this does not mean that every pair of entity occurrences builds a relationship. A relationship defines the associations that can occur.

Attributes of Relationships

Relationships can also contain attributes. For example, the relationship “services” between the employee and equipment could contain attributes date and status, which identifies the date of the service and the status of the equipment after the service is done. These attributes are contained in **association** or **bridge** classes, which we will discuss later.

ERD – UML Notation

UML

The Unified Modeling Language (UML) is a widely accepted language used by analysts and software developers that is an excellent fit for the graphic representation of ER diagrams. By using UML, development teams gain significant benefits, including easier communication between team members.

UML Relationship Structure

The following shows how the relationship between entities can be depicted using UML notation.

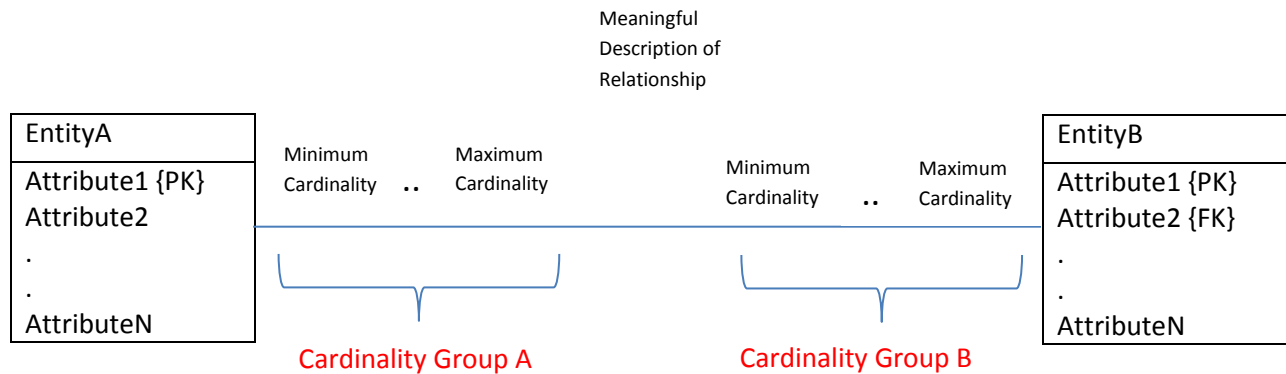


Figure 1

Notes

1. PK identifies the attribute(s) which represent the primary key of the relation.
2. FK identifies the attribute(s) which represent the foreign key(s) of the relation. THIS IS OPTIONAL SINCE ALL RELATIONS DO NOT CONTAIN FOREIGN KEYS.

Cardinality

Cardinality expresses specific values of connectivity. It specifies how many instances of an entity relate to one instance of another entity.

In Figure 1,

- Cardinality Group A is referred to as the cardinalities going **from EntityB to EntityA** and this represents the minimum and maximum of instances of Entity A related to **one** instance of Entity B.
- Cardinality Group B is referred to as the cardinalities going **from EntityA to EntityB** and this represents the minimum and maximum of instances of Entity B related to **one** instance of Entity A.

The minimum and maximum cardinality can be one of three values.

1. Zero (0)
2. One (1)
3. Many (*)

Example

Consider the following relational schema.

Department (DeptNo, DName, Loc)

Employee (EmpNo, DeptNo, FName, LName, HireDate, Sal, Address)

The ERD for the above relational schema will be as follows;



Describing the above relationship

The cardinalities going from Department to Employee can be interpreted as follows;

Minimum: **1** – Each department employs at least **one** employee.

Maximum: ***** - A department can employ **many** employees.

The cardinalities going from Department to Employee can be interpreted as follows;

Minimum: **0** – An employee can be employed in zero departments (E.g. the president)

Maximum: **1** – An employee is employed in at most **one** department.