

Entity Relationship Model

by Sophia



WHAT'S COVERED

This lesson explores the entity-relationship diagram with Chen, crow's foot, and UML notation, in four parts. Specifically, this lesson will cover:

1. Three Notation Styles
2. Chen Notation
 - 2a. Cardinality
 - 2b. Using Chen Notation to Show Cardinality
3. Crow's Foot Notation
4. UML Notation

1. Three Notation Styles

The **entity-relationship diagram (ERD)** represents the relationships between entities (objects or concepts) in a database or system. ERDs provide a clear and concise view of data structure and help organize and flow data. We basically draw out the entire database—all the tables, their keys, and the relationships between the tables, including how they work and what is in them. It is sometimes referred to as an entity-relationship model (ERM).

As a simple example, let's explore how an ERD might express the relationships between entities in a university information system. Students, courses, and instructors are the main entities in the system. Students have attributes such as their StudentID, StudentName, Address, and EmailAddress. The Course entity has attributes such as CourseID, Title, and CreditHours, while the Instructor entity has attributes such as the InstructorID, InstructorName, and Office.

Relationships between entities are illustrated through lines. Using the Enrollment relationship, the Student entity is related to the Course entity, representing that a student can enroll in multiple courses. Instructor and Course entities also have a "Teaching" relationship, which indicates that an instructor can teach multiple courses, while several instructors can teach a course. Relationships like this are portrayed as many-to-many.

Many-to-many relationships are handled using **associative entities**—in other words, additional entities that exist only in order to associate data in one entity with data in another. In addition to capturing enrollment date and

grade, the Enrollment entity represents the relationship between a Student and a Course. Teaching Assignments are associative entities between Instructors and Courses, storing details such as teaching assignment IDs and semesters.

ERDs provide a clear visual representation of university information system entities, attributes, and relationships. By providing stakeholders with a better understanding of the structure and relationships of the data, an ERD assists in system design and database creation, and ensures that student information is managed efficiently. As a result, instructors, students, and courses can be better managed.

There are three commonly used notation systems for representing relationships in an ERD:

- **Chen notation:** Chen notation is used to help illustrate modeling concepts and is a great notation to use when performing the initial design. However, it can get messy quickly, as more relationships, entities, and attributes are added.
- **Crow's foot:** Crow's foot notation is the most widely used standard for diagramming relationships.
- **UML class diagram notation:** UML class diagram notation is used for object-oriented or object/relational databases.



TERMS TO KNOW

Associative Entity

An entity that exists only to associate data in one entity with data in another.

Entity-Relationship Diagram (ERD)

Used to visualize the relationships among entities (objects or concepts) in a system or database, as well as their structure, attributes, and interactions.

2. Chen Notation

Chen notation is a graphical representation technique widely used in entity-relationship modeling that emphasizes the clear and concise depiction of entities, relationships, and attributes. A rectangle represents an entity, a relationship is a diamond, and a line connects entities and relationships. It emphasizes cardinality and participation constraints as a means of conveying the nature and degree of relationships between entities. In addition, Chen notation provides a comprehensive overview of the data structure by depicting entity attributes within entity rectangles. Chen notation simplifies understanding complex data models through intuitive symbols and emphasizes relationships.



TERM TO KNOW

Chen Notation

A visual representation technique for entity-relationship modeling that uses rectangles to represent entities, diamonds for relationships, and lines to represent cardinality and participation constraints.

2a. Cardinality

The concept of **cardinality** describes the numerical relationship between entities in a relationship. This term refers to the relationship between occurrences or instances of one entity and occurrences or instances of another entity.

Types of Cardinality:

1. **One-to-One (1:1) Cardinality:** It indicates that one instance of an entity is associated with exactly one instance of another entity. For example, in a database of employees and their unique employee IDs, each employee would have a unique ID, and the relationship between the employee and the ID would be one-to-one.
2. **One-to-Many (1:N) Cardinality:** It signifies that one instance of an entity is associated with multiple instances of another entity. For instance, in a database of customers and their orders, one customer can have multiple orders, while each order is associated with only one customer.
3. **Many-to-Many (M:N) Cardinality:** It represents a situation where multiple instances of one entity are related to multiple instances of another entity. For example, in a database of students and courses, multiple students can enroll in multiple courses, forming a many-to-many relationship. To represent this relationship in a database, an intermediate table or associative entity is typically introduced.



TERM TO KNOW

Cardinality

The numerical relationship between entities in a relationship. This term refers to the relationship between occurrences or instances of one entity and occurrences or instances of another entity.

2b. Using Chen Notation to Show Cardinality

Chen notation for a one-to-one relationship between table1 and table2 would look like the following:



Chen notation for a one-to-many relationship between table1 and table2 would look like the following:



Chen notation for a many-to-many relationship between table1 and table2 would look like the following:

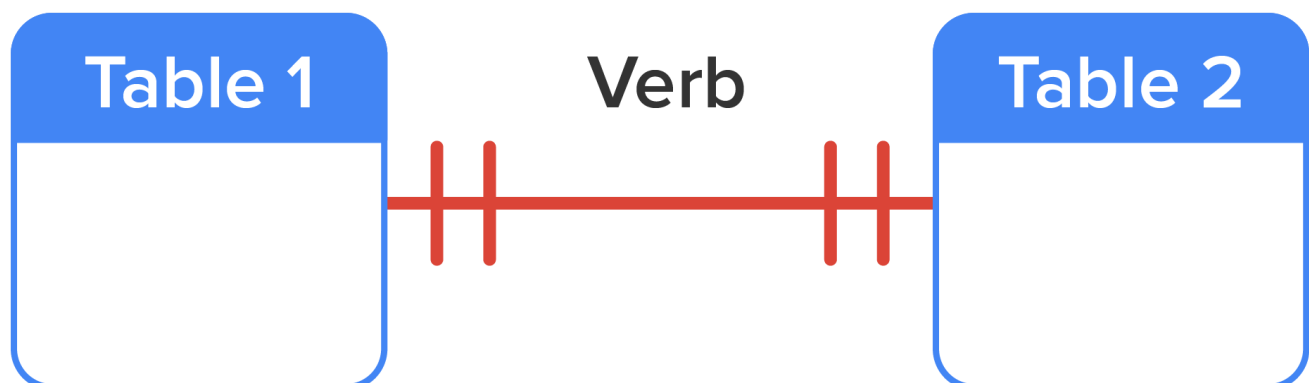


3. Crow's Foot Notation

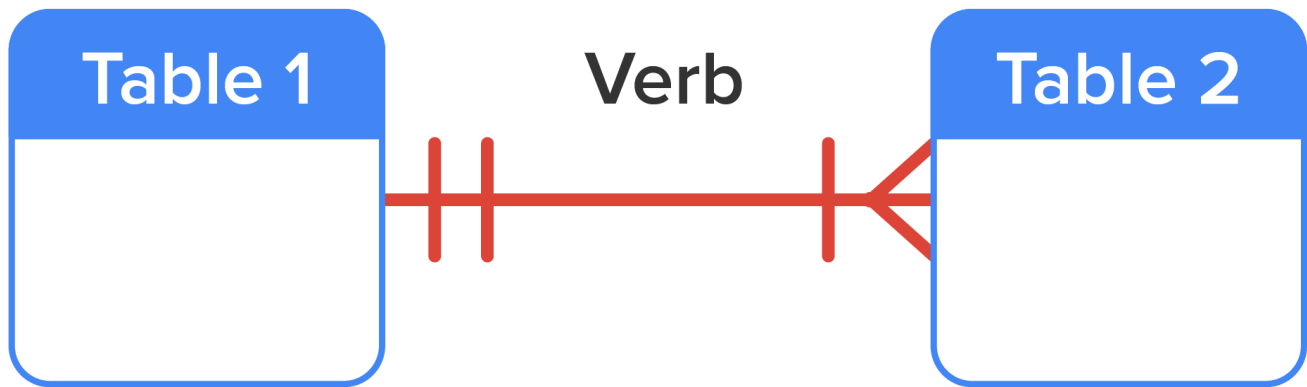
Crow's foot notation is a commonly used graphical representation technique in entity-relationship modeling where various symbols such as crow's feet, lines, and diamonds are used to represent cardinality, relationships, and attributes between entities. A crow's foot symbol (three lines) indicates a "many" side of a relationship, while a straight line indicates a "one" side. Diamonds represent relationships, and associations are represented by lines connecting entities. The data model is also presented with attributes within entity rectangles. As a method of conveying database structure and relationships, crow's foot notation is intuitive and widely adopted.

Crow's foot notation (below) is slightly different from Chen notation in how relationships are identified. In Chen, you have 1:1 or 1:N, whereas in crow's foot, you have lines like -||- for a one-to-one relationship. Notice that the relationship name is placed above the relationship line instead of in a diamond in some cases, but you can use diamonds or names in crow's foot notation. The rectangles contain the table name at the top, and the attributes appear below the table name. The relationship line shows a short bisecting line segment if it is on the "one" side and a crow's foot (two short bisecting lines) if it is on the "many" side.

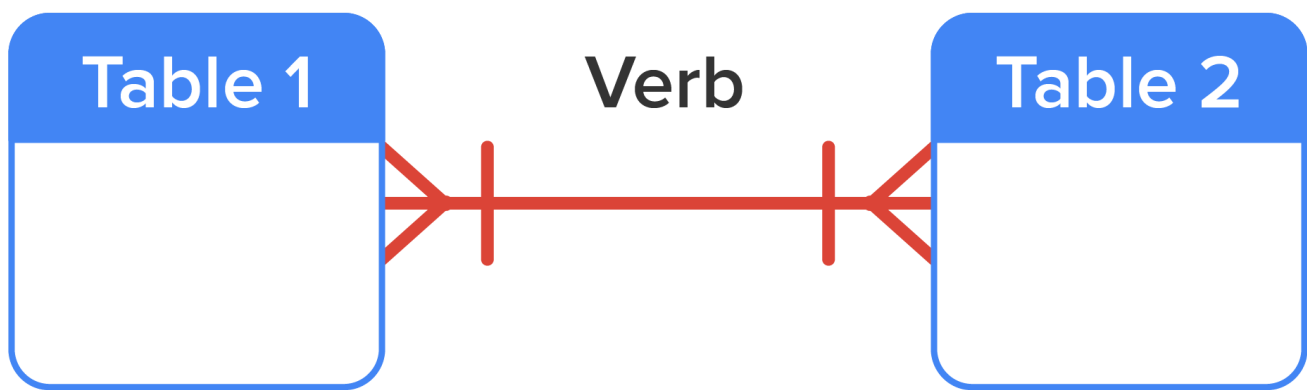
Crow's foot notation for a one-to-one relationship between table1 and table2 would look like the following:



Crow's foot notation for a one-to-many relationship between table1 and table2 would look like the following:



Crow's foot notation for a many-to-many relationship between table1 and table2 would look like the following:



TERM TO KNOW

Crow's Foot Notation

A graphical representation technique that uses various symbols to represent cardinality, relationships, attributes, and relationships between entities, such as crow's feet, lines, and diamonds.

4. UML Notation

Unified Modeling Language (UML) class diagram notation can also be used to visually represent the structure, relationships, and constraints when designing a database system. A UML class diagram represents database entities as classes, with attributes and methods representing the associated data elements and operations. Lines and multiplicity notations indicate the cardinality of associations and relationships between entities. UML notation can easily represent a database's tables, foreign keys, and other database-specific elements. The database schema can be communicated and documented in a standard and intuitive manner, making it easy to understand, develop, and maintain the database system.

A class diagram (below) uses UML notation, which is similar to Chen notation. Notice that the class/entity name is still at the top of the rectangle, with attributes below it (and then methods/functionality below that). The

connectivity is defined along the relationship line with symbols on each side, like 1..1 for one and 1..* for many.

UML class diagram notation for a one-to-one relationship between table1 and table2 would look like the following:



UML class diagram notation for a one-to-many relationship between table1 and table2 would look like the following:



UML class diagram notation for a many-to-many relationship between table1 and table2 would look like the following:





TERM TO KNOW

UML Class Diagram Notation

A notation system that illustrates the structure and relationships among classes in an object-oriented system, showing the attributes, methods, and associations between them.



SUMMARY

In this lesson, you learned that the **three notation styles** of **Chen notation**, **crow's foot notation**, and **UML notation** can all be used to model and represent database structures in PostgreSQL databases. These are the most common notation styles for diagramming relationships between tables, columns and data.

Chen notation is a graphical representation technique in entity-relationship modeling. Entities are represented by rectangles, relationships by diamonds, and participation constraints by lines. Using Chen notation, we can examine the data model holistically and emphasize **cardinality** and relationships between entities.

Another graphical representation technique commonly used in entity-relationship modeling is crow's foot notation. The crow's foot (three lines) depicts cardinality and relationships between entities. The crow's foot notation is intuitive and widely used, making it easy for users to understand and communicate the database structure.

UML notation can also be used to model relationships in databases, particularly in the form of UML class diagrams. Entities are represented as classes with attributes and methods in UML notation. An association represents a relationship between entities, and a multiplicity of notations indicates cardinality. Database models can be standardized and widely recognized using UML notation. This facilitates clear communication and documentation of the database schema.

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TERMS TO KNOW

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Cardinality

The numerical relationship between entities in a relationship. This term refers to the relationship between occurrences or instances of one entity and occurrences or instances of another entity.

Chen Notation

A visual representation technique for entity-relationship modeling that uses rectangles to represent entities, diamonds for relationships, and lines to represent cardinality and participation constraints.

Crow's Foot Notation

A graphical representation technique uses various symbols to represent cardinality, relationships, attributes, and relationships between entities, such as crow's feet, lines, and diamonds.

Entity-Relationship Diagram (ERD)

Used to visualize the relationships among entities (objects or concepts) in a system or database, as well as their structure, attributes, and interactions.

UML Class Diagram Notation

A notation system that illustrates the structure and relationships among classes in an object-oriented system, showing the attributes, methods, and associations between them.