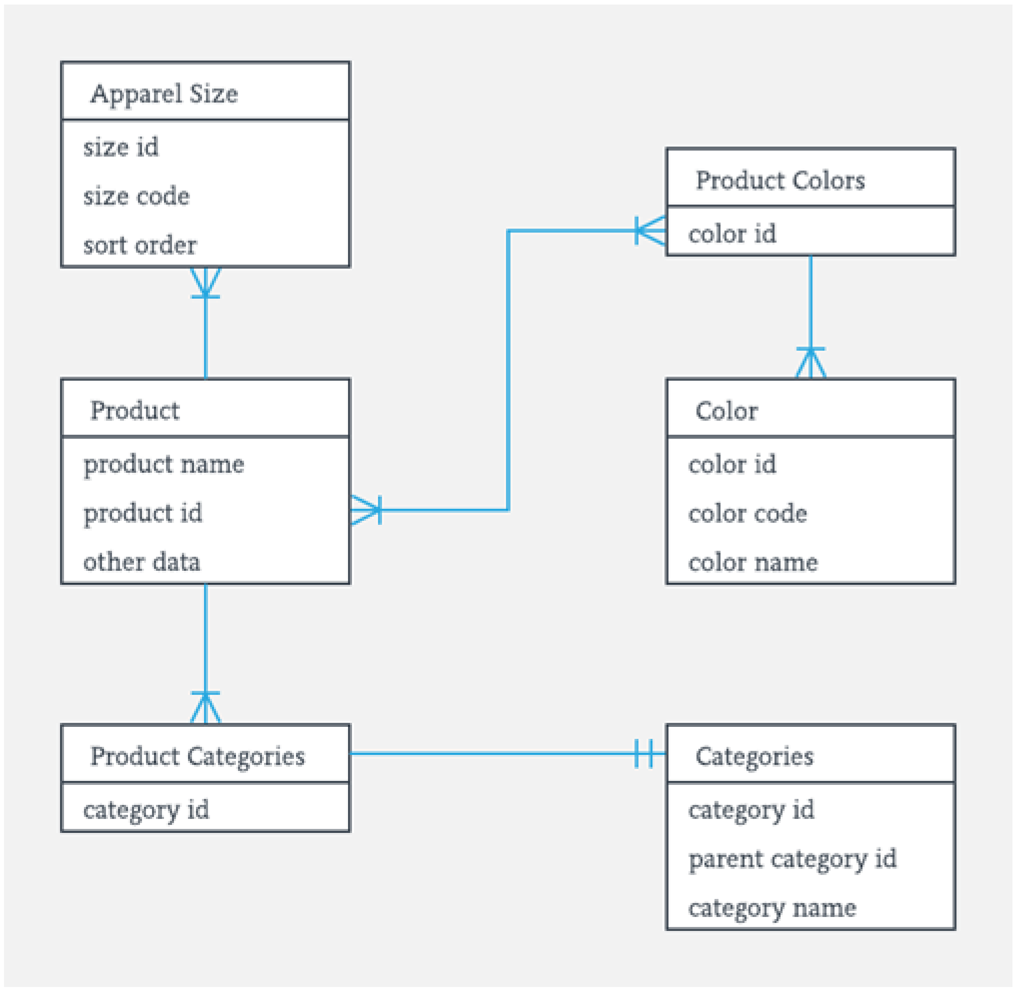
E.R DIAGRAM

Introduction

ER Diagram stands for Entity Relationship Diagram, also known as ERD is a diagram that displays the relationship of entity sets stored in a database. In other words, ER diagrams help to explain the logical structure of databases. ER diagrams are created based on three basic concepts: entities, attributes and relationships.

ER Diagrams contain different symbols that use rectangles to represent entities, ovals to define attributes and diamond shapes to represent relationships.

At first look, an ER diagram looks very similar to the flowchart. However, ER Diagram includes many specialized symbols, and its meanings make this model unique. The purpose of ER Diagram is to represent the entity framework infrastructure.



Entity Relationship Diagram Example

What is ER Model?

ER Model stands for Entity Relationship Model is a high-level conceptual data model diagram. ER model helps to systematically analyze data requirements to produce a well-designed database. The ER Model represents real-world entities and the relationships between them. Creating an ER Model in DBMS is considered as a best practice before implementing your database.

ER Modeling helps you to analyze data requirements systematically to produce a well-designed database. So, it is considered a best practice to complete ER modeling before implementing your database.

In this Entity Relationship Diagram tutorial, you will learn-

- What is ER Diagram?

History of ER models

ER diagrams are visual tools that are helpful to represent the ER model. Peter Chen proposed ER Diagram in 1971 to create a uniform convention that can be used for relational databases and networks. He aimed to use an ER model as a conceptual modeling approach.

Why use ER Diagrams?

Here, are prime reasons for using the ER Diagram

- Helps you to define terms related to entity relationship modeling
- Provide a preview of how all your tables should connect, what fields are going to be on each table
- Helps to describe entities, attributes, relationships
- ER diagrams are translatable into relational tables which allows you to build databases quickly
- ER diagrams can be used by database designers as a blueprint for implementing data in specific software applications
- The database designer gains a better understanding of the information to be contained in the database with the help of ERP diagram
- ERD Diagram allows you to communicate with the logical structure of the database to users

Facts about ER Diagram Model

Now in this ERD Diagram Tutorial, let's check out some interesting facts about ER Diagram Model:

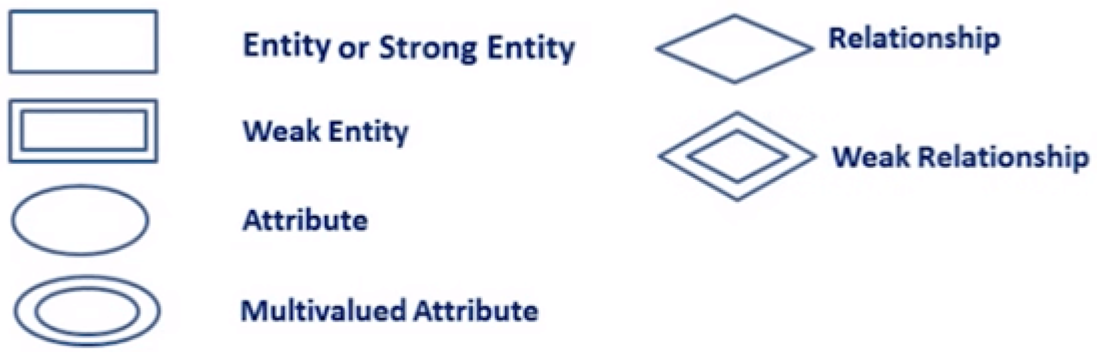
- ER model allows you to draw Database Design
- It is an easy to use graphical tool for modeling data
- Widely used in Database Design
- It is a GUI representation of the logical structure of a Database
- It helps you to identifies the entities which exist in a system and the relationships between those entities

ER Diagrams Symbols & Notations

Entity Relationship Diagram Symbols & Notations mainly contains three basic symbols which are rectangle, oval and diamond to represent relationships between elements, entities and attributes. There are some sub-elements which are based on main elements in ERD Diagram. ER Diagram is a visual representation of data that describes how data is related to each other using different ERD Symbols and Notations.

Following are the main components and its symbols in ER Diagrams:

- **Rectangles:** This Entity Relationship Diagram symbol represents entity types
- **Ellipses :** Symbol represent attributes
- **Diamonds:** This symbol represents relationship types
- **Lines:** It links attributes to entity types and entity types with other relationship types
- **Primary key:** attributes are underlined
- **Double Ellipses:** Represent multi-valued attributes



ER Diagram Symbols

Components of the ER Diagram

This model is based on three basic concepts:

- Entities
- Attributes
- Relationships

ER Diagram Examples

For example, in a University database, we might have entities for Students, Courses, and Lecturers. Students entity can have attributes like Rollno, Name, and DeptID. They might have relationships with Courses and Lecturers.

Components of the ER Diagram

WHAT IS ENTITY?

A real-world thing either living or non-living that is easily recognizable and nonrecognizable. It is anything in the enterprise that is to be represented in our database. It may be a physical thing or simply a fact about the enterprise or an event that happens in the real world.

An entity can be place, person, object, event or a concept, which stores data in the database. The characteristics of entities are must have an attribute, and a unique key. Every entity is made up of some ‘attributes’ which represent that entity.

Examples of entities:

- **Person:** Employee, Student, Patient

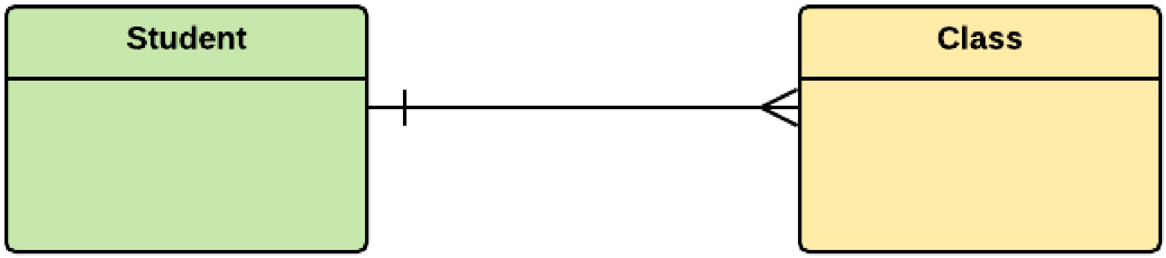
- **Place:** Store, Building
- **Object:** Machine, product, and Car
- **Event:** Sale, Registration, Renewal
- **Concept:** Account, Course

Notation of an Entity

Entity set:

Student

An entity set is a group of similar kind of entities. It may contain entities with attribute sharing similar values. Entities are represented by their properties, which also called attributes. All attributes have their separate values. For example, a student entity may have a name, age, class, as attributes.



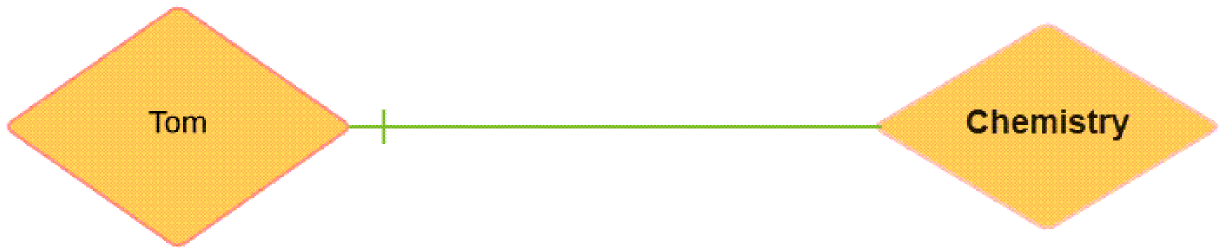
Example of Entities:

A university may have some departments. All these departments employ various lecturers and offer several programs.

Some courses make up each program. Students register in a particular program and enroll in various courses. A lecturer from the specific department takes each course, and each lecturer teaches a various group of students.

Relationship

Relationship is nothing but an association among two or more entities. E.g., Tom works in the Chemistry department.



Entities take part in relationships. We can often identify relationships with verbs or verb phrases.

For example:

- You are attending this lecture
- I am giving the lecture
- Just loke entities, we can classify relationships according to relationship-types:
- A student attends a lecture
- A lecturer is giving a lecture.

Weak Entities

A weak entity is a type of entity which doesn't have its key attribute. It can be identified uniquely by considering the primary key of another entity. For that, weak entity sets need to have participation.

In above ER Diagram examples, "Trans No" is a discriminator within a group of transactions in an ATM.

Let's learn more about a weak entity by comparing it with a Strong Entity

Strong Entity Set	**Weak Entity Set**
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.	It contains a Partial Key which is represented by a dashed underline symbol.

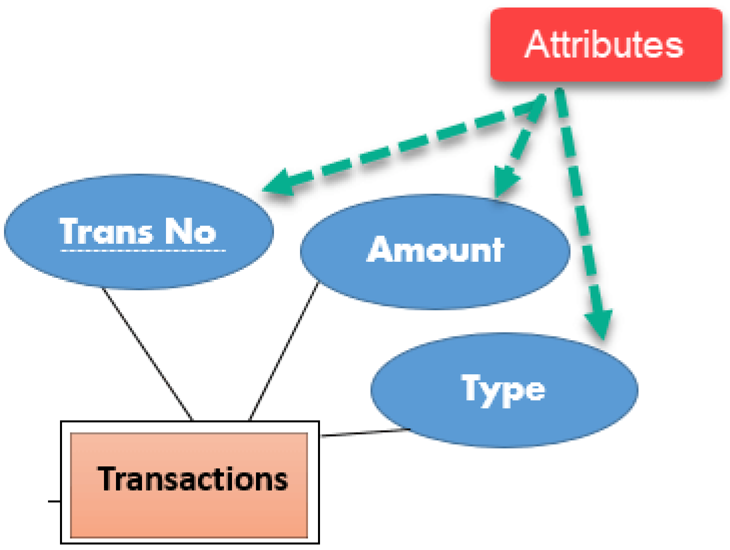
The member of a strong entity set is called as dominant entity set.	The member of a weak entity set called as a subordinate entity set.
Primary Key is one of its attributes which helps to identify its member.	In a weak entity set, it is a combination of primary key and partial key of the strong entity set.
In the ER diagram the relationship between two strong entity set shown by using a diamond symbol.	The relationship between one strong and a weak entity set shown by using the double diamond symbol.
The connecting line of the strong entity set with the relationship is single.	The line connecting the weak entity set for identifying relationship is double.

Attributes

It is a single-valued property of either an entity-type or a relationship-type.

For example, a lecture might have attributes: time, date, duration, place, etc.

An attribute in ER Diagram examples, is represented by an Ellipse



Types of Attributes	Description
Simple attribute	Simple attributes can't be divided any further. For example, a student's contact number. It is also called an atomic value.
Composite attribute	It is possible to break down composite attribute. For example, a student's full

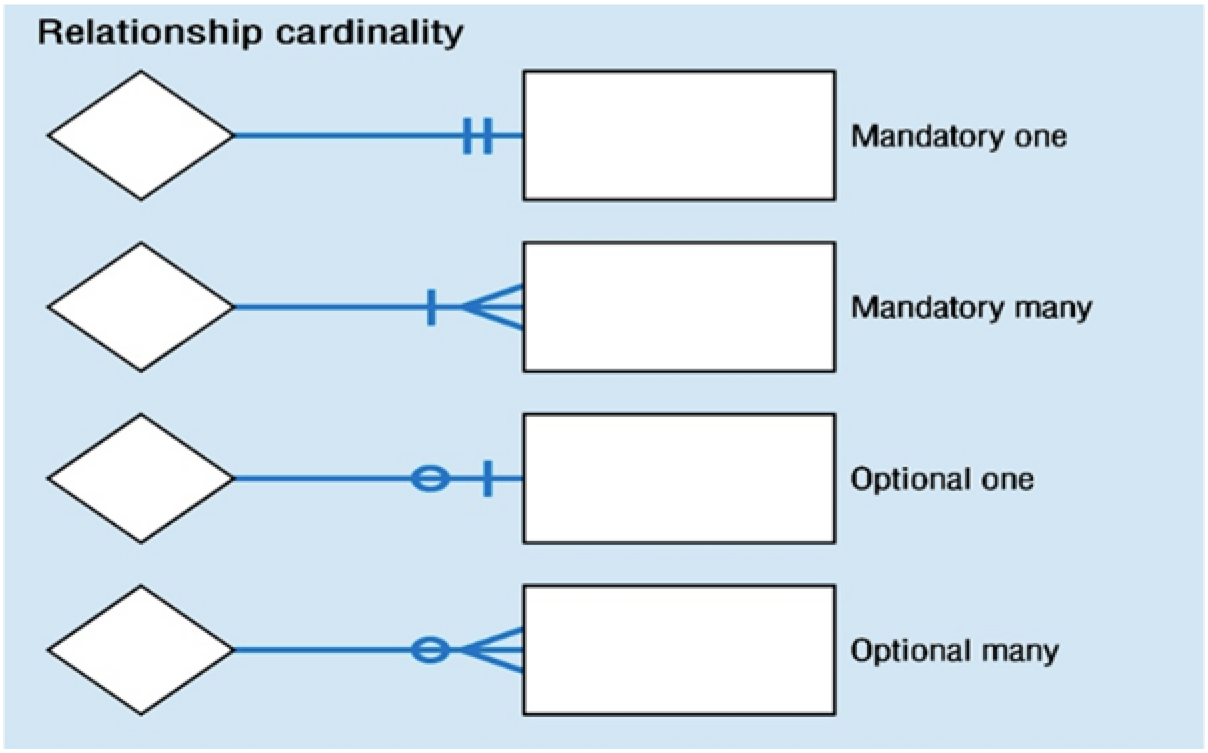
	name may be further divided into first name, second name, and last name.
Derived attribute	This type of attribute does not include in the physical database. However, their values are derived from other attributes present in the database. For example, age should not be stored directly. Instead, it should be derived from the DOB of that employee.
Multivalued attribute	Multivalued attributes can have more than one values. For example, a student can have more than one mobile number, email address, etc.

Cardinality

Defines the numerical attributes of the relationship between two entities or entity sets.

Different types of cardinal relationships are:

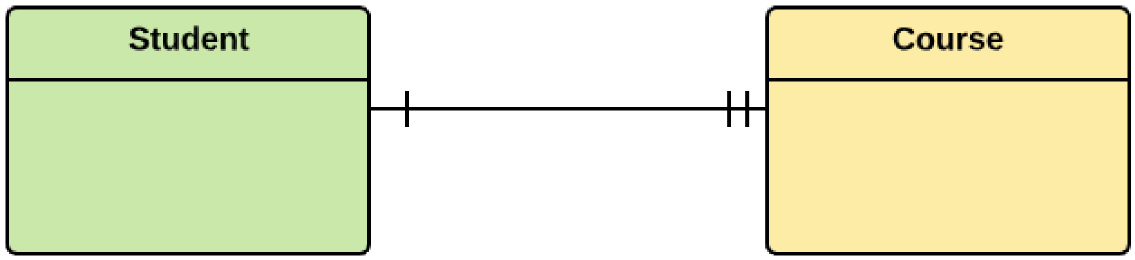
- One-to-One Relationships
- One-to-Many Relationships
- May to One Relationships
- Many-to-Many Relationships



1.One-to-one:

One entity from entity set X can be associated with at most one entity of entity set Y and vice versa.

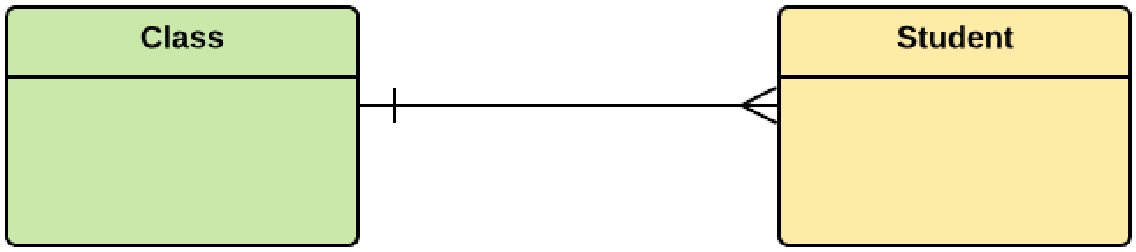
Example: One student can register for numerous courses. However, all those courses have a single line back to that one student.



2.One-to-many:

One entity from entity set X can be associated with multiple entities of entity set Y, but an entity from entity set Y can be associated with at least one entity.

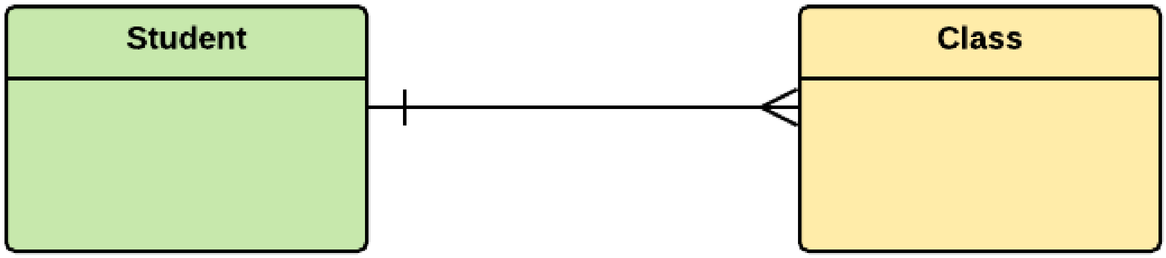
For example, one class is consisting of multiple students.



3. Many to One

More than one entity from entity set X can be associated with at most one entity of entity set Y. However, an entity from entity set Y may or may not be associated with more than one entity from entity set X.

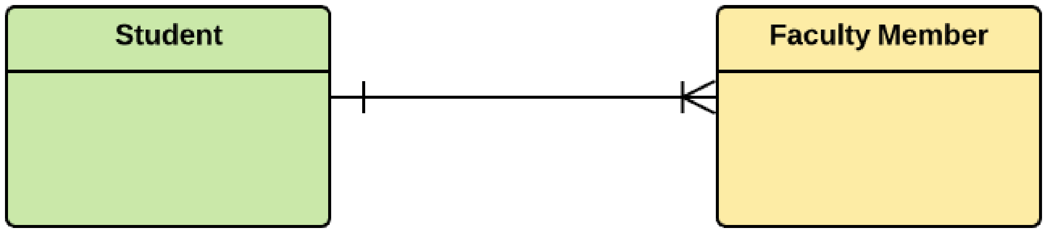
For example, many students belong to the same class.



4. Many to Many:

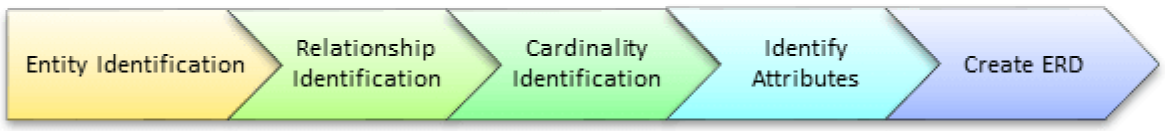
One entity from X can be associated with more than one entity from Y and vice versa.

For example, Students as a group are associated with multiple faculty members, and faculty members can be associated with multiple students.



How to Create an Entity Relationship Diagram (ERD)

Now in this ERD Diagram Tutorial, we will learn how to create an ER Diagram. Following are the steps to create an ER Diagram:



Steps to Create an ER Diagram

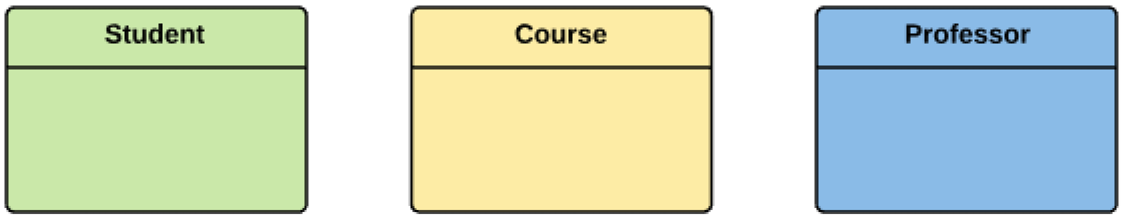
Let’s study them with an Entity Relationship Diagram Example:

```
In a university, a Student enrolls in Courses. A student must
be assigned to at least one or more Courses. Each course is
taught by a single Professor. To maintain instruction quality,
a Professor can deliver only one course
```

Step 1) Entity Identification

We have three entities

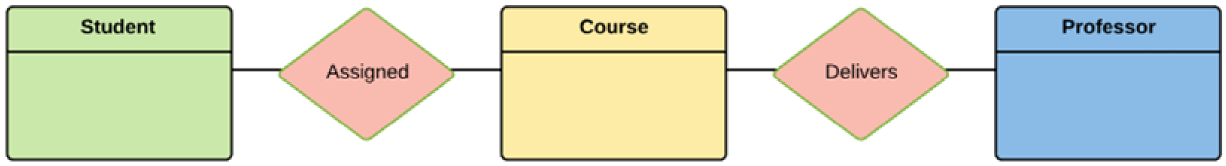
- Student
- Course
- Professor



Step 2) Relationship Identification

We have the following two relationships

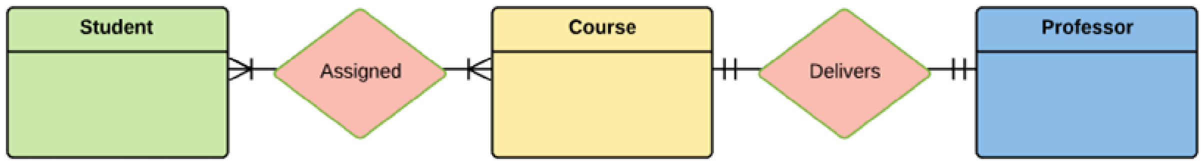
- The student is **assigned** a course
- Professor **delivers** a course



Step 3) Cardinality Identification

For them problem statement we know that,

- A student can be assigned **multiple** courses
- A Professor can deliver only **one** course



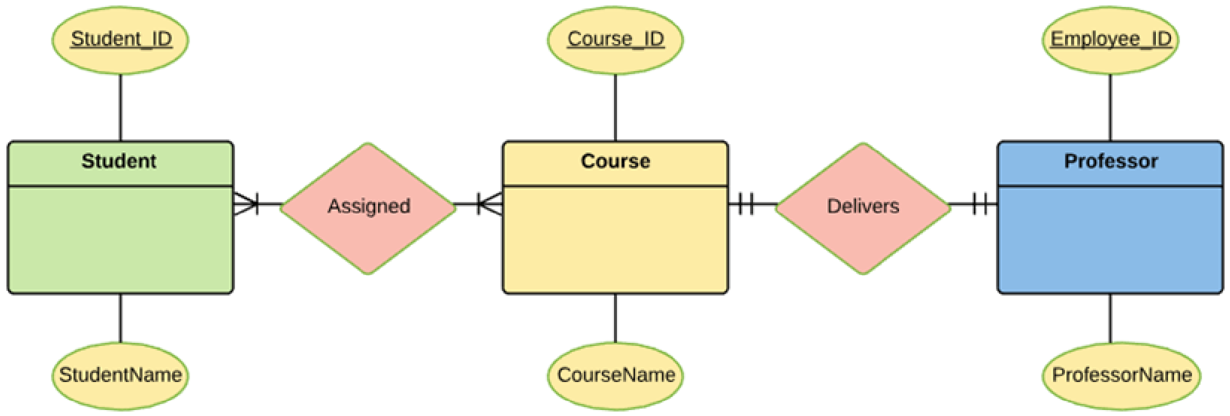
Step 4) Identify Attributes

You need to study the files, forms, reports, data currently maintained by the organization to identify attributes. You can also conduct interviews with various stakeholders to identify entities. Initially, it's important to identify the attributes without mapping them to a particular entity.

Once, you have a list of Attributes, you need to map them to the identified entities. Ensure an attribute is to be paired with exactly one entity. If you think an attribute should belong to more than one entity, use a modifier to make it unique.

Once the mapping is done, identify the primary Keys. If a unique key is not readily available, create one.

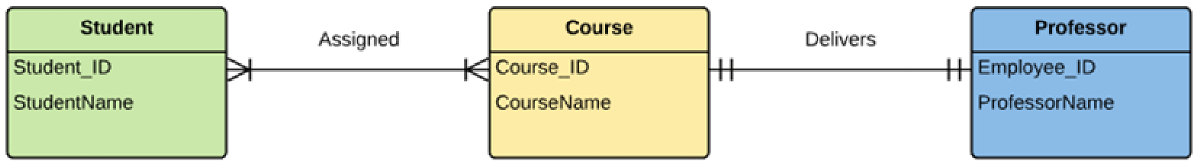
Entity	**Primary Key**	**Attribute**
Student	Student_ID	StudentName
Professor	Employee_ID	ProfessorName
Course	Course_ID	CourseName



For Course Entity, attributes could be Duration, Credits, Assignments, etc. For the sake of ease we have considered just one attribute.

Step 5) Create the ERD Diagram

A more modern representation of Entity Relationship Diagram Example



Best Practices for Developing Effective ER Diagrams

Here are some best practice or example for Developing Effective ER Diagrams.

- Eliminate any redundant entities or relationships
- You need to make sure that all your entities and relationships are properly labeled
- There may be various valid approaches to an ER diagram. You need to make sure that the ER diagram supports all the data you need to store
- You should assure that each entity only appears a single time in the ER diagram
- Name every relationship, entity, and attribute are represented on your diagram
- Never connect relationships to each other
- You should use colors to highlight important portions of the ER diagram

TUPLE IN DATABASE

In a relational database, a tuple contains all the data for an individual record. For example, in a database containing client contact information, the fields may be categories such as name, phone number, email address and mailing address, while a tuple for that database could be:

Bill Gates	206-555-1234	billg@microsoft.com	PO Box 123, Seattle, WA 98100

In mathematics, a tuple is an ordered list of elements. Related to this is an n-tuple, which in set theory is a collection (sequence) of "n" elements. Given this, it might be more properly said that tuples are implemented as records even though the terms are commonly used interchangeably.

NORMALIZATION

Introduction

Normalization is a database design technique that reduces data redundancy and eliminates undesirable characteristics like Insertion, Update and Deletion Anomalies. Normalization rules divides larger tables into smaller tables and links them using relationships. The purpose of Normalization in SQL is to eliminate redundant (repetitive) data and ensure data is stored logically.

The inventor of the relational model Edgar Codd proposed the theory of normalization of data with the introduction of the First Normal Form, and he continued to extend theory with Second and Third Normal Form. Later he joined Raymond F. Boyce to develop the theory of Boyce-Codd Normal Form.

In this Database Normalization tutorial, you will learn:

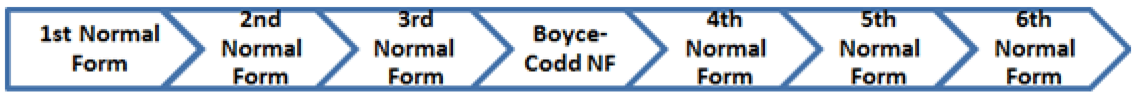
- What is Normalization in DBMS?
- Database Normal Forms

Database Normal Forms

Here is a list of Normal Forms in SQL:

- 1NF (First Normal Form)
- 2NF (Second Normal Form)
- 3NF (Third Normal Form)
- BCNF (Boyce-Codd Normal Form)
- 4NF (Fourth Normal Form)
- 5NF (Fifth Normal Form)
- 6NF (Sixth Normal Form)

The Theory of Data Normalization in MySQL server is still being developed further. For example, there are discussions even on 6th Normal Form. **However, in most practical applications, normalization achieves its best in 3rd Normal Form**. The evolution of Normalization in SQL theories is illustrated below-



Database Normal Forms

Database Normalization With Examples

Database **Normalization Example** can be easily understood with the help of a case study. Assume, a video library maintains a database of movies rented out. Without any normalization in database, all information is stored in one table as shown below. Let’s understand Normalization database with normalization example with solution:

Full Names	Physical Address	Movies rented	Salutation
Janet Jones	First Street Plot No 4	Pirates of the Caribbean, Clash of the Titans	Ms.
Robert Phil	3rd Street 34	Forgetting Sarah Marshal, Daddy’s Little Girls	Mr.
Robert Phil	5th Avenue	Clash of the Titans	Mr.

Here you see **Movies Rented column has multiple values.** Now let’s move into 1st Normal Forms:

1NF (First Normal Form) Rules

- Each table cell should contain a single value.
- Each record needs to be unique.

The above table in 1NF-

1NF Example

Full Names	Physical Address	Movies rented	Salutation
Janet Jones	First Street Plot No 4	Pirates of the Caribbean	Ms.
Janet Jones	First Street Plot No 4	Clash of the Titans	Ms.
Robert Phil	3rd Street 34	Forgetting Sarah Marshal	Mr.
Robert Phil	3rd Street 34	Daddy’s Little Girls	Mr.
Robert Phil	5th Avenue	Clash of the Titans	Mr.

Example of 1NF in DBMS

Before we proceed let’s understand a few things —

What is a KEY in SQL?

A **KEY in SQL** is a value used to identify records in a table uniquely. An SQL KEY is a single column or combination of multiple columns used to uniquely identify rows or tuples in the table. SQL Key is used to identify duplicate information, and it also helps establish a relationship between multiple tables in the database.

Note: Columns in a table that are NOT used to identify a record uniquely are called non-key columns.

What is a Primary Key?

Primary Key in DBMS

A primary is a single column value used to identify a database record uniquely.

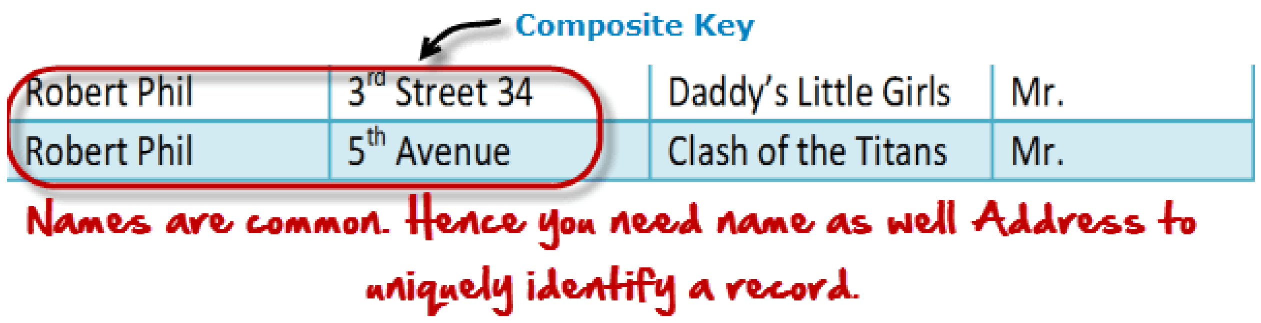
It has following attributes

- A primary key cannot be NULL
- A primary key value must be unique
- The primary key values should rarely be changed
- The primary key must be given a value when a new record is inserted.

What is Composite Key?

A composite key is a primary key composed of multiple columns used to identify a record uniquely

In our database, we have two people with the same name Robert Phil, but they live in different places.


Composite Key
Names are common. Hence you need name as well Address to uniquely identify a record.

Robert Phil	3rd Street 34	Daddy's Little Girls	Mr.
Robert Phil	5th Avenue	Clash of the Titans	Mr.

Composite key in Database

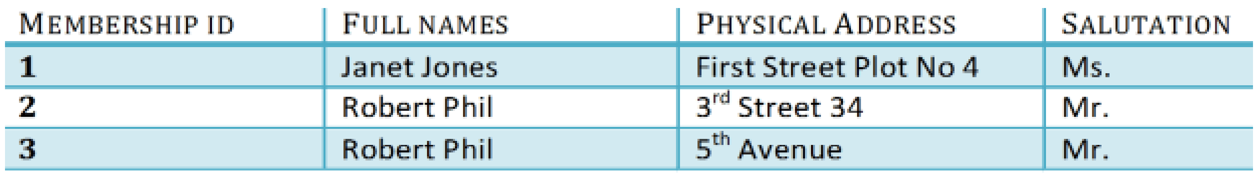
Hence, we require both Full Name and Address to identify a record uniquely. That is a composite key.

Let's move into second normal form 2NF

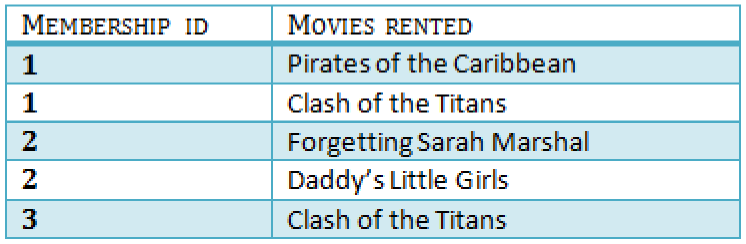
2NF (Second Normal Form) Rules

- Rule 1- Be in 1NF
- Rule 2- Single Column Primary Key that does not functionally dependant on any subset of candidate key relation

It is clear that we can't move forward to make our simple database in 2nd Normalization form unless we partition the table above.



MEMBERSHIP ID	FULL NAMES	PHYSICAL ADDRESS	SALUTATION
1	Janet Jones	First Street Plot No 4	Ms.
2	Robert Phil	3rd Street 34	Mr.
3	Robert Phil	5th Avenue	Mr.



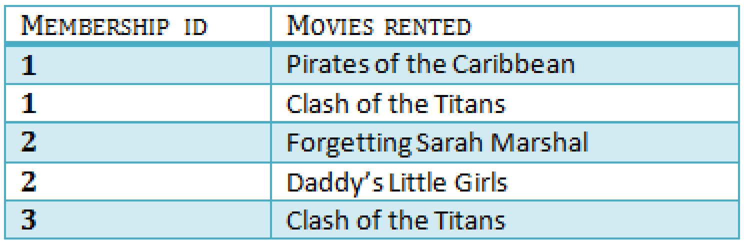
MEMBERSHIP ID	MOVIES RENTED
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

We have divided our 1NF table into two tables viz. Table 1 and Table2. Table 1 contains member information. Table 2 contains information on movies rented.

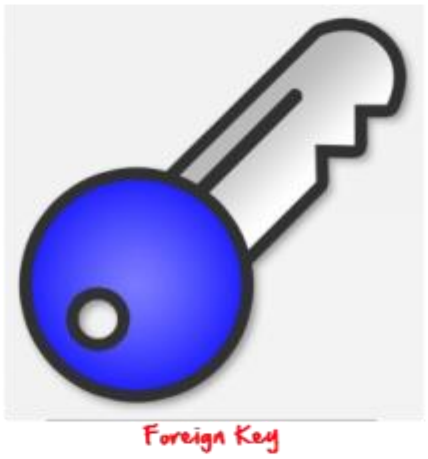
We have introduced a new column called Membership_id which is the primary key for table 1. Records can be uniquely identified in Table 1 using membership id

Database – Foreign Key

In Table 2, Membership_ID is the Foreign Key



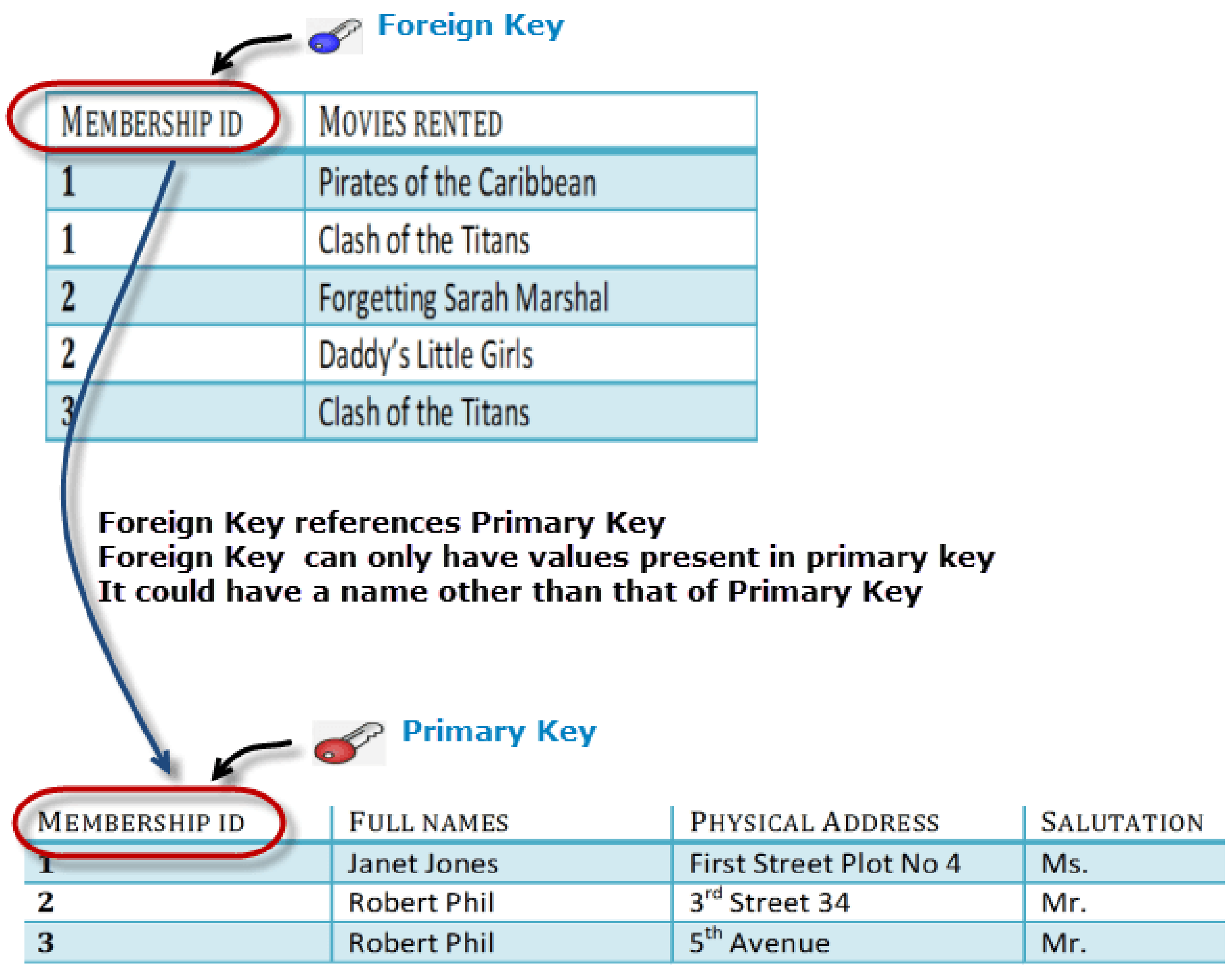
Membership ID	Movies rented
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans



Foreign Key in DBMS

Foreign Key references the primary key of another Table! It helps connect your Tables

- A foreign key can have a different name from its primary key
- It ensures rows in one table have corresponding rows in another
- Unlike the Primary key, they do not have to be unique. Most often they aren't
- Foreign keys can be null even though primary keys can not



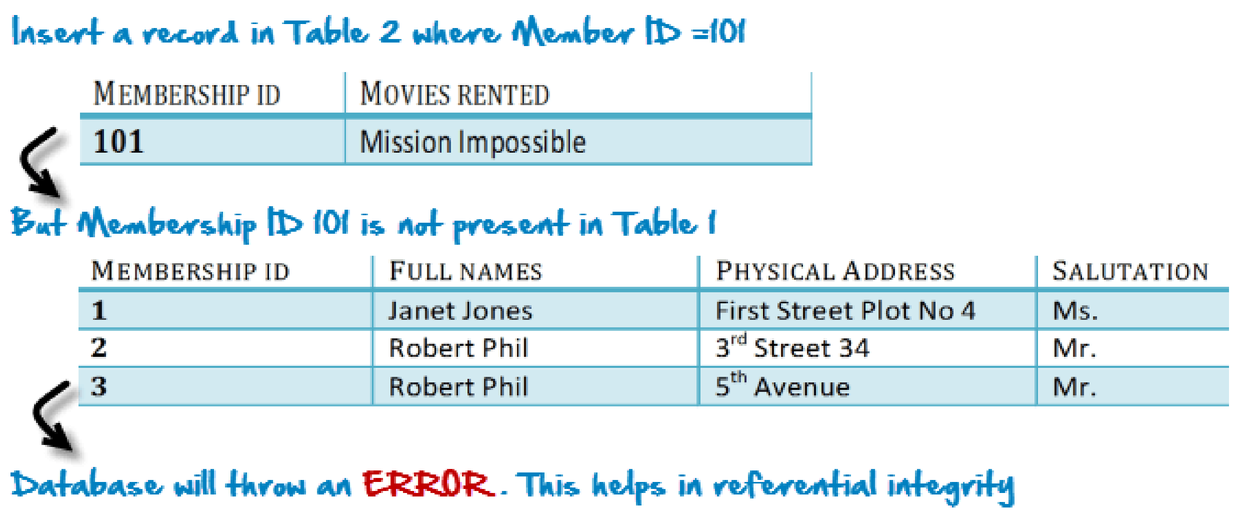
Membership ID	Movies Rented
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

Foreign Key references Primary Key
Foreign Key can only have values present in primary key
It could have a name other than that of Primary Key

Membership ID	Full Names	Physical Address	Salutation
1	Janet Jones	First Street Plot No 4	Ms.
2	Robert Phil	3rd Street 34	Mr.
3	Robert Phil	5th Avenue	Mr.

Why do you need a foreign key?

Suppose, a novice inserts a record in Table B such as



Insert a record in Table 2 where Member ID =101

Membership ID	Movies Rented
101	Mission Impossible

But Membership ID 101 is not present in Table 1

Membership ID	Full Names	Physical Address	Salutation
1	Janet Jones	First Street Plot No 4	Ms.
2	Robert Phil	3rd Street 34	Mr.
3	Robert Phil	5th Avenue	Mr.

Database will throw an ERROR. This helps in referential integrity

You will only be able to insert values into your foreign key that exist in the unique key in the parent table. This helps in referential integrity.

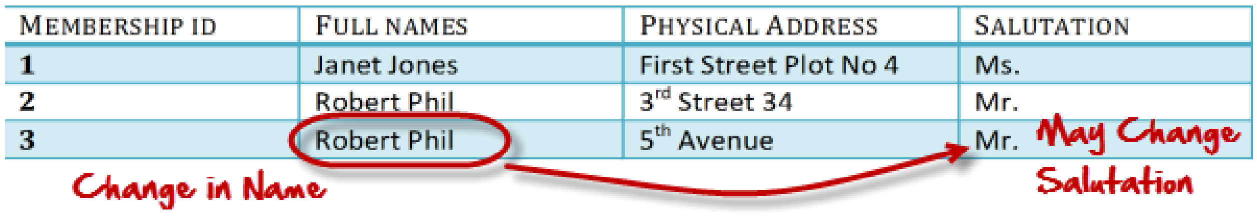
The above problem can be overcome by declaring membership id from Table2 as foreign key of membership id from Table1

Now, if somebody tries to insert a value in the membership id field that does not exist in the parent table, an error will be shown!

What are transitive functional dependencies?

A transitive functional dependency is when changing a non-key column, might cause any of the other non-key columns to change

Consider the table 1. Changing the non-key column Full Name may change Salutation.



MEMBERSHIP ID	FULL NAMES	PHYSICAL ADDRESS	SALUTATION
1	Janet Jones	First Street Plot No 4	Ms.
2	Robert Phil	3rd Street 34	Mr.
3	Robert Phil	5th Avenue	Mr.

Change in Name
May Change Salutation

Let's move into 3NF

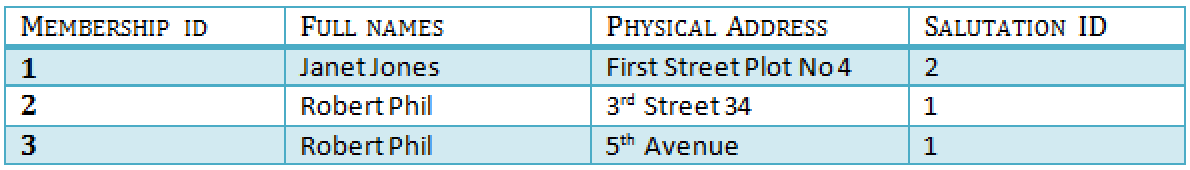
3NF (Third Normal Form) Rules

- Rule 1- Be in 2NF
- Rule 2- Has no transitive functional dependencies

To move our 2NF table into 3NF, we again need to again divide our table.

3NF Example

Below is a 3NF example in SQL database:



MEMBERSHIP ID	FULL NAMES	PHYSICAL ADDRESS	SALUTATION ID
1	Janet Jones	First Street Plot No 4	2
2	Robert Phil	3rd Street 34	1
3	Robert Phil	5th Avenue	1

Membership ID	Movies rented
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

Salutation ID	Salutation
1	Mr.
2	Ms.
3	Mrs.
4	Dr.

We have again divided our tables and created a new table which stores Salutations.

There are no transitive functional dependencies, and hence our table is in 3NF

In Table 3 Salutation ID is primary key, and in Table 1 Salutation ID is foreign to primary key in Table 3

Now our little example is at a level that cannot further be decomposed to attain higher normal form types of normalization in DBMS. In fact, it is already in higher normalization forms. Separate efforts for moving into next levels of normalizing data are normally needed in complex databases. However, we will be discussing next levels of normalization in DBMS in brief in the following.

BCNF (Boyce-Codd Normal Form)

Even when a database is in 3rd Normal Form, still there would be anomalies resulted if it has more than one **Candidate** Key.

Sometimes is BCNF is also referred as **3.5 Normal Form.**

4NF (Fourth Normal Form) Rules

If no database table instance contains two or more, independent and multivalued data describing the relevant entity, then it is in 4th Normal Form.

5NF (Fifth Normal Form) Rules

A table is in 5th Normal Form only if it is in 4NF and it cannot be decomposed into any number of smaller tables without loss of data.

6NF (Sixth Normal Form) Proposed

6th Normal Form is not standardized, yet however, it is being discussed by database experts for some time. Hopefully, we would have a clear & standardized definition for 6th Normal Form in the near future.

DATABASE ADMINSTRATOR (D.B.A)

Database administration involves the installing, configuring, monitoring, maintaining, and improving the performance of databases and data stores. While design of databases would be part of solution architecture, the implementation and maintenance of development and production database environments would be the work of the DBA.

ROLES OF THE D.B.A

The day-to-day activities that a DBA performs as outlined in ITIL® Service Operation include:

- Creating and maintaining database standards and policies
- Supporting database design, creation, and testing activities
- Managing the database availability and performance, including incident and problem management
- Administering database objects to achieve optimum utilization
- Defining and implementing event triggers that will alert on potential database performance or integrity issues
- Performing database housekeeping, such as tuning, indexing, etc.
- Monitoring usage, transaction volumes, response times, concurrency levels, etc.
- Identifying reporting, and managing database security issues, audit trails, and forensics
- Designing database backup, archiving, and storage strategy

What competencies does a DBA require?
At a bare minimum, the DBA will:

- Have an IT, computer science, or engineering educational background
- Need to be conversant with structured query language (SQL) and relevant database technologies (whether proprietary or open source)
- Understand coding and service management (to some degree)

Relevant database technologies include SQL Server, MySQL, Oracle, IBM Db2, and MongoDB, among others. Now, this doesn't mean you have to be certified in all of them, but a working knowledge of a few of them is required.

The European e-Competence framework (e-CF) outlines five associated competencies that the DBA should have. These competences are all proficiency level 3 (on a scale of 1 to 5):

E-CF AREA	E-CF COMPETENCE	LEVEL 3
Build	Application Development	Acts creatively to develop applications and to select appropriate technical options. Accounts for others development activities. Optimizes application development, maintenance and performance by employing design patterns and by reusing proved solutions.

	Component integration	Accounts for own and others’ actions in the integration process. Complies with appropriate standards and change control procedures to maintain integrity of the overall system functionality and reliability.
Run	Change Support	Ensures the integrity of the system by controlling the application of functional updates, software or hardware additions and maintenance activities. Complies with budget requirements.
	Information and Knowledge Management	Analyses business processes and associated information requirements and provides the most appropriate information structure.
Manage	Information Security Management	Evaluates security management measures and indicators and decides if compliant to information security policy. Investigates

		and instigates remedial measures to address any security breaches.

A cursory search across popular talent recruiting websites indicates additional soft skills needed by DBAs include:

- Business awareness and understanding of business requirements of IT.
- Excellent problem-solving and analytical skills.
- Good communication, teamwork, and negotiation skills.
- Good organizational skills.
- Flexibility and adaptability.
- Excellent business relationship and user support skills.

DBA career development

SFIA 8 defines four levels of responsibility for the DBA which you can map to your career development roadmap:

Level 2 (Assist)

- Assists in database support activities

Level 3 (Apply)

- Performs standard database maintenance and administration tasks
- Uses database management system software and tools to collect performance statistics

Level 4 (Enable)

- Develops and configures tools to enable automation of database administration tasks
- Monitors performance statistics and create reports
- Identifies and investigates complex problems and issues and recommends corrective actions

- Performs routine configuration, installation, and reconfiguration of database and related products

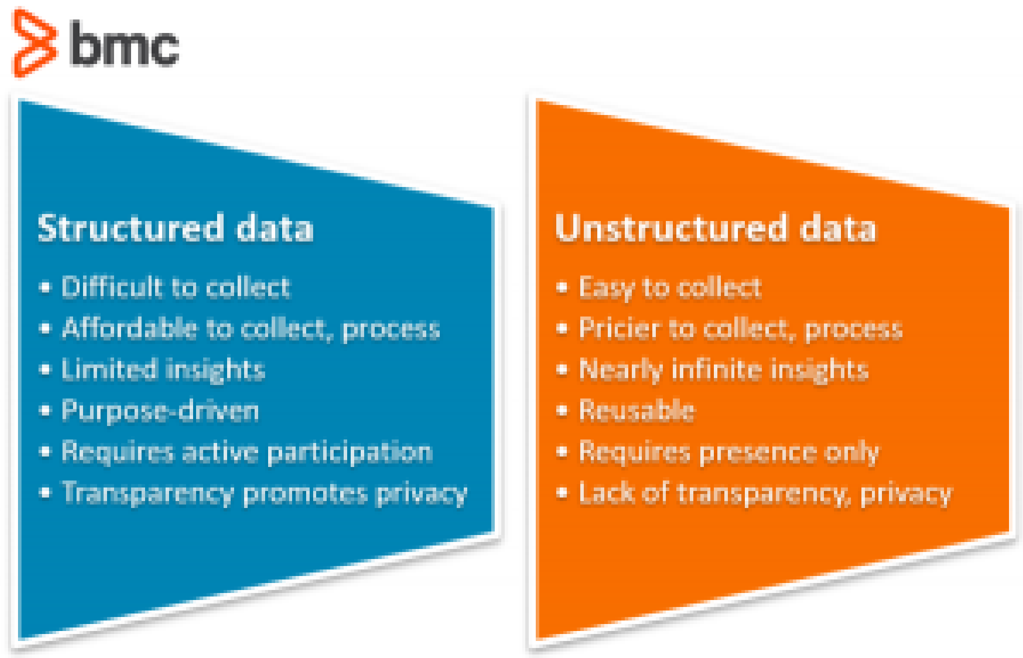
Level 5 (Ensure, Advise)

- Identifies, evaluates, and manages the adoption of database administration tools and processes, including automation
- Develops and maintains procedures and documentation for databases. Contributes to the setting of standards for definition, security, and integrity of database objects and ensures conformance to these standards
- Manages database configuration including installing and upgrading software and maintaining relevant documentation
- Monitors database activity and resource usage. Optimizes database performance and plans for forecast resource needs

Outlook for DBAs

The DBA role is here to stay when it comes to data administration, but it is clear that the name might need some tweaking.

The digital age has resulted in the huge growth in unstructured data such as text, images, sensor information, audio, and videos, on account of e-commerce, IoT, AI and social media. As a result, the job title 'database administrator' seems to be giving way to 'data administrator', to cater for management of both structured (database) and unstructured (big data) data sets.



Structured data

- Difficult to collect
- Affordable to collect, process
- Limited insights
- Purpose-driven
- Requires active participation
- Transparency promotes privacy

Unstructured data

- Easy to collect
- Pricier to collect, process
- Nearly infinite insights
- Reusable
- Requires presence only
- Lack of transparency, privacy

Since most digital organizations are no longer restricted to transactional data only, the modern day DBA must be conversant with file, block and object storage solutions.

And because of the sheer volume of data, as well as the ability to access AI/machine learning solutions to digest such data, the preferred data storage mode for most digital organizations is cloud based. Therefore, the modern DBA must become fully conversant with cloud architectures and technologies, including data lakes and big data solutions like Hadoop.

The rise of DevOps as the preferred model for end-to-end product management means that the DBA must become a comb-shaped specialist, working in an autonomous environment with platform engineers to develop automated self-service tools that software developers can utilize to create the data solutions they require for their applications.

This means the DBA will need to build software engineering capabilities as part of their repertoire.

DBAs must acknowledge data privacy
Data protection regulation has become a key focus area for enterprises around the world. The stringent requirements and hefty fines have resulted in scrutiny of data management becoming a critical corporate governance imperative.

The DBA must become conversant with data protection regulation such as GDPR, and how to implement the relevant security controls to ensure user/customer privacy rights are respected in business operations.