PLURALSIGHT

# SNOWFLAKE

Week 4

# Snowflake Topics

LAST WEEK

- Python/SQL Review (Activities)
- Intro to SQL/SELECT
- CTEs
- Create Views and Tables
- ETL Project using SQL

NEXT WEEK

- ETL Project using Python (Snowpark)
- Snowflake Architecture
- Advanced Window Functions
- Sampling Data
- COPY command
- Loading data from AWS (S3)
- Zero Copy Cloning
- Data Masking
- Snowpipe
- Time Travel

# Using CRUD

**Create Read Update Delete** is a set of operations used with persistent storage.

| | |
|---|---|
| Create | Create data in a table with the `INSERT` statement. |
| Read | Read data by using `SELECT`. |
| Update | Updated a table's data by using `UPDATE`. |
| Delete | Deleted data via `DELETE`. |

# SQL Joins

| | |
|---|---|
| `INNER JOIN` | Returns records that have matching values in both tables. |
| `LEFT JOIN` | Returns all records from the left table and the matched records from the right table. |
| `RIGHT JOIN` | Returns all records from the right table and the matched records from the left table. |
| `CROSS JOIN` | Returns records that match every row of the left table with every row of the right table. This type of join has the potential to make very large tables. |
| `FULL OUTER JOIN` | Places null values within the columns that do not match between the two tables, after an inner join is performed. |

# Order By Aggregates

The `ORDER BY` function:

- Is added towards the end of a query.
- Returns in an ascending order by default.
- Can also return in a descending order by adding `DESC`.
- Can limit the return by adding `LIMIT`.
- **NOTE:** Use the `ROUND` function to round up the number after the the decimal.

## Wildcard: % and _

Use wildcards to substitute zero, one, or multiple characters in a string.
The keyword `LIKE` indicates the use of a wildcard.

```
SELECT *
FROM actor
WHERE last_name LIKE 'Will%';
```

## Wildcard: % and _

The % will substitute zero, one, or multiple characters in a query.
In this example, all of the following are matches: Will, Willa, and Willows.

```
SELECT *
FROM actor
WHERE last_name LIKE 'Will%';
```

## Wildcard: % and _

The _ will substitute only **one** character in a query.

_an returns all actors whose first name contains three letters,
the second and third of which are an.

```
SELECT *
FROM actor
WHERE first_name LIKE '_an';
```

**Aggregate functions** allow you to perform a calculation on a set of values to return a single value.

# Aggregate Functions

The most commonly used aggregate functions are:

| | |
|---|---|
| AVG | Calculates the average of a set of values |
| COUNT | Counts the rows in a specific table or view |
| MIN | Returns the minimum value in a set of values |
| MAX | Returns the maximum value in a set of values |
| SUM | Calculates the sum of a set of values |

# Aggregate Functions

Aggregate functions are often used with:

01 The `GROUP BY` clause

02 The `HAVING` clause

03 The `SELECT` statement

## Subqueries

A subquery is nested inside a larger query. Subqueries occur in:

01 The `SELECT` statement

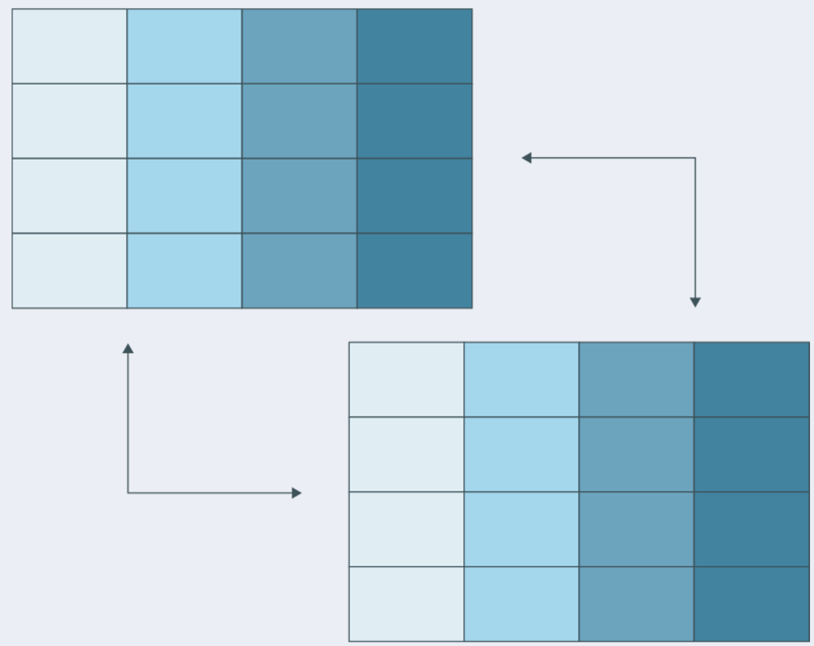
02 The `FROM` clause

03 The `WHERE` clause

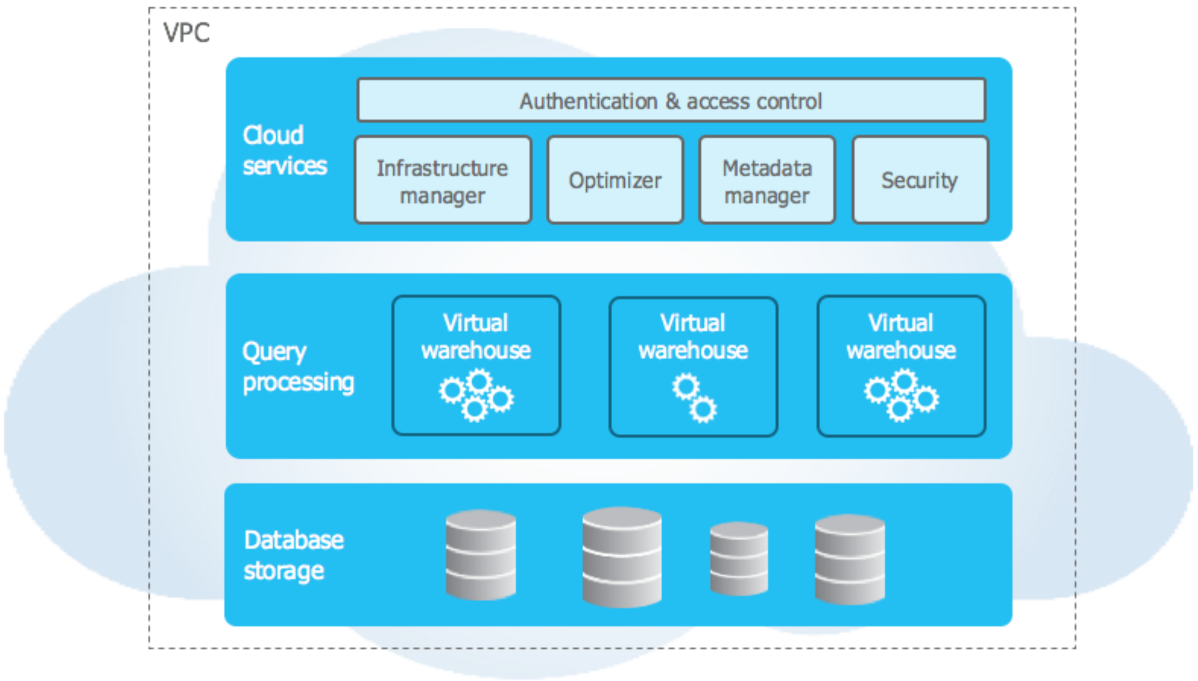
# SQL Views

Views are created by using the `CREATE VIEW` statement.

Views are created from a single table, multiple tables, or another view.



# Snowflake Architecture



# Saving Query and Query Results

## Standard or Permanent Tables

- Standard tables are permanent and provide full data protection and recovery capabilities, including time travel and fail-safe.
- **Used for storing persistent data.**

## Temporary Tables

- These are session-specific, meaning they last only for the duration of your session. They can be useful for intermediate computations.
- **Useful for storing intermediate results and data that do not need to persist.**

## Transient Tables

- Transient tables are similar to regular tables, but they don’t have the fail-safe (historical data) feature, meaning Snowflake doesn't keep the historical data of the table for restoring. This might save on storage costs.
- **Suitable for staging data or storing data that can be easily re-created.**

## External Tables

- External tables allow querying data stored in external stages (like S3 buckets) without loading it into Snowflake.
- **Useful for querying large datasets stored outside of Snowflake.**

# Saving Query and Query Results

## Standard Views

- A view creates a virtual table based on the result set of a SQL statement.
- They don't store data physically but represent data that is stored in tables.
- **Useful for simplifying complex queries and creating reusable query logic.**

## Materialized Views

- A materialized view stores the result of a query physically, and it gets refreshed based on the criteria you set (on each transaction or on a set schedule).
- They are useful when you have complex calculations that you don't want to run every time you query the data.
- Useful for improving performance of frequently run queries.

## Secure Views

- Secure views hide the underlying query logic and data from unauthorized users.
- Useful for sharing data securely with external or internal users.

# Why Use Views?

**1. Security:**

**Data Access Control**: You can use views to restrict access to sensitive data in the underlying tables. For instance, if a table has 10 columns and you want users to see only 5 of them, a view can be created with just those 5 columns.

**Mask Data**: Views can be used to present a sanitized version of the data, where sensitive information is either omitted or obfuscated.

**2. Simplification of Complex Queries:**

**Query Abstraction**: If you have a complex query that joins several tables and has multiple conditions, you can encapsulate this complexity in a view. Users can then query the view without having to know the underlying complexity.

**Consistent Analysis**: Analysts and developers can use views as a predefined template to ensure they're always working with data in a consistent manner.

# Why Use Views?

**3. Maintainability:**

**Centralized Logic**: By putting logic into views (like calculations, transformations, or aggregations), you centralize this logic. If there's a need to change the logic, you change the view, not every individual query.

**Schema Evolution**: If the underlying table structures change, you can often adjust just the view to accommodate those changes without affecting all the queries and applications that use the view.

4.**Encapsulation:**

**Hide Complexity**: Views can hide the complexity of data. For instance, data might be spread across multiple tables or even databases. A view can bring it together as if it's coming from a single table.

5.**Business Logic Layer:**
**Consistent Business Rules**: By defining business rules and logic inside views, you ensure that all applications and users accessing the view will get data that adheres to the same set of rules.

# SQL Window Functions

**Definition**

- A function that calculates values across a set of rows and returns a value for each row.

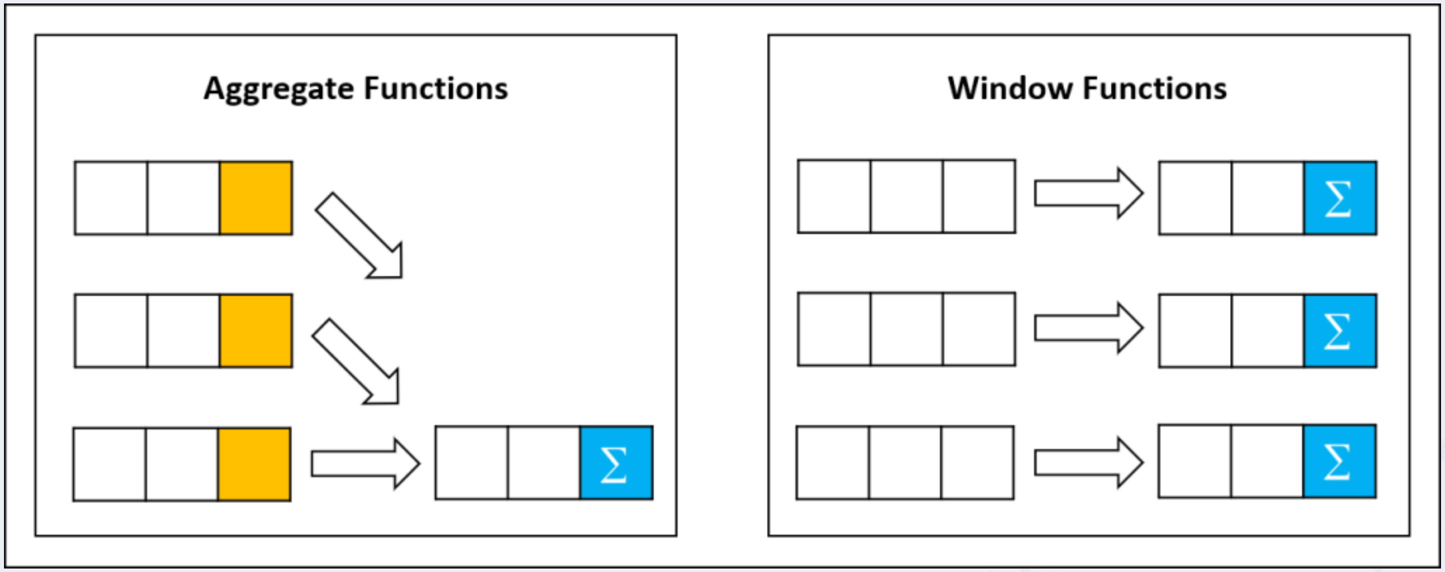
**Contrast with aggregate functions**

- Unlike aggregate functions that return a single value for multiple rows, window functions return multiple values.

**OVER clause**

- Window functions are identified by having an OVER clause; lacking this clause classifies a function as either an aggregate or a scalar function.

# SQL Window Functions



# SQL Window Functions

## Window Functions

| Aggregate | Value | Ranking |
|---|---|---|
| AVG() | ROW_NUMBER() | LAG() |
| MAX() | RANK() | LEAD() |
| MIN() | DENSE_RANK() | FIRST_VALUE() |
| SUM() | PERCENT_RANK() | LAST_VALUE() |
| COUNT() | NTILE() | NTH_VALUE() |

# SQL Window Functions

<window function name>( ) OVER (

PARTITION BY <expression>

ORDER BY <expression> [ASC | DESC]

)

# Data Modeling Defined

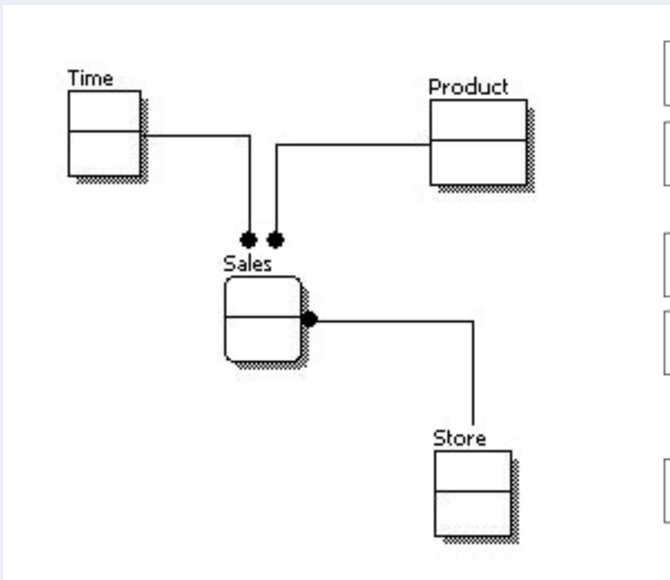
**What is data modeling?**

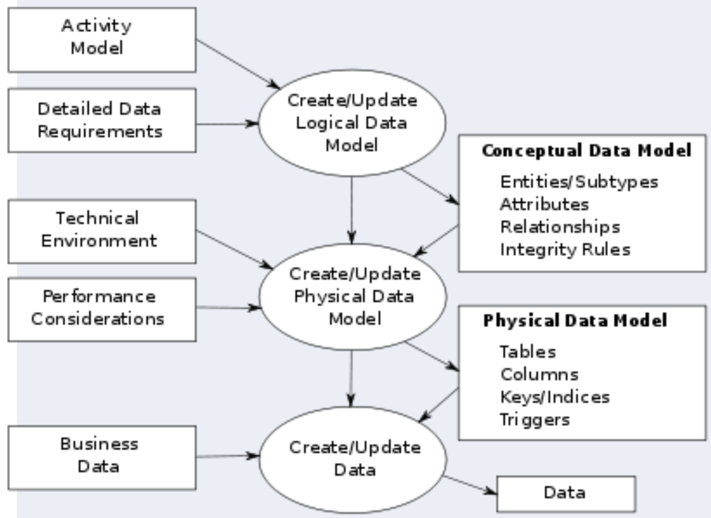
“A set of symbols and text which precisely explain a subset of real information.”

-Steve Hoberman and George McGeachie (Technics, 2011)

**Data modeling** is often the first step in database design and object-oriented programming . It consists of a conceptual model of how data items relate to each other.

# What is Data Modeling?



# Data Modeling Forms and Standards

- Helps business and IT users relate to one another
- Facilitates the management of data as a resource
- Improves and expedites the integration of information systems
- Informs the  designing databases/data warehouses (aka data repositories)

# Modeling

**Conceptual**

Entities

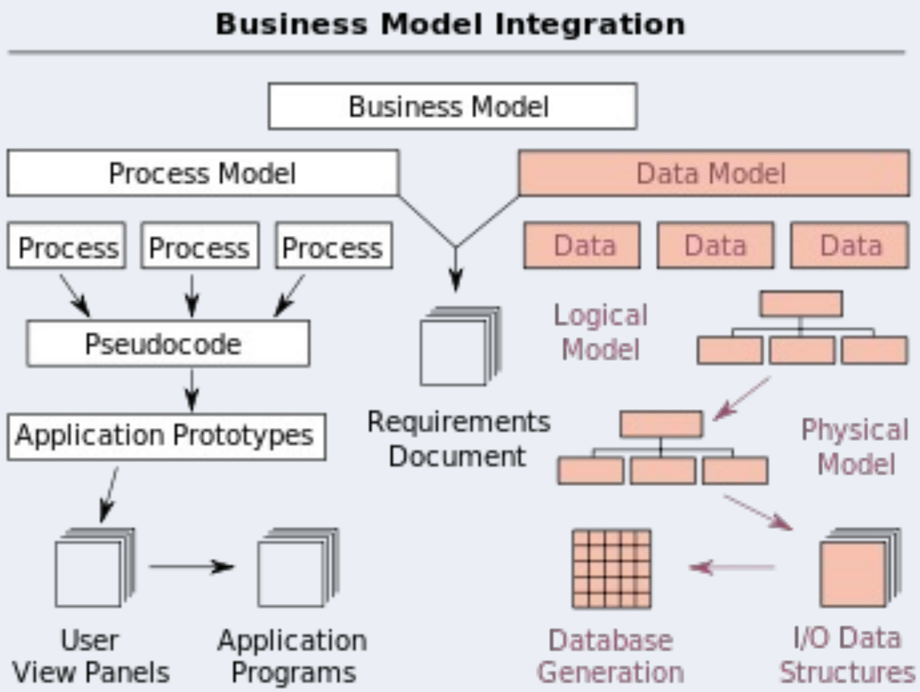
**Logical**

Attributes

**Physical**

Constraints

# Modeling Evolution

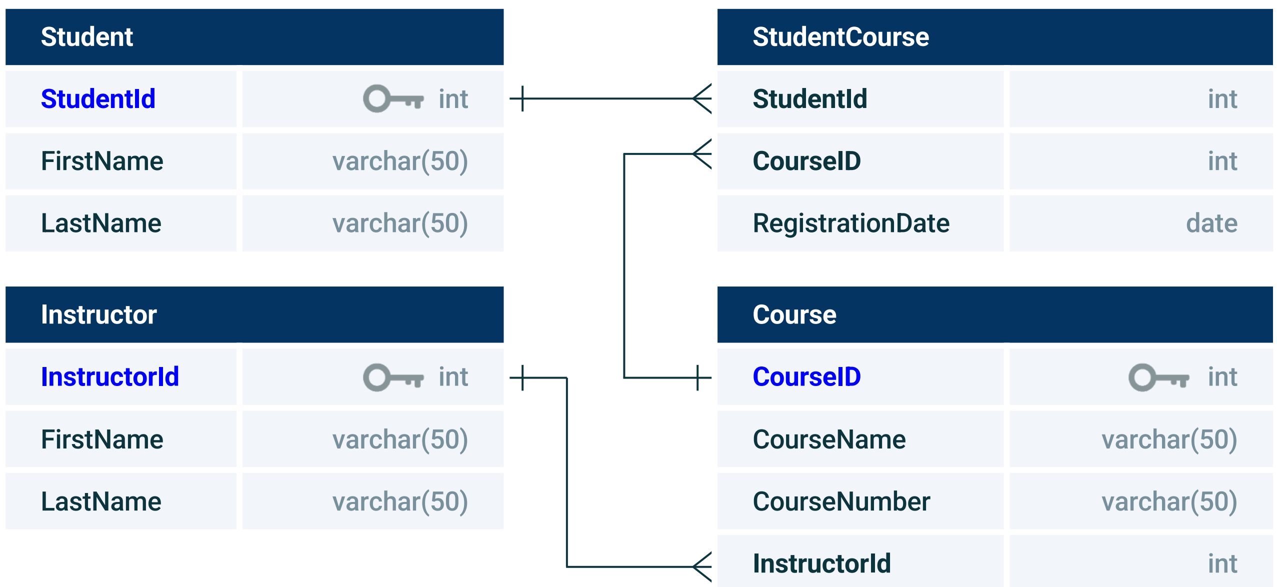


An **ERD** (Entity Relationship Diagram) shows the connections between the tables.

# Entity Relationship Diagram

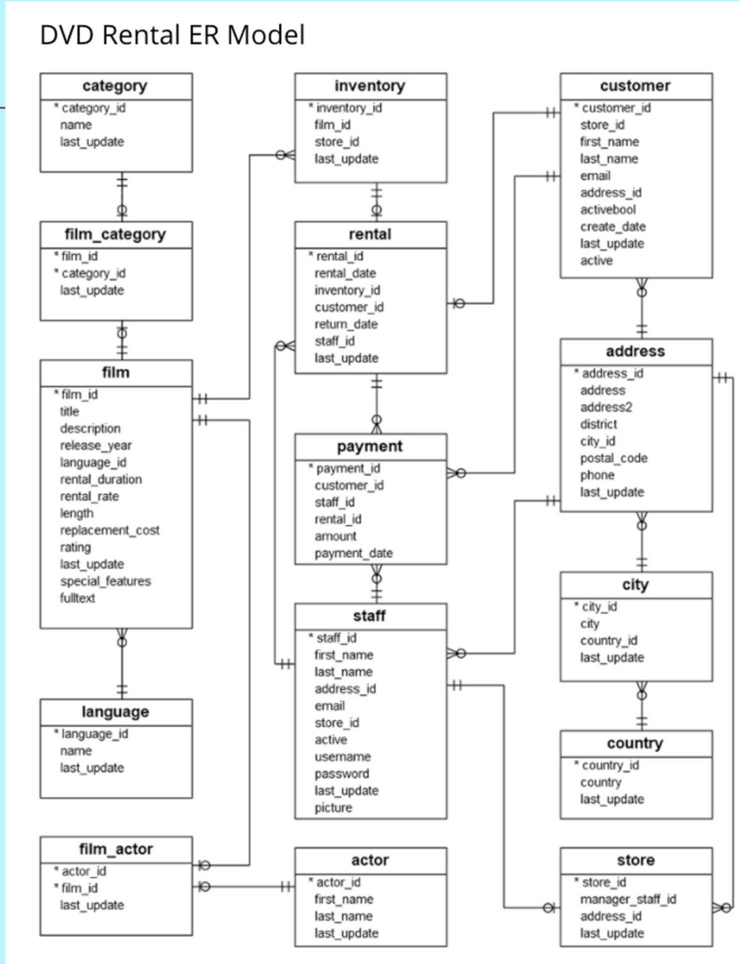
It's called an Entity Relationship Diagram because it shows:

- The entities in your data model
- The relationship between entities



# Entity Relationship Diagram

The schema makes it easier to identify the tables we need as well as the keys we will use to link our subqueries.



# Data Normalization

**Data normalization** is the process of restructuring data to a set of defined "normal forms."

**Data normalization** is the process of restructuring data to a set of defined “normal forms”, which eliminates data redundancy and inconsistencies.

The process of data normalization **eliminates data redundancy and inconsistencies**.

# Data Normalization

Three most common forms:

01 First normal form (1NF)

02 Second normal form (2NF)

03 Third normal form (3NF)

# First normal form (1NF)

Each field in a table row should contain a single value.

**Raw Data**

| VIN | Services Performed | Customer Name | Model |
|---|---|---|---|
| 3D7LX39C86G106066 | Oil Change | Marcia Jackson | Prius |
| 1FAFP33Z24W147740 | Oil Change, Alignment | Patricia Smith | Equinox |
| KNDJD736875757954 | Oil Change, Brake Replacement | Mikhail Ivanov | CRV |
| 3N1AB7AP7EL611028 | Transmission Rebuild | Lucas Gonzalez | Tahoe |

**Normalization**

**First Normal Form**
(Each row is unique)

| VIN | Services Performed | Customer Name | Salutation |
|---|---|---|---|
| 3D7LX39C86G106066 | Oil Change | Marcia Jackson | Prius |
| 1FAFP33Z24W147740 | Oil Change | Patricia Smith | Equinox |
| 1FAFP33Z24W147740 | Alignment | Patricia Smith | Equinox |
| KNDJD736875757954 | Oil Change | Mikhail Ivanov | CRV |
| KNDJD736875757954 | Brake Replacement | Mikhail Ivanov | CRV |
| 3N1AB7AP7EL611028 | Transmission Rebuild | Lucas Gonzalez | Tahoe |

# First Normal Form (1NF)

Each field in a table row should contain a single value.

Each row is unique.

- Rows can have fields that repeat.
- Whole rows do not fully match.

**Raw Data**

| family | children |
|---|---|
| Smith | Chris, Abby, Susy |
| Jones | Steve, Mary, Dillion |

**Normalization**

**First Normal Form**

| family | children |
|---|---|
| Smith | Abby |
| Smith | Susy |
| Jones | Mary |
| Smith | Chris |
| Jones | Dillion |
| Jones | Mary |

# Second Normal Form (2NF)

Adds a Primary Key, and all columns are directly dependent on that key. To transform the data below, we'll need separate tables for Vehicle, Customer, and Service Performed.

| VIN | Services Performed | Customer Name | Model | Make |
|---|---|---|---|---|
| 3D7LX39C86G106066 | Oil Change | Marcia Jackson | Prius | Toyota |
| 1FAFP33Z24W147740 | Oil Change | Patricia Smith | Escape | Ford |
| 1FAFP33Z24W147740 | Alignment | Patricia Smith | Escape | Ford |
| KNDJD736875757954 | Oil Change | Mikhail Ivanov | CRV | Honda |
| KNDJD736875757954 | Brake Replacement | Mikhail Ivanov | CRV | Honda |
| 3N1AB7AP7EL611028 | Transmission Rebuild | Lucas Gonzalez | Tahoe | Chevy |

**2NF Normalization**

# Second Normal Form (2NF)

| Customer | | |
|---|---|---|
| **ID** | **First** | **Last** |
| 1 | Marcia | Jackson |
| 2 | Patricia | Smith |
| 3 | Mikhail | Ivanov |
| 4 | Lucas | Gonzalez |

This is the same data in 2NF; note that yellow columns are Primary Keys and blue columns are Foreign Keys which reference the Primary Keys from other tables.

| Vehicle | | | |
|---|---|---|---|
| **VIN** | **Customer ID** | **Model** | **Make** |
| 3D7LX39C86G106066 | 1 | Prius | Toyota |
| 1FAFP33Z24W147740 | 2 | Equinox | Chevy |
| KNDJD736875757954 | 3 | CRV | Honda |
| 3N1AB7AP7EL611028 | 4 | Tahoe | Chevy |

| Services | | |
|---|---|---|
| **ID** | **Vehicle** | **Service** |
| 1 | 3D7LX39C86G106066 | Oil Change |
| 2 | 1FAFP33Z24W147740 | Oil Change |
| 3 | 1FAFP33Z24W147740 | Alignment |
| 4 | KNDJD736875757954 | Oil Change |
| 5 | KNDJD736875757954 | Brake Replacement |
| 6 | 3N1AB7AP7EL611028 | Transmission Rebuild |

# Second Normal Form (2NF)

Must be in first normal form

Single column primary key

- Primary key
- Identifies the table and row uniquely

Generally, there could be a need to create a new table.

**Data in 1NF**

| family | children |
|---|---|
| Smith | Abby |
| Smith | Susy |
| Jones | Mary |
| Smith | Chris |
| Jones | Dillion |
| Jones | Mary |

**2NF Normalization**

**Family Table**

| family_id | family |
|---|---|
| 1 | Smith |
| 2 | Jones |

**Child Table**

| child_id | family_id | children |
|---|---|---|
| 11 | 1 | Chris |
| 22 | 1 | Abby |
| 33 | 1 | Susy |
| 44 | 2 | Steve |
| 55 | 2 | Mary |
| 66 | 2 | Dillion |

# Second Normal Form (2NF)

Table contains a primary key.

- Provides unique identifier for each row.
- Ideally in a single column.
- All columns are entirely dependent on the table's primary key.

# Generally there could be a need to create a new table

**Transitive dependency** is the reliance of a column's value on another column through a third column.

# Transitive Dependency

| | |
|---|---|
| **Transitive** | `If A ⟹ B and B ⟹ C then A ⟹C` |
| **Dependence** | • One value relies on another.<br>• City relies on ZIP code; age depends on birthday. |
| **For example** | • Consider the `VIN`, `Customer`, `Model`, and `Make` columns in the `Vehicle` table.<br>• `Customer` depends on `VIN`.<br>• `Model` depends on `Customer`.<br>• `Make` thus depends on `Model`.<br>• This is an example of transitive dependency |

# Third Normal Form (3NF) — "Simplify the Relationships"

To transition to 3NF, data must be in 2NF. Additionally, no column can imply another column in the same table. For instance, "Make" is implied by "Model" in the table below. That is, a model "Prius" will always have a make of "Toyota".

**Vehicle**

| VIN | Customer | Model | Make |
|---|---|---|---|
| 3D7LX39C86G106066 | 1 | Prius | Toyota |
| 1FAFP33Z24W147740 | 2 | Equinox | Chevy |
| KNDJD736875757954 | 3 | CRV | Honda |
| 3N1AB7AP7EL611028 | 4 | Tahoe | Chevy |

# Third Normal Form (3NF) — “Simplify the Relationships”

To break the same data into 3NF, we’d use the tables below.

**Make**

| ID | Make |
|---|---|
| 1 | Toyota |
| 2 | Chevy |
| 3 | Honda |

**Vehicle**

| VIN | Customer ID | Model |
|---|---|---|
| 3D7LX39C86G106066 | 1 | 1 |
| 1FAFP33Z24W147740 | 2 | 2 |
| KNDJD736875757954 | 3 | 3 |
| 3N1AB7AP7EL611028 | 4 | 4 |

**Model**

| VIN | Model | Make |
|---|---|---|
| 1 | Prius | 1 |
| 2 | Equinox | 2 |
| 3 | CRV | 3 |
| 4 | Tahoe | 2 |

# Third Normal Form (3NF)

- Must be in second normal form
- Contains non-transitively dependent columns

| owner_id | owner_name | owner_address | store_name |
|---|---|---|---|
| 11 | Marshall | 123, Fake Street | Soups and Stuff |
| 22 | Susan | 44, New Drive | Sink Emporium |
| 33 | Molly | 99, Old Lane | Tasty Burgers |

## 3NF Normalization

| owner_id | owner_name | owner_address |
|---|---|---|
| 11 | Marshall | 123, Fake Street |
| 22 | Susan | 44, New Drive |
| 33 | Molly | 99, Old Lane |

| store_id | store_name | Owner_id (fk) |
|---|---|---|
| 1 | Soups and Stuff | 11 |
| 2 | Sink Emporium | 22 |
| 3 | Tasty Burgers | 33 |

# Foreign Keys

Foreign Keys reference the primary key of another table.

Can have a different name. It does not have to be unique.

Primary Key

| | A | B |
|---|---|---|
| 1 | family_id | family |
| 2 | 1 | Smiths |
| 3 | 2 | Jones |

Primary Key Foreign Key

| | A | B | C |
|---|---|---|---|
| 1 | child_id | family_id | children |
| 2 | 11 | 1 | Chris |
| 3 | 22 | 1 | Abby |
| 4 | 33 | 1 | Suzy |

# Data Relationships

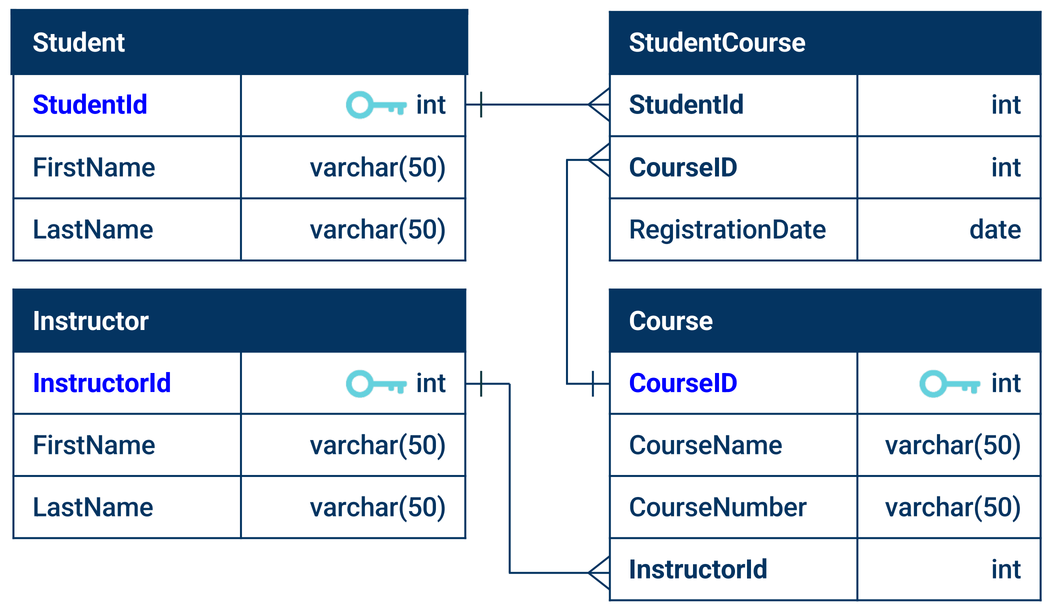
Relationships Link Tables/Entities.

Types of relationships:

01 One-to-One

02 One-to-Many

03 Many-to-Many



# One-to-One Relationship

Each item in one column is linked to only one other item from the other column.

| ID | Name | Social Security |
|---|---|---|
| 1 | Homer | 111111111 |
| 2 | Marge | 222222222 |
| 3 | Lisa | 333333333 |
| 4 | Bart | 444444444 |
| 5 | Maggie | 555555555 |

**Here, each person in the Simpsons family can have only one social security number.**

**Each social security number can be assigned only to one person.**

# One-to-Many Relationship

This example has two tables. The first table lists only addresses.

The second table lists each person's Social Security number and address. As before, one Social Security number is unique to one individual.

| ID | Address | ID | Name | Social Security | AddressID |
|---|---|---|---|---|---|
| 11 | 742 Evergreen Terrace | 1 | Homer | 111111111 | 11 |
| 12 | 221B Baker Street | 2 | Marge | 222222222 | 11 |
| | | 3 | Lisa | 333333333 | 11 |
| | | 4 | Bart | 444444444 | 11 |
| | | 5 | Maggie | 555555555 | 11 |
| | | 6 | Sherlock | 112233445 | 12 |
| | | 7 | Watson | 223344556 | 12 |

# One-to-Many Relationship

- Each address can be associated with multiple people.
- Each person has an address.
- The two tables, joined, would look like this.

| ID | Address | ID | Name | Social Security | AddressID |
|---|---|---|---|---|---|
| 11 | 742 Evergreen Terrace | 1 | Homer | 111111111 | 11 |
| 12 | 221B Baker Street | 2 | Marge | 222222222 | 11 |
| | | 3 | Lisa | 333333333 | 11 |
| | | 4 | Bart | 444444444 | 11 |
| | | 5 | Maggie | 555555555 | 11 |
| | | 6 | Sherlock | 112233445 | 12 |
| | | 7 | Watson | 223344556 | 12 |

# Many-to-Many Relationship

- Each child can have more than one parent.
- Each parent can have more than one child.

| ID | Child | ID | Parent |
|---:|---|---:|---|
| 1 | Bart | 11 | Homer |
| 2 | Lisa | 12 | Marge |
| 3 | Maggie | | |

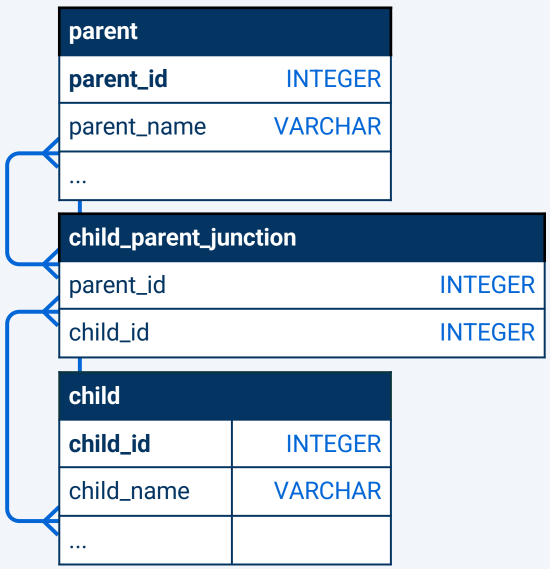
# Many-to-Many Relationship

- Each child can have more than one parent.
- Each parent can have more than one child.
- The two tables are joined in a **junction table**.

| ChildID | Child | ParentID | Parent |
| ---: | --- | ---: | --- |
| 1 | Bart | 11 | Homer |
| 1 | Bart | 12 | Marge |
| 2 | Lisa | 11 | Homer |
| 2 | Lisa | 12 | Marge |
| 3 | Maggie | 11 | Homer |
| 3 | Maggie | 12 | Marge |

# Junction Table

The junction table contains many parent_id’s and many child_id's.




| | parent_id integer | child_id integer |
|---|---|---|
| 1 | 11 | 1 |
| 2 | 11 | 2 |
| 3 | 11 | 3 |
| 4 | 12 | 1 |
| 5 | 12 | 2 |
| 6 | 12 | 3 |

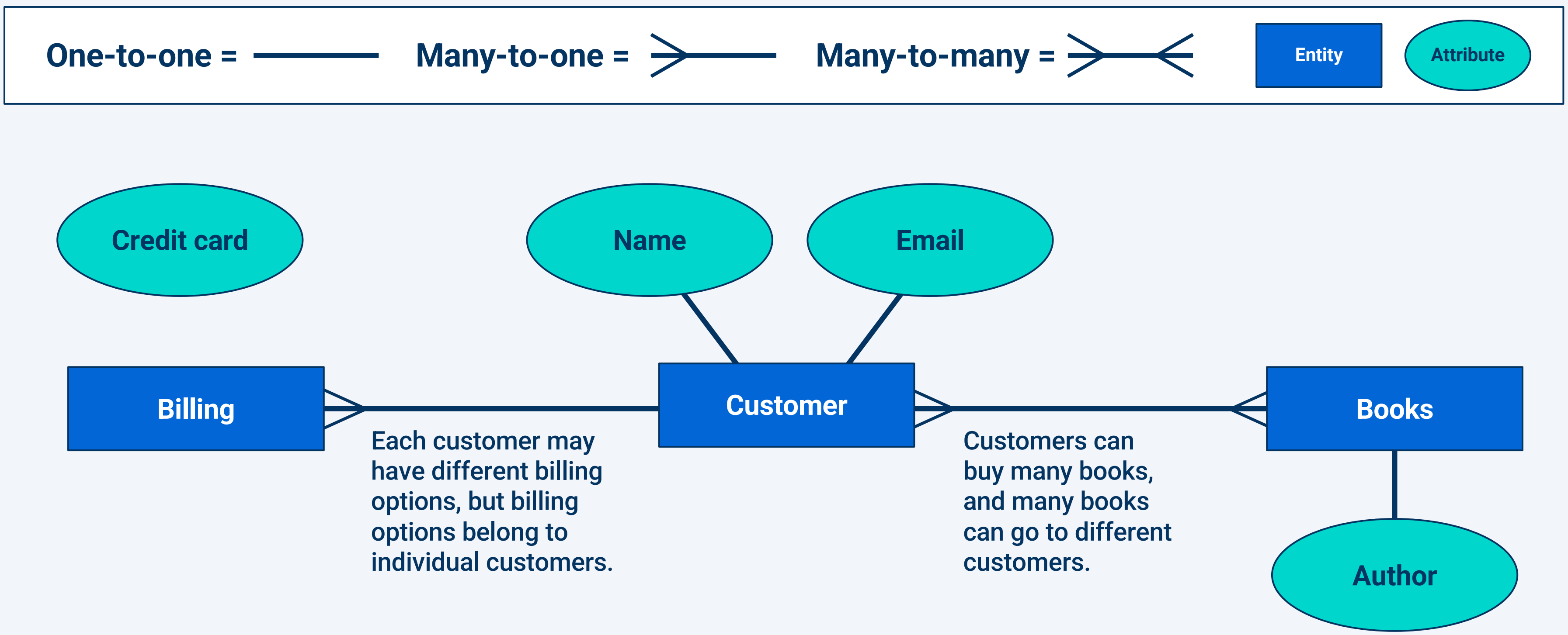
Join child and parent table to junction table

| | parent_name character varying (255) | child_name character varying (255) |
|---|---|---|
| 1 | Homer | Bart |
| 2 | Homer | Lisa |
| 3 | Homer | Maggie |
| 4 | Marge | Bart |
| 5 | Marge | Lisa |
| 6 | Marge | Maggie |

An **entity relationship diagram**, or ERD, is a visual representation of entity relationships within a database.

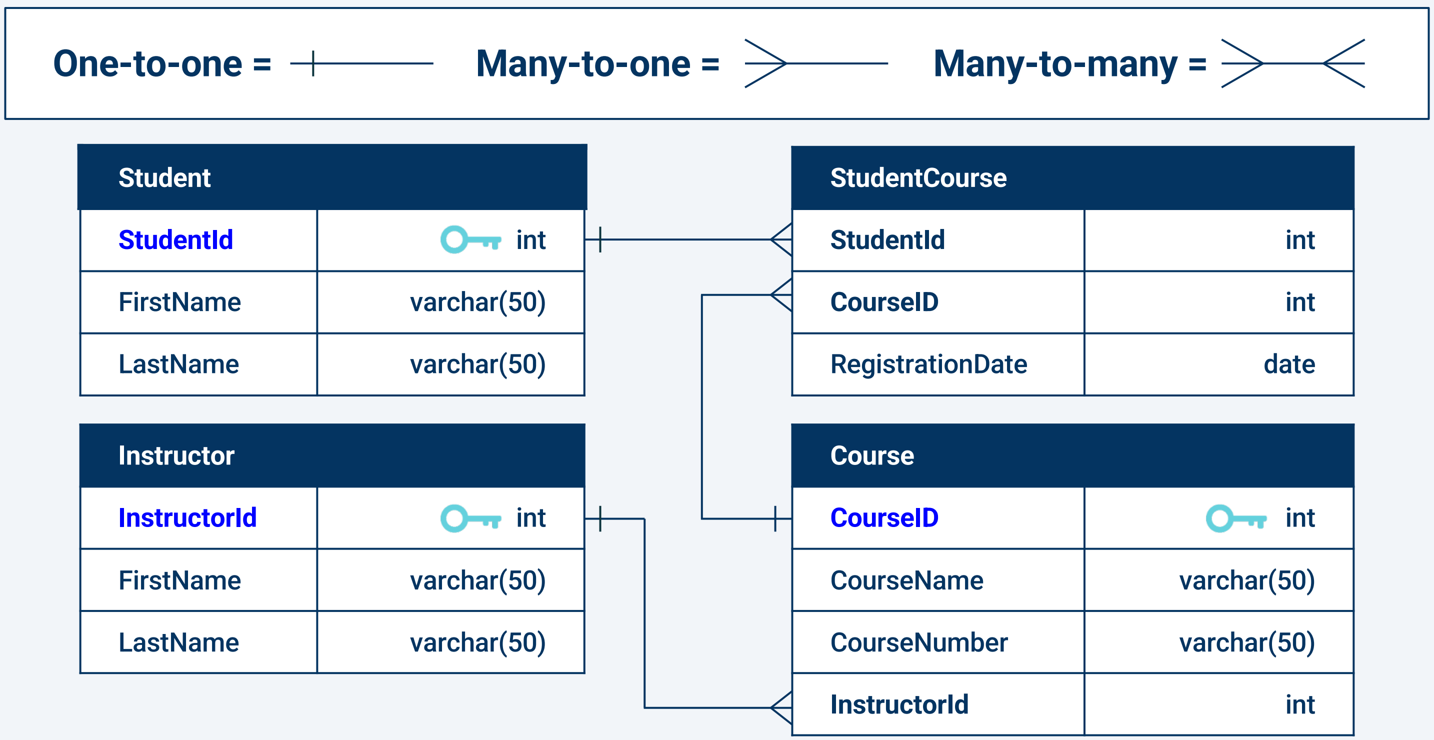
# Entity Relationship Diagram

ERD uses the following notations to create the relationships.



# Entity Relationship Diagram

A typical ERD design.



# Entity Relationship Diagram

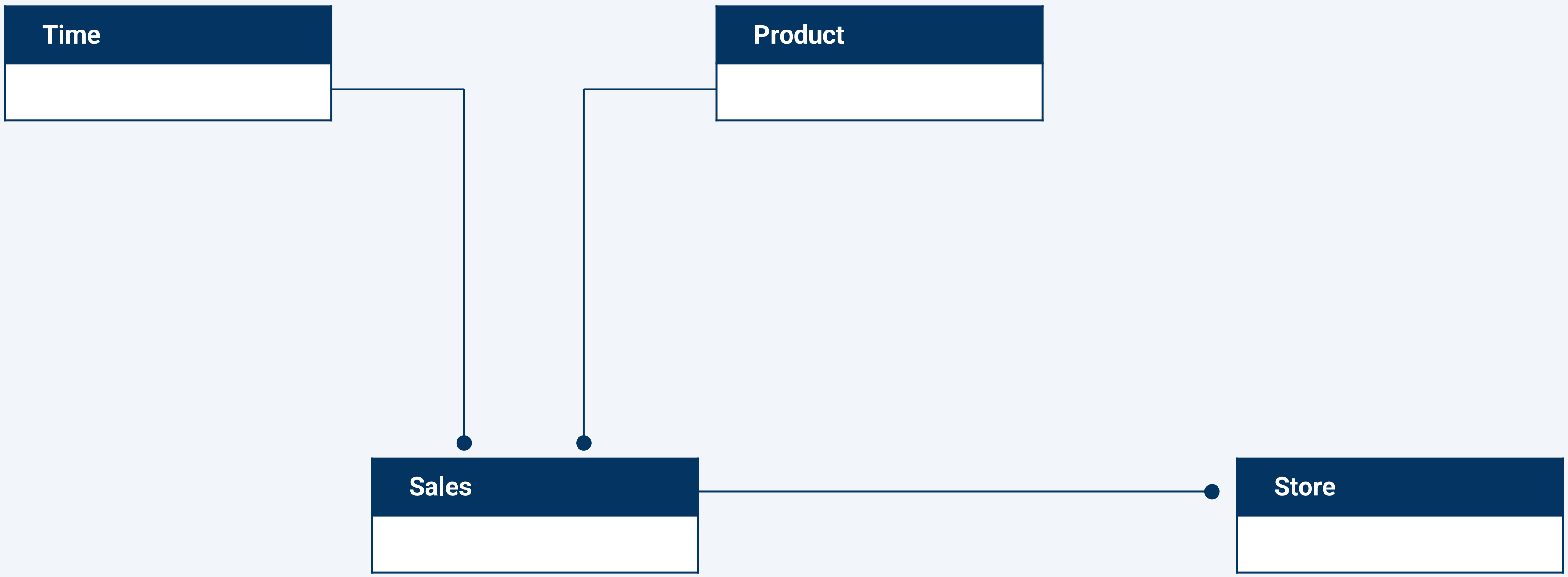
Three Types of ERDs or Data Models

01 Conceptual Model Design

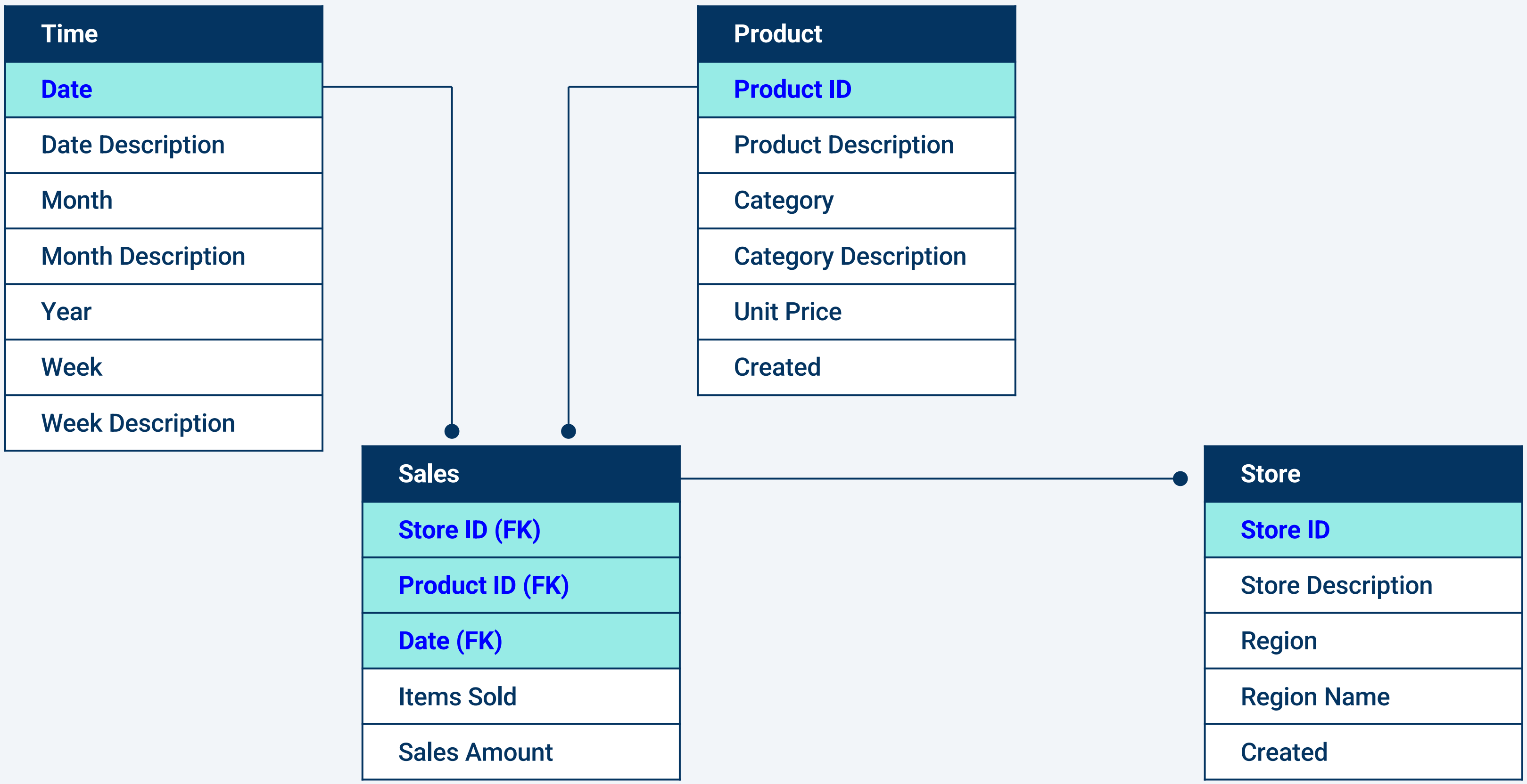
02 Logical Model Design

03 Physical Model Design

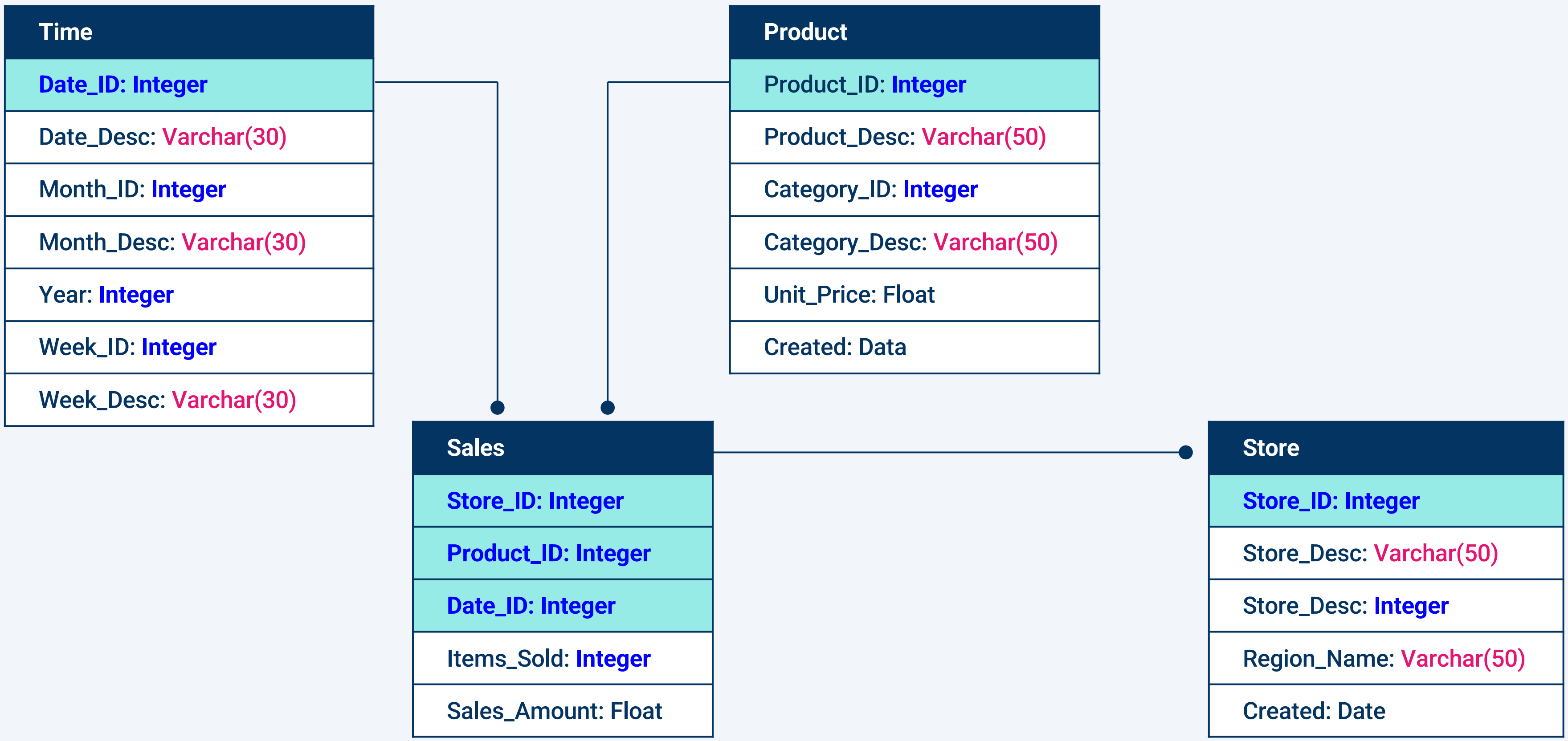
# Conceptual Model Design



# Logical Model Design



# Physical Model Design



# Entity Relationship Diagram

An ERD illustrates entities, their data types, and relationships.