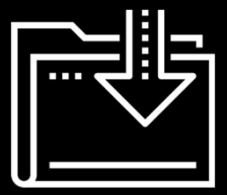
Data Modeling

Data Analytics and Visualization



Class Objectives

By the end of today's class, you will:

- ❑ Apply data modeling techniques to database design.
- ❑ Normalize data.
- ❑ Identify data relationships.
- ❑ Create visual representations of a database through entity relationship diagrams.

Data Normalization

Data Normalization

- Data normalization is the process of restructuring data to a set of “normal forms.”
- This reduces and eliminates data redundancy and inconsistencies.
- Three most common forms:
  - First normal form (1NF)
  - Second normal form (2NF)
  - Third normal form (3NF)
- There are even more levels!

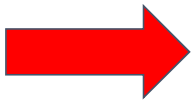
First Normal Form (1NF)

- 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
Smiths	Chris, Abby, Susy
Jones	Steve, Mary, Dillion

Normalization



First Normal Form

family	child
Smiths	Abby
Smiths	Susy
Jones	Mary
Smiths	Chris
Jones	Dillion
Jones	Mary

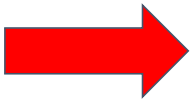
Second Normal Form (2NF)

- Data is in first normal form.
- Duplicated data is split into separate tables.
- Primary keys identify unique rows of data.

Data in 1NF

family	children
Smiths	Chris
Smiths	Abby
Smiths	Susy
Jones	Steve
Jones	Mary
Jones	Dillion

2NF Normalization



Family Table

family_id	family
1	Smiths
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

Transitive Dependence

- Transitive dependence is a column value's reliance on another column through a third column.
- Transitive:
  - If X > Y and Y > Z, then X> Z.
- Dependence:
  - One value relies on another.
  - Examples: city relies on ZIP code, age relies on birthday
- For example:
  - Say you have three columns in a table: StoreName, OwnerAddress, and OwnerName.
  - OwnerName and OwnerAddress rely on the the StoreName.
  - OwnerAddress also relies on the OwnerName.
  - So, OwnerAddress relies on the StoreName via the OwnerName.

Third Normal Form (3NF)

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

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

3NF Normalization

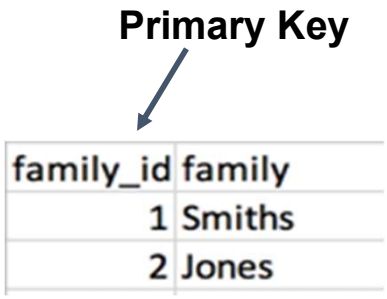
owner_id	owner_name	owner_address
11	Marshall	123, Fake St.
22	Susan	44, New Drive
33	Molly	99, Old Lane

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

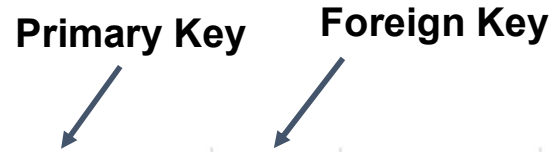
Foreign Keys

Foreign Keys

- Before we can get data into third normal form, we need to understand the concept of foreign keys.
- Foreign keys reference the primary key of another table.
- Foreign keys can have a different name and do not need to be unique.



family_id	family
1	Smiths
2	Jones



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

Data Relationships

Data Relationhsips

- One to One
- One to Many
- Many to Many

One-to-One Relationship

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

- Each item in one column is linked to only one item from the other column.
- Here, each member of the Simpson family has only one Social Security number.
- Each Social Security number can be assigned only to one person.

One-to-Many Relationship

ID	Address
11	742 Evergreen Terrace
12	221B Baker Street

ID	Name	Social Security	AddressID
1	Homer	111111111	11
2	Marge	222222222	11
3	Lisa	333333333	11
4	Bart	444444444	11
5	Maggie	555555555	11
6	Sherlock	112233445	12
7	Watson	223344556	12

- Here are two tables: one for people, and another for addresses.
- Each person has only one address.
- However, each address can be associated with multiple people.

One-to-Many Relationship

ID	Address
11	742 Evergreen Terrace
12	221B Baker Street

ID	Name	Social Security	AddressID
1	Homer	111111111	11
2	Marge	222222222	11
3	Lisa	333333333	11
4	Bart	444444444	11
5	Maggie	555555555	11
6	Sherlock	112233445	12
7	Watson	223344556	12

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

Many-to-Many Relationship

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

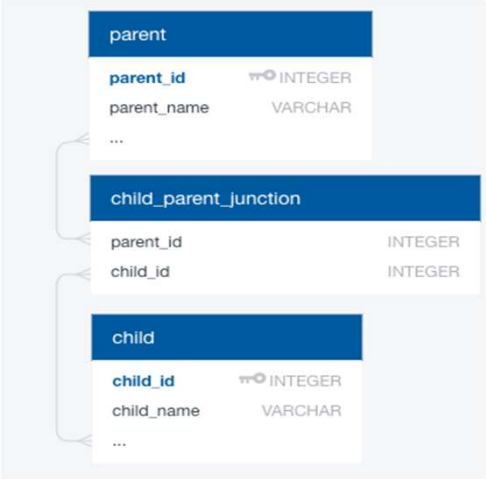
- Each child here has more than one parent.
- Each parent has more than one child.

Many-to-Many Relationship

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

- 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.

Junction Table



- A junction table contains many parent_ids and child_ids.

	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 through 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

Entity Relationship Diagrams

Entity Relationship Diagrams (ERDs)

- An **E**ntity **R**elationship **D**iagram provides a visual method of modeling data.
- Entities, their data types, and relationships are all illustrated in the diagram.
- There are three models used when creating diagrams:
  - **Conceptual**: Basic information containing table and column names
  - **Logical**: Slightly more complex than conceptual models, with IDs and data types defined
  - **Physical**: The blueprint of the database, reflecting physical relationships between entities