1.3.2 Relational Databases

Databases

A **database** is an organised collection of data.

A **flat file** database is a database where all the data is stored in one table.

A **relational database** stores data in multiple tables with relationships between them

The data in a database is stored in **tables**.

Each entry/row in the table is a **record**.

Each column in the table is a **field/attribute**.

customerID	firstName	lastName	phone	country
1	John	Smith	020-4034-4930	USA
2	Harriet	Jones	523-4231-9970	UK
3	Billy	Baggins	060-2095-4937	FR
4	Fred	Tomlin	159-6344-4932	UK
5	Rebecca	Taylor	628-1135-6133	SP
6	David	Roberts	941-6274-7330	USA
7	Rohey	Doe	824-3334-1932	USA

Flat File Database

A **flat file** database is a database where all the data is stored in one table.

They are very simple to implement but:

- Can have a lot of repeating data.
- Are slower to query as the database grows.
- Are difficult to maintain as the database becomes larger.

Student ID	First name	Surname	Teacher	Subject
1	John	Smith	Mr. Bear	Mathematics
2	Harriet	Jones	Mr. Bear	Mathematics
3	Billy	Baggins	Ms. Peacock	English
4	Fred	Tomlin	Mr. Bear	Mathematics
5	Rebecca	Taylor	Mr. Bear	Mathematics
6	David	Roberts	Ms. Peacock	English
7	Rohey	Doe	Ms. Peacock	English

The teachers and their subjects are repeated multiple times in the table.

Relational Database

A **relational database** is a database which is created using multiple tables with relationships between those tables.

An **entity** is an object or concept about which data is stored. In a relational database, an entity is usually represented by a table.

For example, a database for a site that stores details of customers and downloaded movies may have 3 tables. One for the customers, one for the movies and the other for storing details about the downloads.

There are 3 entities: customer, movie and download

customer		
customerID	**firstName**	**lastName**
1	John	Smith
2	Harriet	Jones
3	Billy	Baggins
4	Fred	Tomlin
5	Rebecca	Taylor
6	David	Roberts
7	Rohey	Doe

movie	
movieID	**movie**
1	Alien
2	The Hobbit
3	Troy
4	Avatar
5	Terminator
6	Shrek
7	Thor

download		
customerID	**movieID**	**date**
1	2	02/06/22
1	3	08/06/22
2	1	14/07/22
4	6	05/08/22
5	6	11/09/22
7	3	12/10/22
7	7	25/10/22

Benefits of relational databases

- Reduced data redundancy.
- Improved data consistency.
- Fields can be more easily added or removed from tables.
- Security can be improved by controlling access to different table.
- Easier to query.

Primary and Composite Keys

A **primary key** is a field that can be used to uniquely identify a record in a table.

A **composite key** is a primary key that is made up of two or more fields.

The *customerID* is the customer table is a primary key as it is a unique identifier for a customer. *movieID* is a primary key for the movie table

The download table has a composite key. Its primary key is the combination of the *customerID* and *movieID* fields.

customer		
customerID	**firstName**	**lastName**
1	John	Smith
2	Harriet	Jones
3	Billy	Baggins
4	Fred	Tomlin
5	Rebecca	Taylor
6	David	Roberts
7	Rohey	Doe

movie	
movieID	**movie**
1	Alien
2	The Hobbit
3	Troy
4	Avatar
5	Terminator
6	Shrek
7	Thor

download		
customerID	**movieID**	**date**
1	2	02/06/22
1	3	08/06/22
2	1	14/07/22
4	6	05/08/22
5	6	11/09/22
7	3	12/10/22
7	7	25/10/22

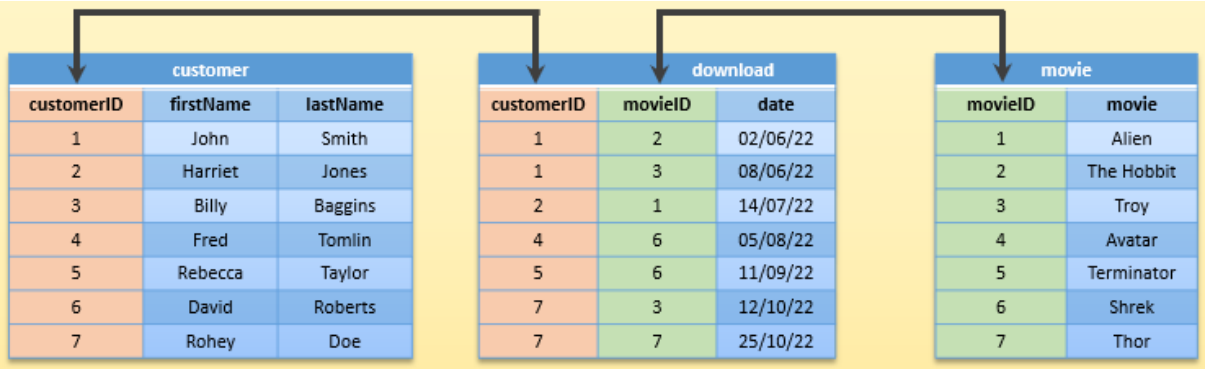
Foreign Keys

A foreign key is a field in one table that links to a primary key in another table.

The foreign key – primary key pairings form the relational links between the entities.

The customerID field in the download table is a foreign key that links to the primary key in the customer table.

The movieID field in the download table is a foreign key that links to the primary key in the movie table.



Entity-relationship Diagram

An **entity-relationship diagram** is a visual description of relationships between entities.

There are three types of relationship that can exists between entities:

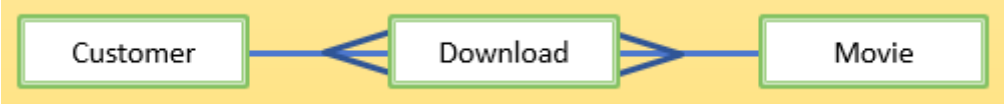
1 **One-to-one** – For example, an employee may have one office and that office is only used by that employee.

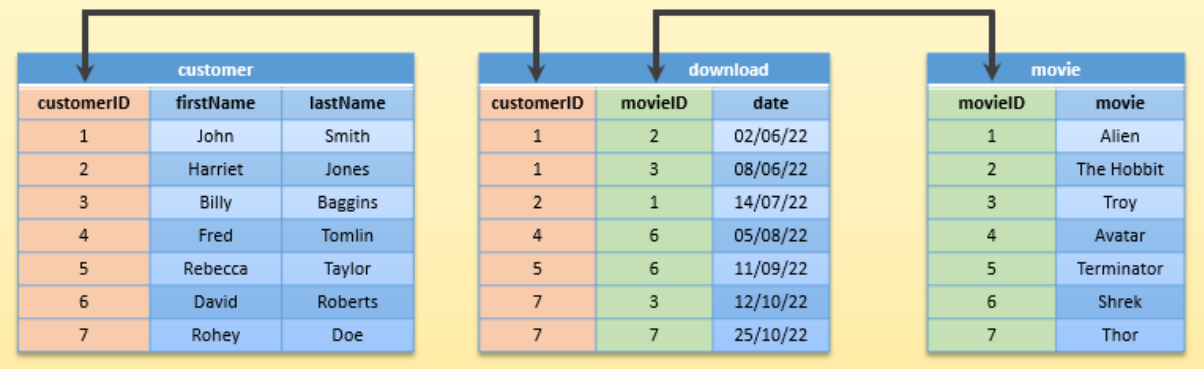
2 **One-to-many** – For example, customer may make many downloads, but each download will be by one customer.

3 **Many-to-many** – For example, a customer may purchase many movies, and a movie may have been purchased by many customers.

You can work out the entity relationship diagram for a database by finding the foreign keys.

For a one-to-many relationship, the table containing the foreign key is the 'many' side, while the table containing the referenced primary key is the 'one' side.





customer

customerID	firstName	lastName
1	John	Smith
2	Harriet	Jones
3	Billy	Baggins
4	Fred	Tomlin
5	Rebecca	Taylor
6	David	Roberts
7	Rohey	Doe

download

customerID	movieID	date
1	2	02/06/22
1	3	08/06/22
2	1	14/07/22
4	6	05/08/22
5	6	11/09/22
7	3	12/10/22
7	7	25/10/22

movie

movieID	movie
1	Alien
2	The Hobbit
3	Troy
4	Avatar
5	Terminator
6	Shrek
7	Thor

Entity Descriptions

Details of a database can be written in simple notation. The table name is given with the attributes after in brackets. The primary key, or fields making up a composite key, are underlined.

customer (<u>customerID</u>, firstName, lastName)

movie (<u>movieID</u>, movie)

download (<u>customerID, movieID</u>, date)

customer

customerID	firstName	lastName
1	John	Smith
2	Harriet	Jones
3	Billy	Baggins
4	Fred	Tomlin
5	Rebecca	Taylor
6	David	Roberts
7	Rohey	Doe

movie

movieID	movie
1	Alien
2	The Hobbit
3	Troy
4	Avatar
5	Terminator
6	Shrek
7	Thor

download

customerID	movieID	date
1	2	02/06/22
1	3	08/06/22
2	1	14/07/22
4	6	05/08/22
5	6	11/09/22
7	3	12/10/22
7	7	25/10/22