Databases

INTRODUCTION TO SQL

Introducing databases

A database is an organized collection of structured information, or data, typically stored electronically in a computer system.

patrons

card_num	name	member_year	total_fine
54378	Izzy	2012	9.86
94722	Maham	2020	0
45783	Jasmin	2022	2.05
90123	James	1989	0

books

id	title	author	genre	pub_year
638	Being Mortal	Atul Gawande	Non-Fiction	2015
912	Educated	Tara Westover	Non-Fiction	2018
322	Night	Elie Wiesel	Non-Fiction	1956
156	Where the Wild Things Are	Maurice Sendak	Childrens	1963

checkouts

id	start_date	due_date	card_num	book_id
567	2022-05-13	2022-05-27	54378	638
568	2022-06-10	2022-06-24	54378	322
569	2022-06-27	2022-07-11	45783	156
570	2022-08-14	2022-08-28	90123	912

Introducing databases

patrons

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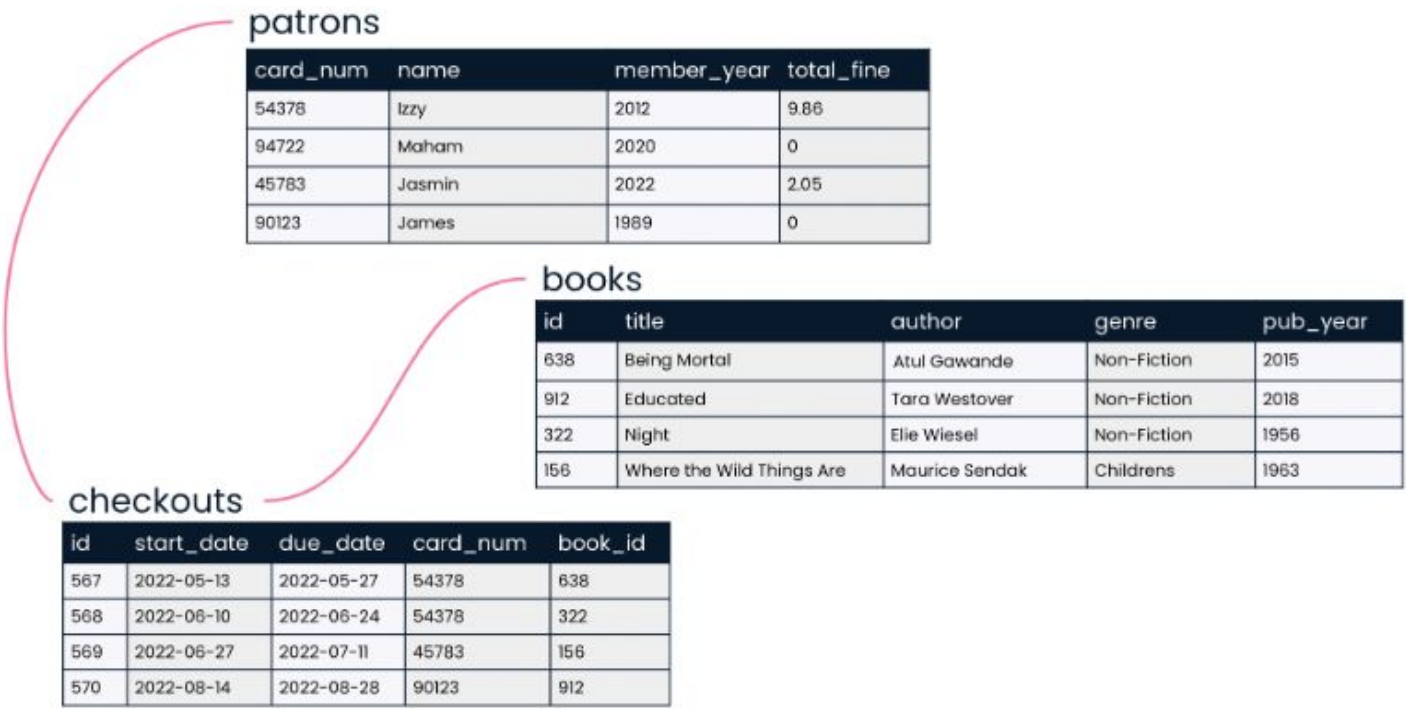
90123	James	1989	0

Relational databases

- Define relationships between tables of data inside the database



patrons

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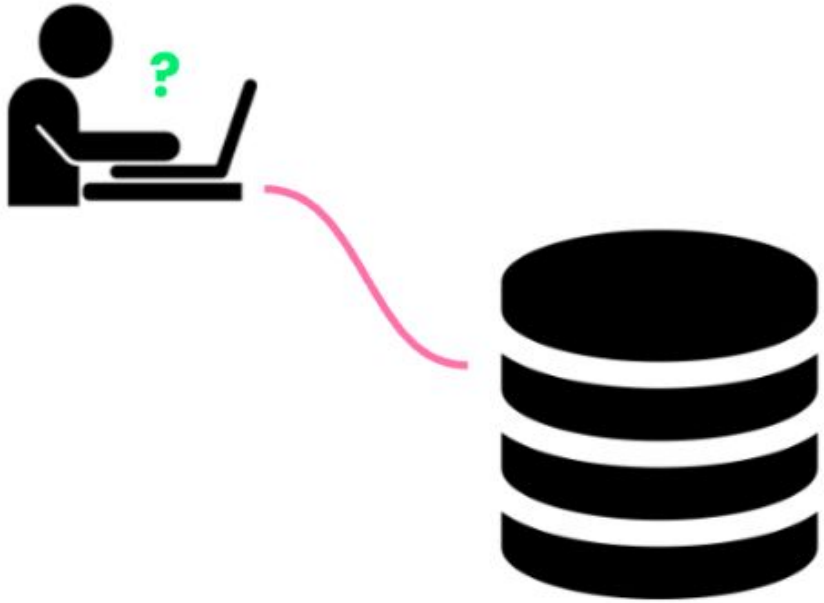
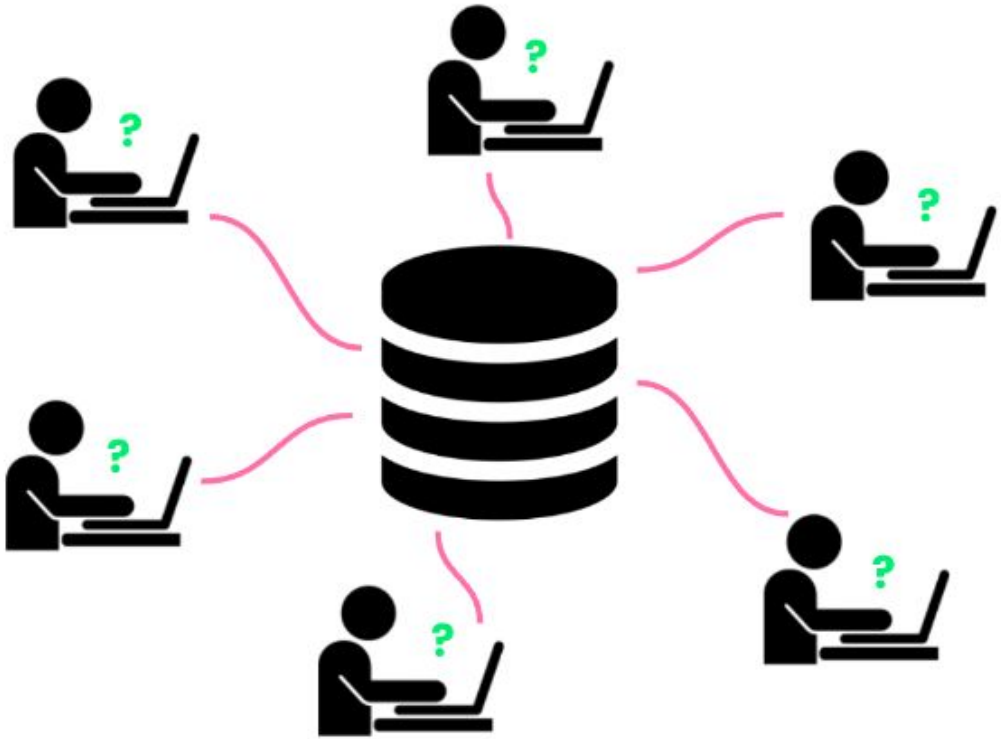
Database advantages

- More storage than spreadsheet applications
- Storage is more secure



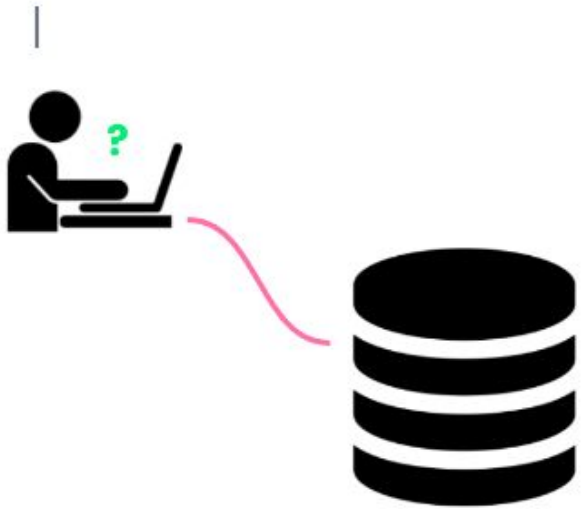
Database advantages



SQL

- Short for Structured Query Language
- The most widely used programming language for databases

```sql
SELECT *
FROM patrons
LIMIT 30
```

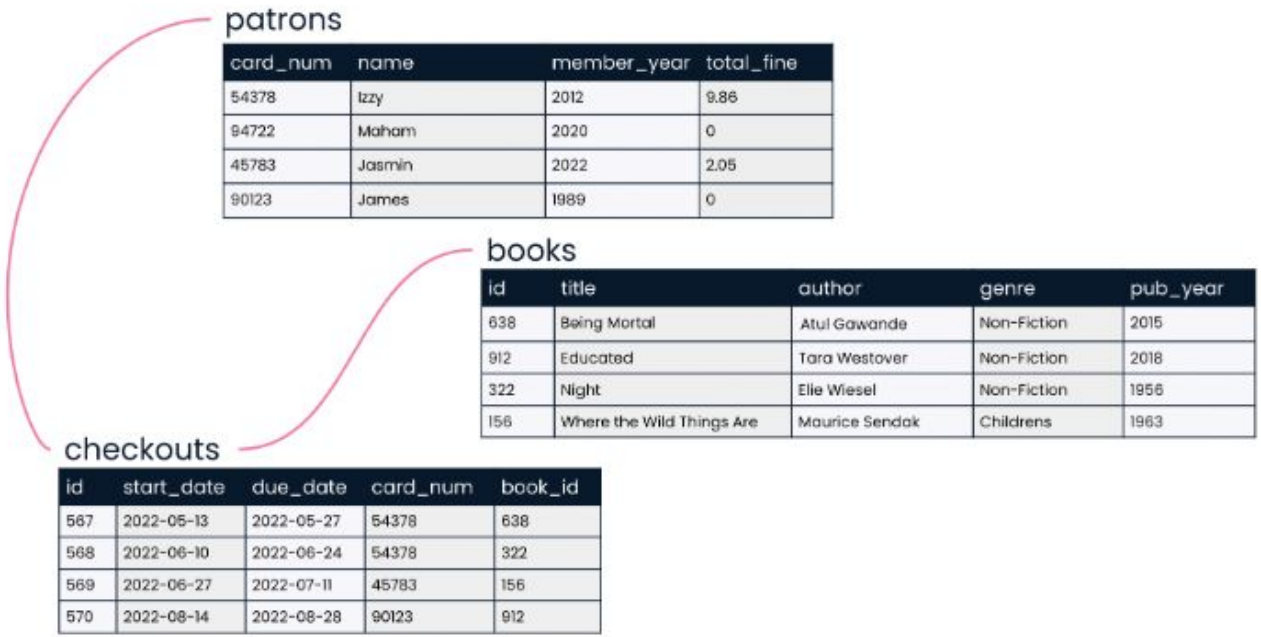


Tables

INTRODUCTION TO SQL

A seat at the table

- Table rows and columns are referred to as *records* and *fields*
- Fields are set at database creation; there is no limit to the number of records



patrons

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Good table manners

Table names should...

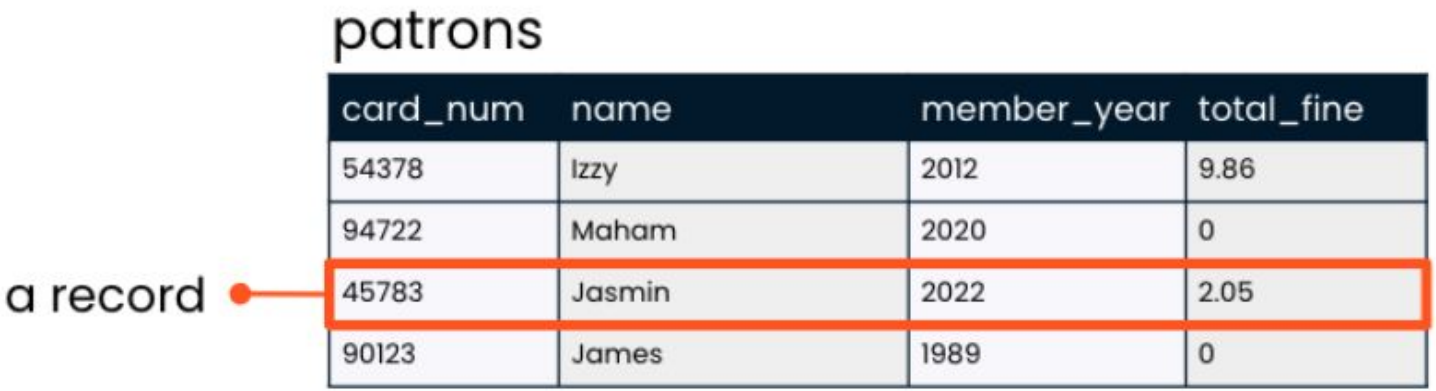
- be lowercase
- have no spaces—use underscores instead
- refer to a collective group or be plural

patrons

card_num	name	member_year	total_fine
54378	Izzy	2012	9.86
94722	Maham	2020	0
45783	Jasmin	2022	2.05
90123	James	1989	0

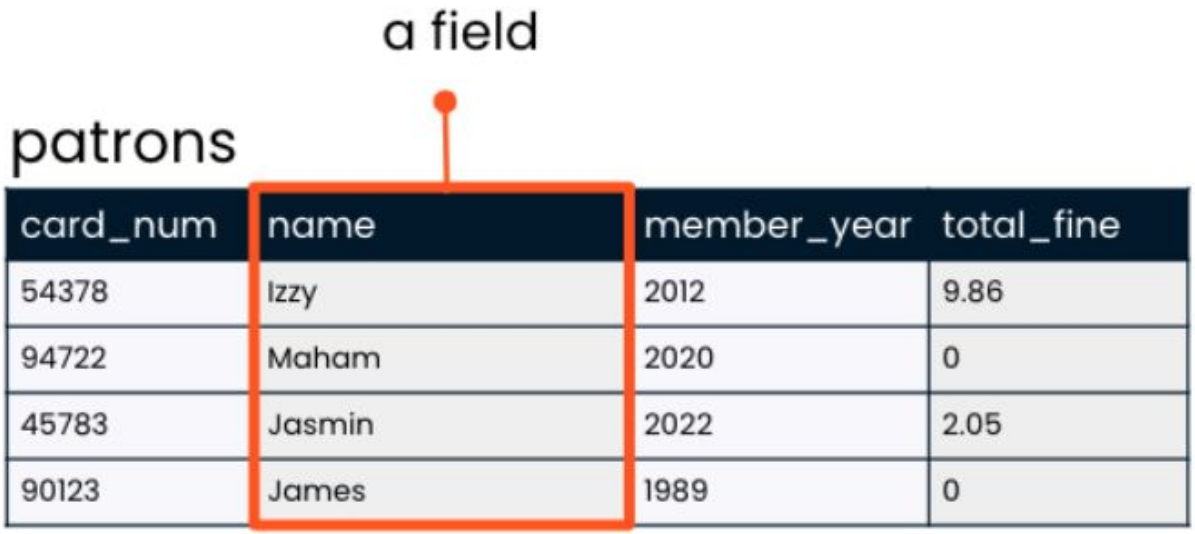
Laying the table: records

A record is a row that holds data on an individual observation



Laying the table: fields

A field is a column that holds one piece of information about all records



card_num	name	member_year	total_fine
54378	Izzy	2012	9.86
94722	Maham	2020	0
45783	Jasmin	2022	2.05
90123	James	1989	0

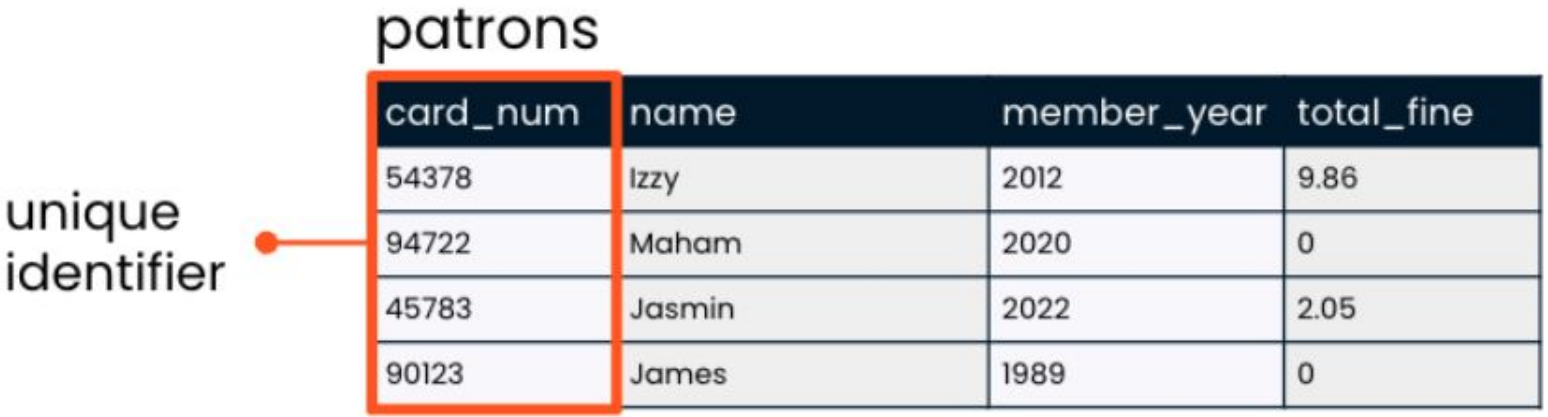
More table manners

Field names should...

- be lowercase
- have no spaces
- be singular
- be different from other field names
- be different from the table name

Assigned seats

- *Unique identifiers* are used to identify records in a table
- They are unique and often numbers



The more the merrier

patrons

card_num	name	member_year	total_fine
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checkouts

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570	2022-08-14	2022-08-28	90123	912

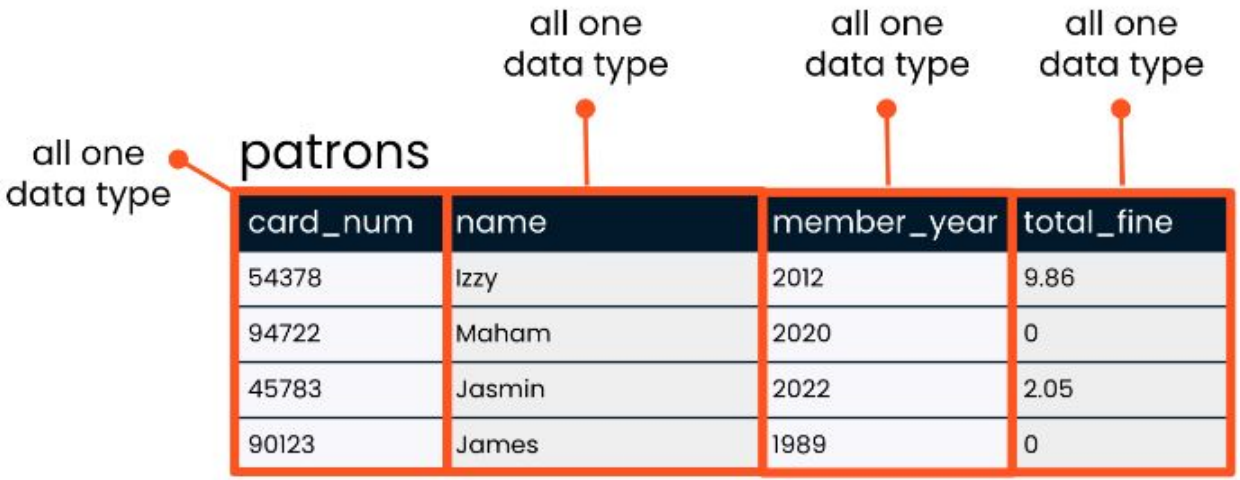
patron_checkouts

card_num	name	member_year	total_fine	checkout_id	start_date	due_date	book_id
54378	Izzy	2012	9.86	567	2022-05-13	2022-05-27	638
54378	Izzy	2012	9.86	568	2022-06-10	2022-06-24	322
94722	Maham	2020	0				
45783	Jasmin	2022	2.05	2022-06-27	2022-07-11	45783	156
90123	James	1989	0	570	2022-08-14	2022-08-28	912

Data

INTRODUCTION TO SQL

SQL data types



card_num	name	member_year	total_fine
54378	Izzy	2012	9.86
94722	Maham	2020	0
45783	Jasmin	2022	2.05
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- Different types of data are stored differently and take up different space
- Some operations only apply to certain data types

Strings

- A string is a sequence of characters such as letters or punctuation
- `VARCHAR` is a flexible and popular string data type in SQL

Integers

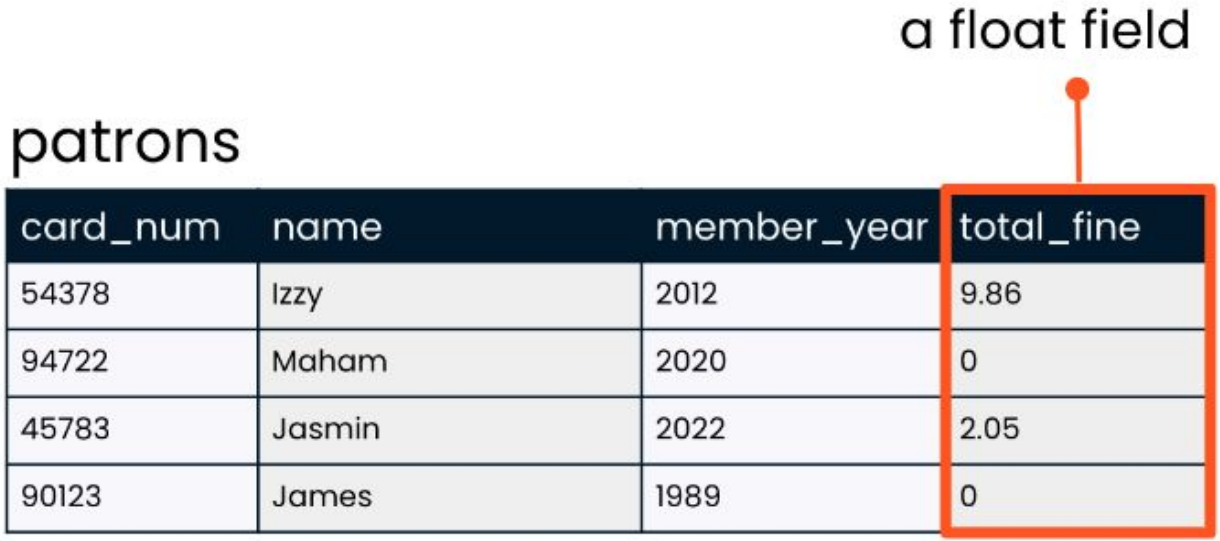
an integer field

patrons

card_num	name	member_year	total_fine
54378	Izzy	2012	9.86
94722	Maham	2020	0
45783	Jasmin	2022	2.05
90123	James	1989	0

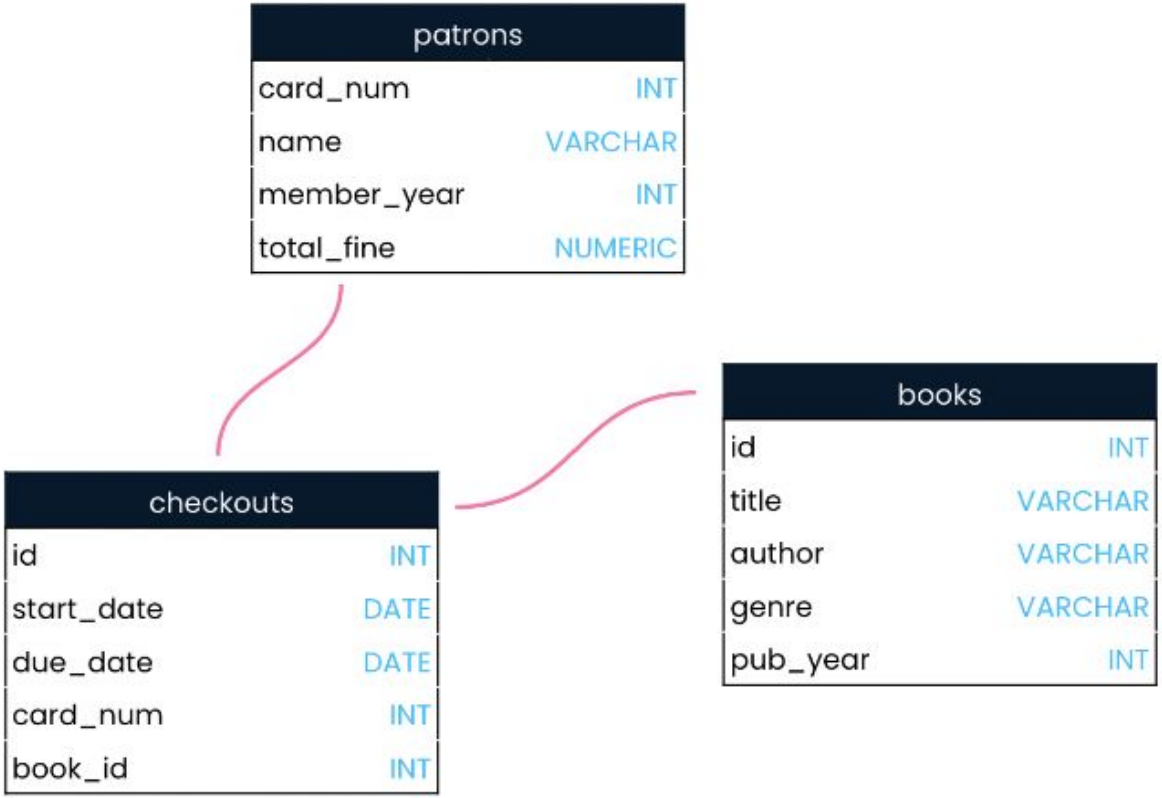
- Integers store whole numbers
- `INT` is a flexible and popular integer data type in SQL

Floats



- Floats store numbers that include a fractional part
- `NUMERIC` is a flexible and popular float data type in SQL

Schemas


patrons
card_num INT
name VARCHAR
member_year INT
total_fine NUMERIC
checkouts
id INT
start_date DATE
due_date DATE
card_num INT
book_id INT
books
id INT
title VARCHAR
author VARCHAR
genre VARCHAR
pub_year INT

Introducing queries

What is SQL useful for?

patrons

card_num	name	member_year	total_fine
54378	Izzy	2012	9.86
94722	Maham	2020	0
45783	Jasmin	2022	2.05
90123	James	1989	0

SQL is used to communicate with a database and it is used to store, retrieve, and manipulate data in relational databases

books

id	title	author	genre	pub_year
638	Being Mortal	Atul Gawande	Non-Fiction	2015
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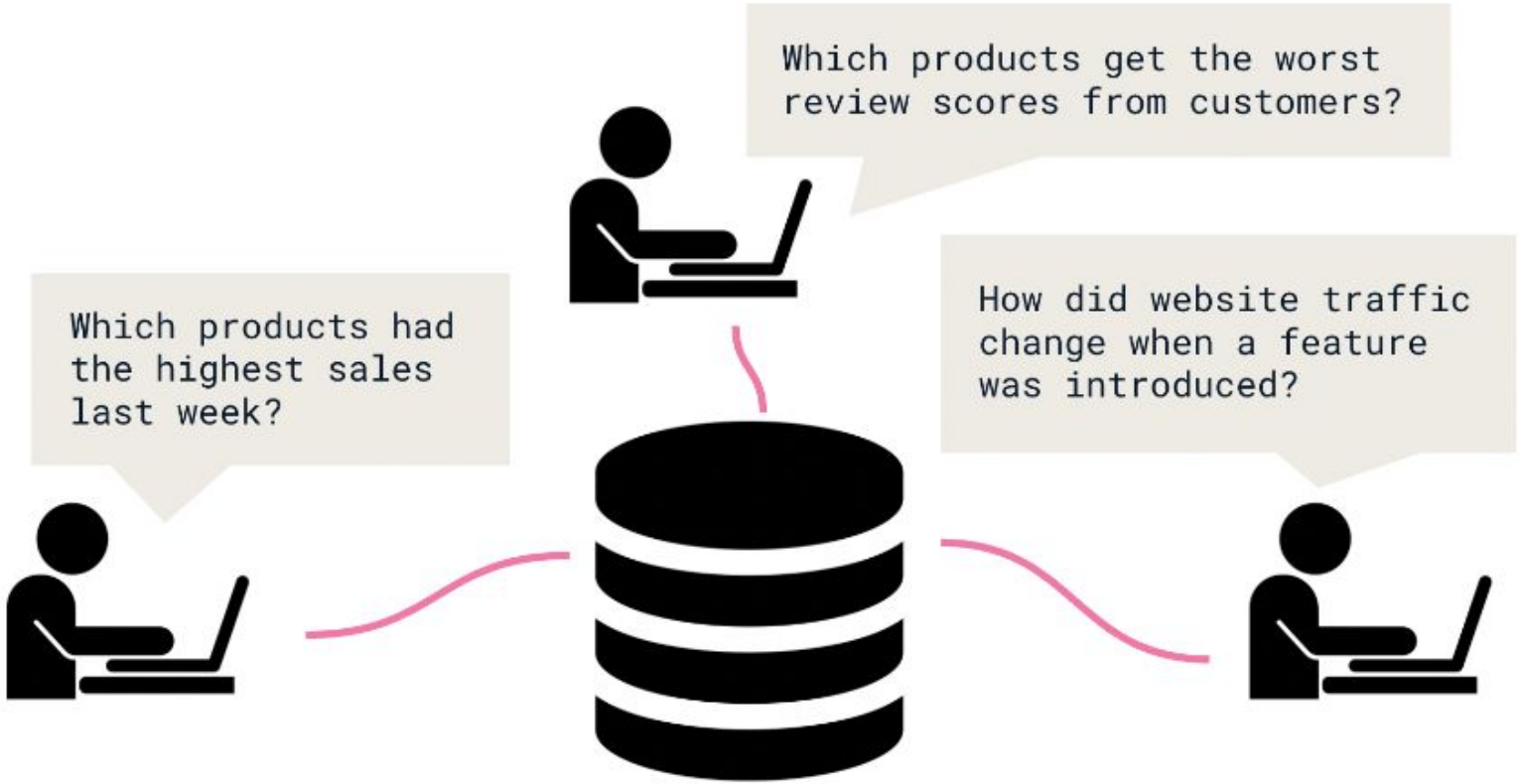
Best for large datasets



Keywords

Keywords are reserved words for operations

Common keywords: `SELECT` , `FROM`

```
SELECT name
```

```
FROM patrons
```

patrons

card_num	name	member_year	total_fine
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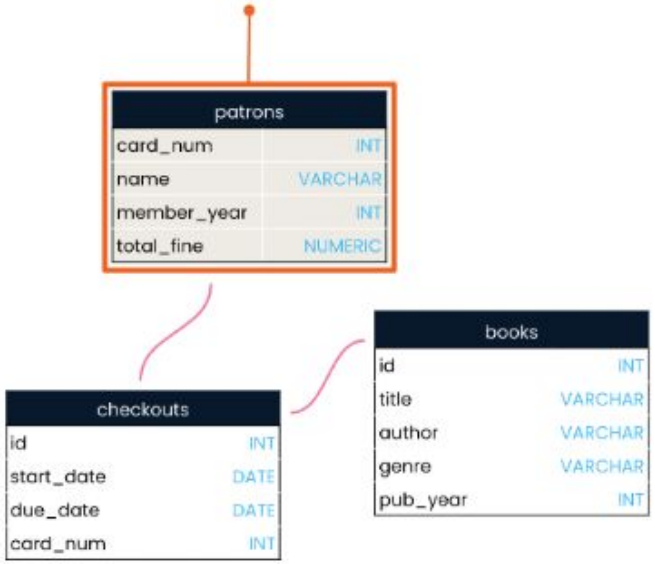

Our first query

```
SELECT name
FROM patrons;
```

```
| name   |
|--------|
| Izzy   |
| Maham  |
| Jasmin |
| James  |
```

patrons

card_num	name	member_year	total_fine
54378	Izzy	2012	9.86
94722	Maham	2020	0
45783	Jasmin	2022	2.05
90123	James	1989	0

- Query results often called *result set*

Selecting multiple fields

```
SELECT card_num, name
FROM patrons;
```

```
| card_num | name   |
|----------|--------|
| 54378    | Izzy   |
| 94722    | Maham  |
| 45783    | Jasmin |
| 90123    | James  |
```

```
SELECT name, card_num
FROM patrons;
```

```
| name   | card_num |
|--------|----------|
| Izzy   | 54378    |
| Maham  | 94722    |
| Jasmin | 45783    |
| James  | 90123    |
```

Selecting multiple fields

```
SELECT name, card_num, total_fine
FROM patrons;
```

```
| card_num | name   | total_fine |
|----------|--------|------------|
| 54378    | Izzy   | 9.86       |
| 94722    | Maham  | 0          |
| 45783    | Jasmin | 2.05       |
| 90123    | James  | 0          |
```

Selecting all fields

```
SELECT *
FROM patrons;
```

```
| card_num | name   | member_year | total_fine |
|----------|--------|-------------|------------|
| 54378    | Izzy   | 2012        | 9.86       |
| 94722    | Maham  | 2020        | 0          |
| 45783    | Jasmin | 2022        | 2.05       |
| 90123    | James  | 1989        | 0          |
```

Writing queries

INTRODUCTION TO SQL

Aliasing

Use *aliasing* to rename columns

```
SELECT name AS first_name, year_hired
FROM employees;
```

```
| first_name | year_hired |
|------------|------------|
| Darius     | 2020       |
| Raven      | 2017       |
| Eduardo    | 2022       |
| Maggie     | 2021       |
| Amy        | 2020       |
| Meehir     | 2021       |
```

Selecting distinct records

```sql
SELECT year_hired
FROM employees;
```

```
| year_hired |
|------------|
| 2020       |
| 2017       |
| 2022       |
| 2021       |
| 2020       |
| 2021       |
```

```sql
SELECT DISTINCT year_hired
FROM employees;
```

```
| year_hired |
|------------|
| 2020       |
| 2017       |
| 2022       |
| 2021       |
```

DISTINCT with multiple fields

employees

id	name	dept_id	job_level_id	year_hired
54378	Darius	1	3	2020
94722	Raven	2	3	2017
45783	Eduardo	2	1	2022
90123	Maggie	3	2	2011
67284	Amy	2	2	2009
26148	Meehir	3	3	2021

```
SELECT dept_id, year_hired
FROM employees;
```

```
| dept_id | year_hired |
|---------|------------|
| 1       | 2020       |
| 2       | 2017       |
| 2       | 2022       |
| 3       | 2021       |
| 2       | 2020       |
| 3       | 2021       |
```

DISTINCT with multiple fields

```
SELECT DISTINCT dept_id, year_hired
FROM employees;
```

```
| dept_id | year_hired |
|---------|------------|
| 1       | 2020       |
| 2       | 2017       |
| 2       | 2022       |
| 3       | 2021       |
| 2       | 2020       |
```

Views

- A *view* is a virtual table that is the result of a saved SQL `SELECT` statement
- When accessed, views automatically update in response to updates in the underlying data

```
CREATE VIEW employee_hire_years AS
SELECT id, name, year_hired
FROM employees;
```

Using views

```
SELECT id, name
FROM employee_hire_years;
```

```
| id    | name    |
|-------|---------|
| 54378 | Darius  |
| 94722 | Raven   |
| 45783 | Eduardo |
| 90123 | Maggie  |
| 67284 | Amy     |
| 26148 | Meehir  |
```

SQL flavors

INTRODUCTION TO SQL

SQL flavors

- Both free and paid
- All used with relational databases
- Vast majority of keywords are the same
- All must follow universal standards
- Only the additions on top of these standards make flavors different

Two popular SQL flavors

PostgreSQL

- Free and open-source relational database system
- Created at the University of California, Berkeley
- "PostgreSQL" refers to both the PostgreSQL database system and its associated SQL flavor

SQL Server

- Has free and paid versions
- Created by Microsoft
- T-SQL is Microsoft's SQL flavor, used with SQL Server databases

Comparing PostgreSQL and SQL Server

- Like dialects of the same language

PostgreSQL:

```
SELECT id, name
FROM employees
LIMIT 2;
```

```
| id    | name   |
|-------|--------|
| 54378 | Darius |
| 94722 | Raven  |
```

- Example: limiting number of results

SQL Server:

```
SELECT TOP(2) id, name
FROM employees;
```

```
| id    | name   |
|-------|--------|
| 54378 | Darius |
| 94722 | Raven  |
```

Choosing a flavor

Just like with ice cream, any flavor is probably a good choice!