

ICT. Databases

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- When do we use databases?
- How are databases structured?
- How to handle databases with `sqlite3`?

A first example : train schedules

From Uccle to Leuven : <https://www.belgiantrain.be/en>

- 1 The application asks us : "Departure from".
- 2 We answer "Uccle Vivier d'Oie"
- 3 The application asks us : "Arrival at".
- 4 We answer "Leuven".
- 5 The application sends a SQL request to the database :

```
SELECT timeStart, timeStop FROM trains
WHERE stationStart = "Uccle Vivier d'Oie" AND
      stationStop = "Leuven";
```

- 6 The database gives the answers {(15h47, 17h22); (18h21, 19h58)}
- 7 The application prints on our screen :

```
Results for the journey Uccle Vivier d'Oie -> Leuven
First train  : 15h47 -> 17h22
Second train : 18h21 -> 19h58
```

A sub-set of our library : 2× “L’avare”, 3× “Les fleurs du mal”, 1× “Jane Eyre” and 2× “King Lear”. A table contains different fields. Each row of our table is a book, and each column shows the values of each field :

Author	Title	Genre
Molière	L'avare	Theater
Molière	L'avare	Theater
Baudelaire	Les fleurs du mal	Poetry
Baudelaire	Les fleurs du mal	Poetry
Baudelaire	Les fleurs du mal	Poetry
Brontë	Jane Eyre	Novel
Shakespeare	King Lear	Theater
Shakespeare	King Lear	Theater

First problem : we can't distinguish the different books we have. We add a unique identifier (an integer) for each book : this field is the primary key for our books.

Identifrier	Author	Title	Genre
1	Molière	L'avare	Theater
2	Molière	L'avare	Theater
3	Baudelaire	Les fleurs du mal	Poetry
4	Baudelaire	Les fleurs du mal	Poetry
5	Baudelaire	Les fleurs du mal	Poetry
6	Brontë	Jane Eyre	Novel
7	Shakespeare	King Lear	Theater
8	Shakespeare	King Lear	Theater

Second problem : we can't know who borrowed which book nor when.
We add two more fields to the table.

Id.	Author	Title	Genre	Borrower	From
1	Molière	L'avare	Theater	Bob	07/01/2022
2	Molière	L'avare	Theater	—	—
3	Baudelaire	Les fleurs du mal	Poetry	—	—
4	Baudelaire	Les fleurs du mal	Poetry	Alice	12/02/2022
5	Baudelaire	Les fleurs du mal	Poetry	—	—
6	Brontë	Jane Eyre	Novel	—	—
7	Shakespeare	King Lear	Theater	—	—
8	Shakespeare	King Lear	Theater	—	—

Third problem : we can't keep track of the history of borrowers.

Id.	Author	Title	Genre	B.1	From1	To1	B.2	From2	To2	...
...

Very bad solutions : our table can grow very fast, with a lot of empty cells.

Better strategy : create a second table for the users, and a third table for the borrowings.

I/ Our first database : Platon library

Identifrier	Author	Title	Genre
1	Molière	L'avare	Theater
2	Molière	L'avare	Theater
3	Baudelaire	Les fleurs du mal	Poetry
4	Baudelaire	Les fleurs du mal	Poetry
5	Baudelaire	Les fleurs du mal	Poetry
6	Brontë	Jane Eyre	Novel
7	Shakespeare	King Lear	Theater
8	Shakespeare	King Lear	Theater

Identifrier	Surname	First name
1	Smith	Alice
2	Johnson	Bob

Identifrier	Borrower id.	Book id.	From	To
1	2	1	07/01/2022	—
2	1	4	12/02/2022	—

This third table transforms our database into a relational database. It is impossible to understand this table without the two others. For each borrowing :

- to know who is the borrower, we need the user table, and
- to know what is the book borrowed, we need the book table.

Identifier	Borrower id.	Book id.	From	To
1	2	1	07/01/2022	—
2	1	4	12/02/2022	—