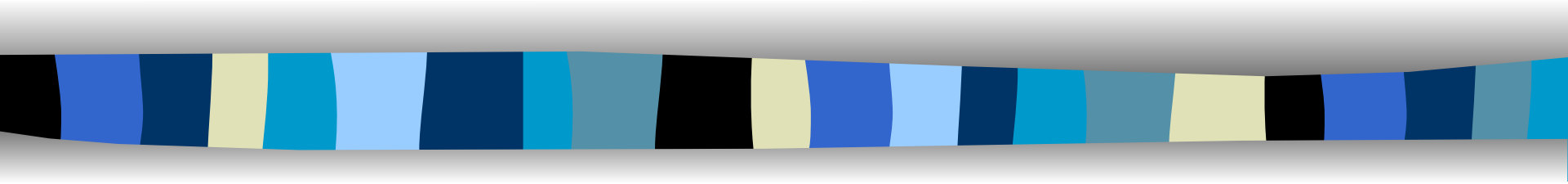
Web Databases



CSCI 3000
Web Programming

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Introduction

- Databases are important components of information systems.
- It is particularly important when we use them as part of web applications.
- In this course we will try to answer some questions like:
  - Why do we need a database?
  - What problems do we face if we do not have one?
  - What are the available database software options?

Understanding Databases

- What are databases? They are tools for solving certain problems.
- Those problems arise from having data that need to be stored.
- Data or information may include information about customers, products, employees, orders, details about the visits to your website, etc.

Understanding Databases

- The data could be in text format, it could be names and descriptions, or numeric amounts, or dates, or this could be document files or images, audio, or video.
- You can store some of this data in files and/or spreadsheets. If they are documents you can store them in folders.
- Having data is not a good enough reason to need a database.
- Having data is not the problem.

Potential Problems Related to Data

- Problems with data:
  - Size of the data is a potential problem.
  - Ease of updating your data
  - Accuracy of it
  - Security of it
  - Redundancy in it
  - Importance of the data.
- These are the reasons of having a database

Potential Solutions

- The database can make the data:
  - Scalable
  - Accessible
  - Accurate
  - Secure
  - Consistent
  - Permanent
- Databases give us structure. It imposes rules on the data.

Database Management Systems (DBMS)

- Oracle
- SQL Server
- MySQL
- PostgreSQL
- MongoDB

- DBMS are software that need to be installed

Database and DBMS

- The **database** is your data and your rules about that data.
- The **database management system**, the DBMS, is the program or the set of programs that surround and manage it, to make sure your rules are applied.

Relational DBMS

- Oracle
- SQL Server
- DB2
- MySQL
- PostgreSQL
- SQLite
- MS Access

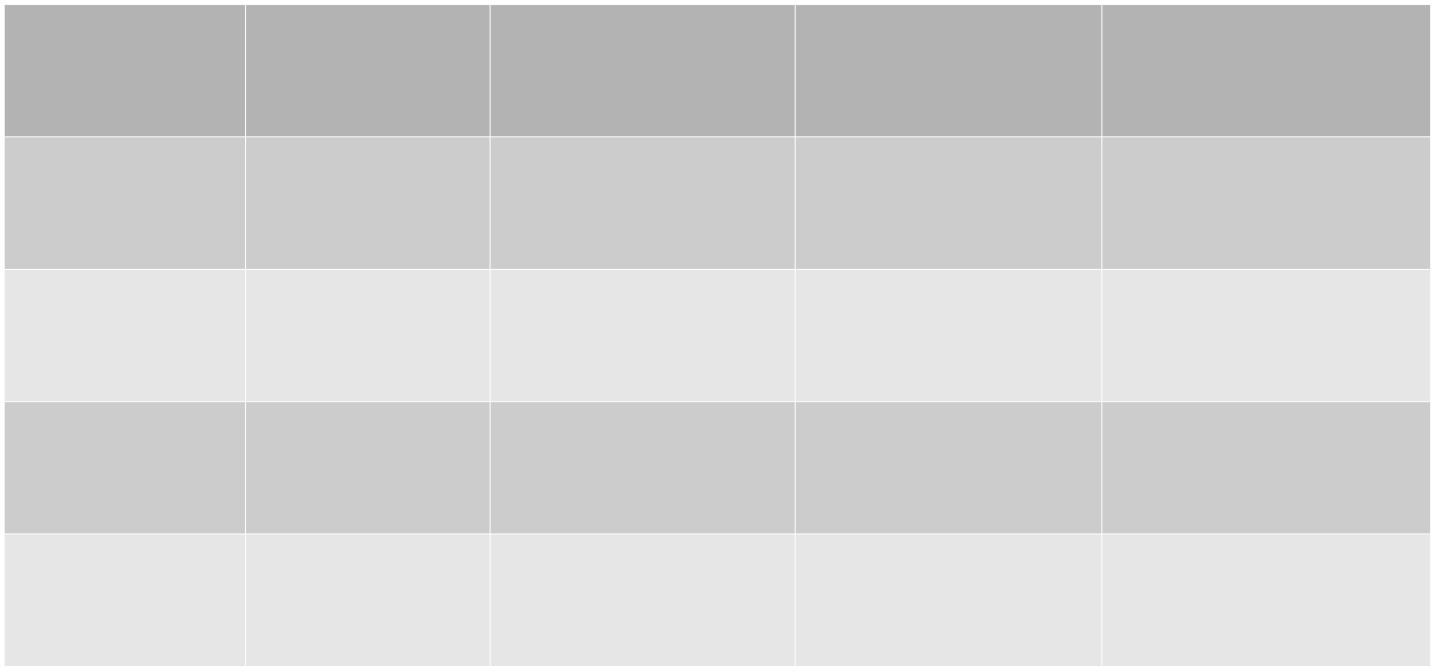
- Relational DBMS are the most common

Relational DBMS

- Relational DBMS are the most widely used
- They use the same principles across all offerings
- Are foundational for understanding other systems.

Database Fundamentals

- Features of Relational Database:
  - Consists of Tables as main building blocks
- Tables: Rows and Columns



Tables

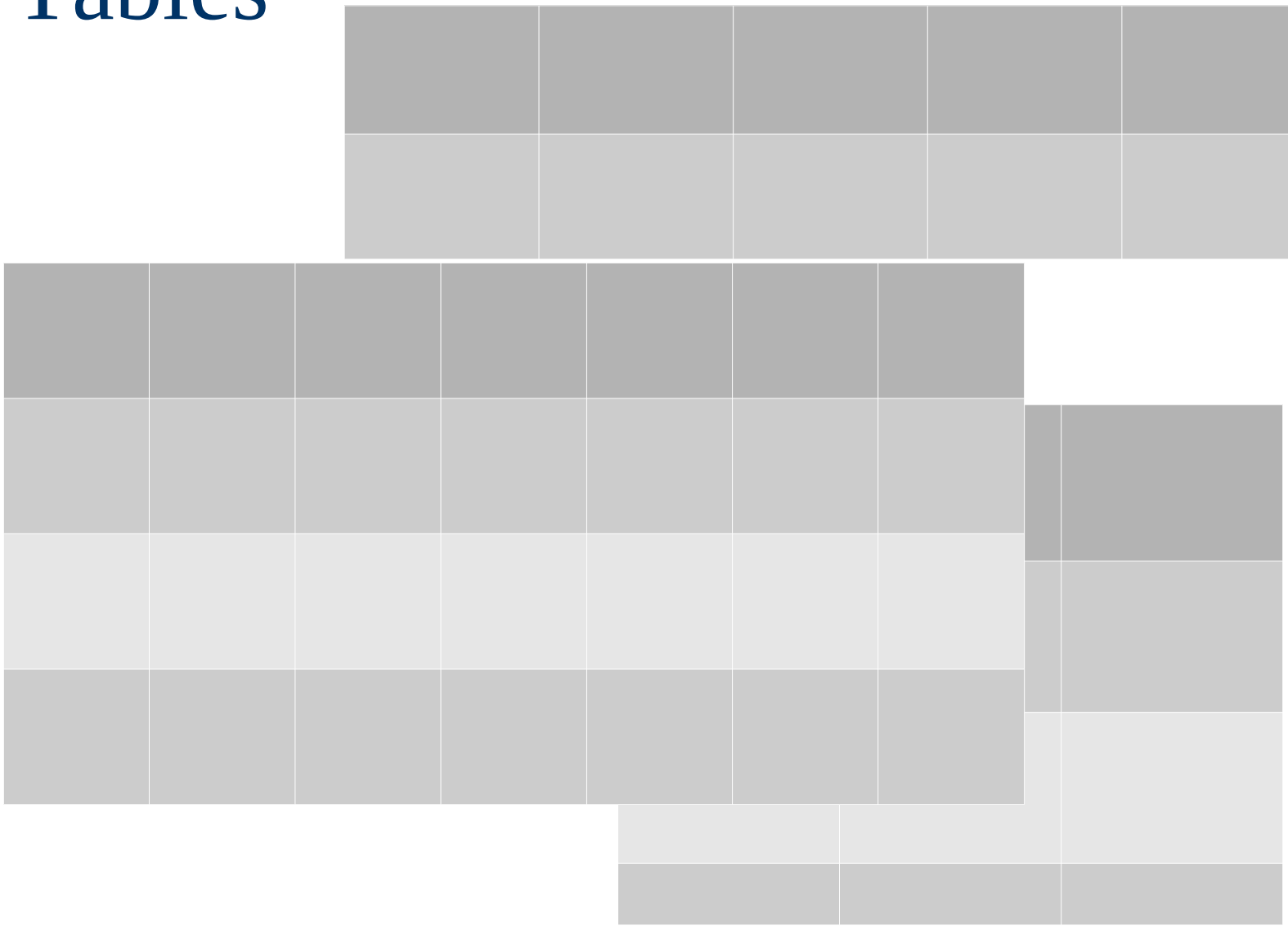


Table Design

- Apply structure to data defining how the information will be stored in the table.

FirstName	LastName	HireDate	Grade	Salary
Alice	Mann	4/4/2012	5	80000
James	Black	3/7/2016	4	75000
Calista	Guerra	8/15/2008	7	90000
Fay	Fitzgerald	11/5/2014	5	80000

Table Design

- By deciding what the columns are, and defining them, we are imposing rules on the data.
- Once we describe these rules, the database management system will not let us break them.
- **Tables** and **columns** are defined up front.
- Day-to-day use is in creating and updating **rows**.

Unique Values and Primary Keys

- All tables in a database will require a **key**.
- A **key** identifies one particular row in a table.
- The **key** will be in a defined column, which contains ***unique values*** per row.
- Examples of **keys** are ISBN numbers, SS numbers, employee ID numbers, etc.
- The main **key** in a database is called ***primary key***.

Unique Values and Primary Keys

- If natural unique values are not suitable for being keys (e.g. SS numbers) then the DBMS generates a primary key (e.g. customer number)
- Generated primary keys are also called ***synthetic keys*** or ***surrogate keys.***

Defining Table Relationships

- Customer Table

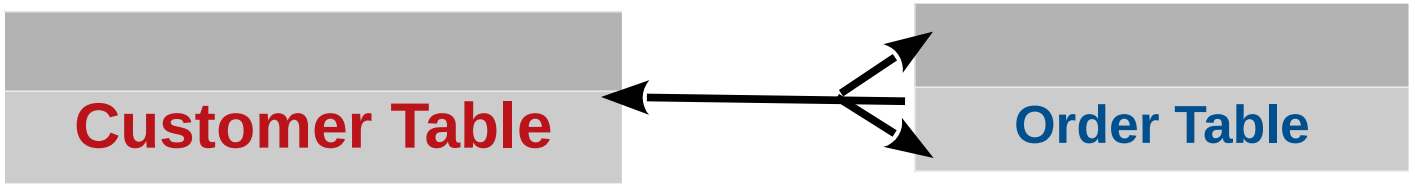
ID	fisrtName	lastName	email	address
367	Carl	Brown	br@a	22 Stone Ct
368	Vincent	Scott	sc@b	123 River Rd
369	Lynn	Allen	all@c	47 Main st.

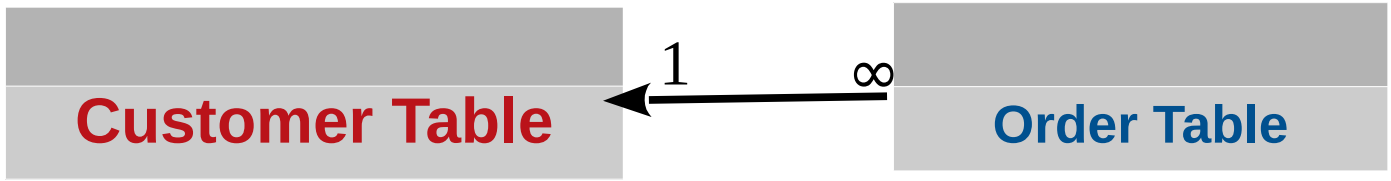
- Order table

orderID	Date	Quantity	Total	ID
367	2/11/2018	23	$956.00	367
368	6/23/2017	14	$580.00	368
369	5/11/2016	56	$1590.00	367

One to Many Relationship

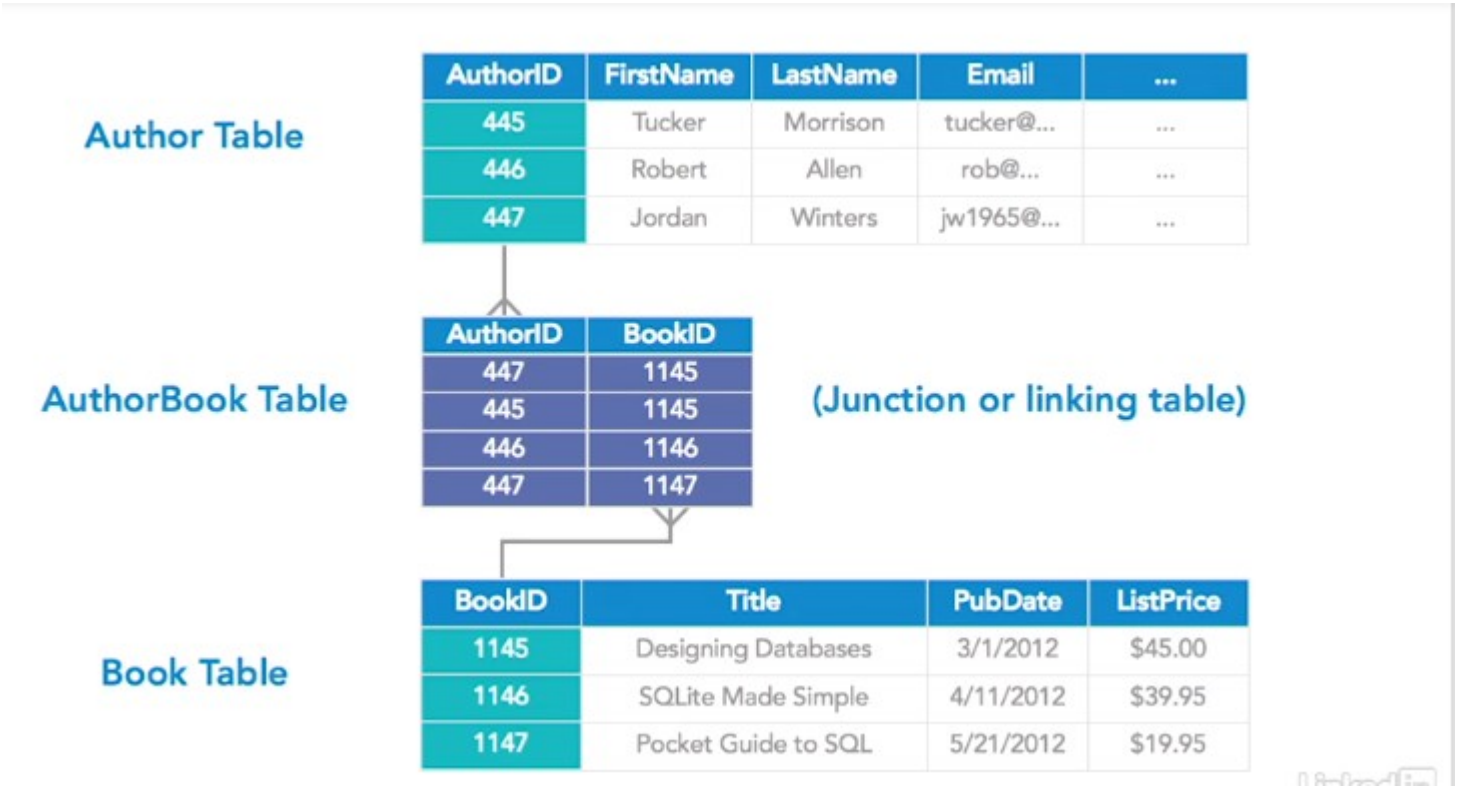
- One customer can have multiple orders.





Many to Many Relationship

- Multiple authors can publish multiple books.



One to One Relationship

Transactions and the ACID Test

Banking Transaction

Account	AccountType	Balance
A2354542	Savings	$6000

Account	AccountType	Balance
C9876567	Checking	$12

Transaction

- $2000

+ $2000

ACID Test

- A transaction should be:
  - **A**tomic
  - **C**onsistent
  - **I**solated
  - **D**urable
- This can be guaranteed by the DBMS after we provide the definition of the transaction.

Introduction to SQL

- SQL stands for Structured Query Language.
  - SQL
  - Microsoft SQL Server
  - MySQL
  - PostgreSQL
  - SQLite
  - T-SQL
  - PL-SQL
  - etc

Introduction to SQL

- SQL is a declarative query language, not a procedural, imperative language.
- SQL is small and focused.
- Example:
  - If we have a bookstore database
  - “I want all books with list price more than $40”
  - SQL: `SELECT * FROM Books WHERE ListPrice > 40`

Introduction to SQL

- SQL
  - Create
  - Read
  - Update
  - Delete

  data from the database.
- An SQL can be used to create, not just your data, but to define the databases themselves.