Database – an organized collection of data, stored and accessed electronically.

Accessed two ways

* Client-Server based – Designed to have many different users interacting with the system at the same time.
* Local databases – operated primarily by one user.

Primary Components

* Database Engine – Responsible for storing and retrieving data
* Database Management system (DBMS)
  + Means to interact with the database engine to send it commands to perform requested operations. E.g. Add new data, retrieve data, or modify it somehow.
* API (Application Programming Interface)
  + A way for programs and external software to interact with the database in similar ways as the DBMS system.
  + Also referred to as ‘Connectors’ and may be specific to each programming language.

What is a Database used for?

* Storing Information
* Providing Information to multiple Users
* Secure Data Management
* Easy Access To data
* Fast information Recall
* Cut Down on Staff Size
* Increased Efficiency

1960a Business Mainframes became available. Large, room-size computers.

Relational databases are our focus. Basis of this model was developed in the 1970s to overcome the shortcomings of data storage of the time. Goals were to reduce redundancy, efficient retrieval, and intuitive data modification.

Primary Components of a Database

* Software
  + Provides an interface to interact with the database system. Start and stop the service, create new databases, enter data, review results.
* Hardware
  + Can be contained on one physical machine or housed on many servers all working together to provide information to thousands.
* Command/Query Language
  + A way to tell the database system what to do, such as saving some new information or requesting saved information. We’re using SQL
* Database Engine
  + Defines exactly how information is stored, written to, or read form the computer disk or memory.
* Data
  + Multiple tables and information collected and saved into a database.
* User Roles
  + Various roles exist to provide security and permission levels to different parts of the database system.

What is a Database Model?

Defines how the structure and relationships between tables are managed.

* Pre-Relational database models
  + Any model developed prior to relational models
* Relational Model
  + The time in which the relational model dominated the database landscape. Still widely used
* Post-Relational database models
  + Models developed after the widespread use of the Relational Model.
* Pre-Relational Model
  + Flat Files – Spreadsheets
    - List of records with defined columns of data
  + Hierarchical and Network Models
    - Allowed separating the data into smaller chunks called ‘sets’ that could reference one another.
* Relational Model
  + Allow multiple connecting relationships between tables using a system of ID’s to cross-reference from one table to another.
* Post-Relational Database Models
  + Object-Oriented database model
    - Based on the objects created in a programming language.
  + Non-Relational database model (NoSQL)
    - Data typically isn’t stored in tables. Stores in XML format
      * Key-Value stores
      * Graph Stores
      * Column Stores
      * Document Stores
  + Store – Collection of data

Relational Database Terminology

* Tables
  + Collection information
  + Also known as an Entity or known as Relations
  + Tables contain named columns and rows of data like spreadsheets.
* Rows
  + Contain the data values for a single record
  + Often called records/Tuples
  + Each record must be unique
  + Rows are not ordered
* Columns
  + Define a value type to be saved
  + Called attributes or fields
  + Specified data type which defines info that can be entered and how it’s stored.
  + Columns are named
    - Short but descriptive
    - No spaces allowed
    - Can use underscore
  + Primary Keys
    - Defined to serve as Primary Keys
    - Unique identifiers to reference a specific record
      * Bank account number
      * Student ID
  + Foreign Keys
    - References to primary keys in parent tables
    - Must have same data type
  + Cell
    - Intersection between a record and a field which stores a single piece of information.

Relational Model Properties

* Values are Atomic
  + Field should have one data value that is an atomic value, meaning it’s singular.
  + Each cell can only hold one value
    - Cannot store two separate phone number into one field called ‘PhoneNumber’
* Column Values are of the same kind
* Each Row (Record) is Unique
* The sequence of the columns is insignificant
* Each column has a unique name

What makes up a Relation (Table)?

* Each relation contains data about one type of entity
* An entity is a person, place, object, event, or idea for which you want to store and process data
  + Student/Course/Customer/Product