



Database Management Systems: Fundamentals and Introduction to SQL

Introduction



Syllabus



Syllabus

Instructor's Information

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TA: Khushali Jiten Rathod <krathod@scu.edu>

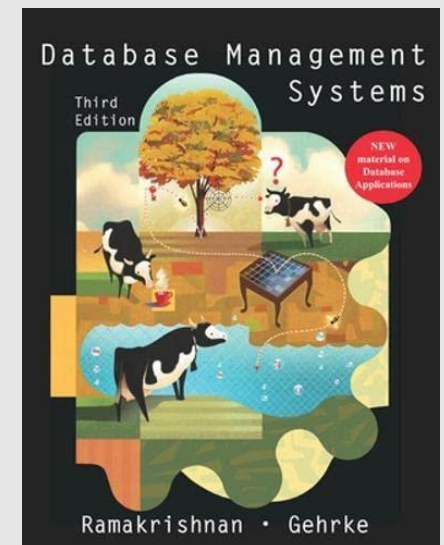
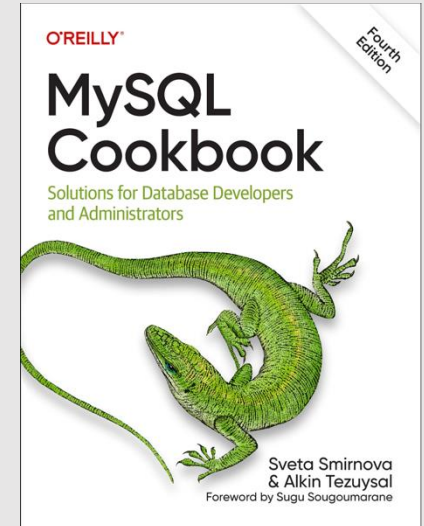
Recommended Textbooks

Textbook

- 1. Sveta Smirnova, Alkin Tezuysal (2022). ***MySQL cookbook: Solutions for database developers and administrators (4th ed.)***. O'Reilly Media. ISBN: 9781492093169.
- 2. Ramakrishnan, R., & Gehrke, J. (2002). ***Database management systems (3rd ed.)***. McGraw Hill. ISBN: 978-0072465631

MySQL 8.0 Reference Manual

- <https://dev.mysql.com/doc/refman/8.0/en/>



Course Objectives

Objectives	Assessments
Identify and define the characteristics of relational databases and modern database management systems.	Assignments, final exam
Write SQL commands to retrieve data from relational databases to answer business questions.	
Manipulate strings, dates, and numerical data from different sources for analysis.	
Understand advanced SQL topics, like MySQL-based programming, multiple table manipulation, data import, etc.	
Answer business questions and extract business insights using data analytics with SQL.	

Topics

Week	Topic	Reading (1 and 2 represent the sequence in the optional textbook list)
1	Intro to Relational Databases and SQL	1. Ch 1 2. Ch 1, 3
2	Intro to SQL Queries	1. Ch 5, 9, 10, 15 2. Ch5
3	Complex SQL Queries and Data Analytics	1. Ch 16, 17
4	Data Types	1. Ch 7, 8
5	Advanced Topics	1. Ch 11 2. Ch 16, 17



Grading

Assignment Type	Grade %
Participation	5%
Assignment	55%
Final Exam	40%



Others

- Technology requirement
 - MySQL Server – **required**
 - MySQL Workbench – **required**
 - Bring your laptop – highly recommended
- Accommodation, conflicts, etc.



Course Activities

- Lectures on basics
- Demonstration of major functions of SQL
- Learning by doing
 - In-class problem solving
 - Lab and practice



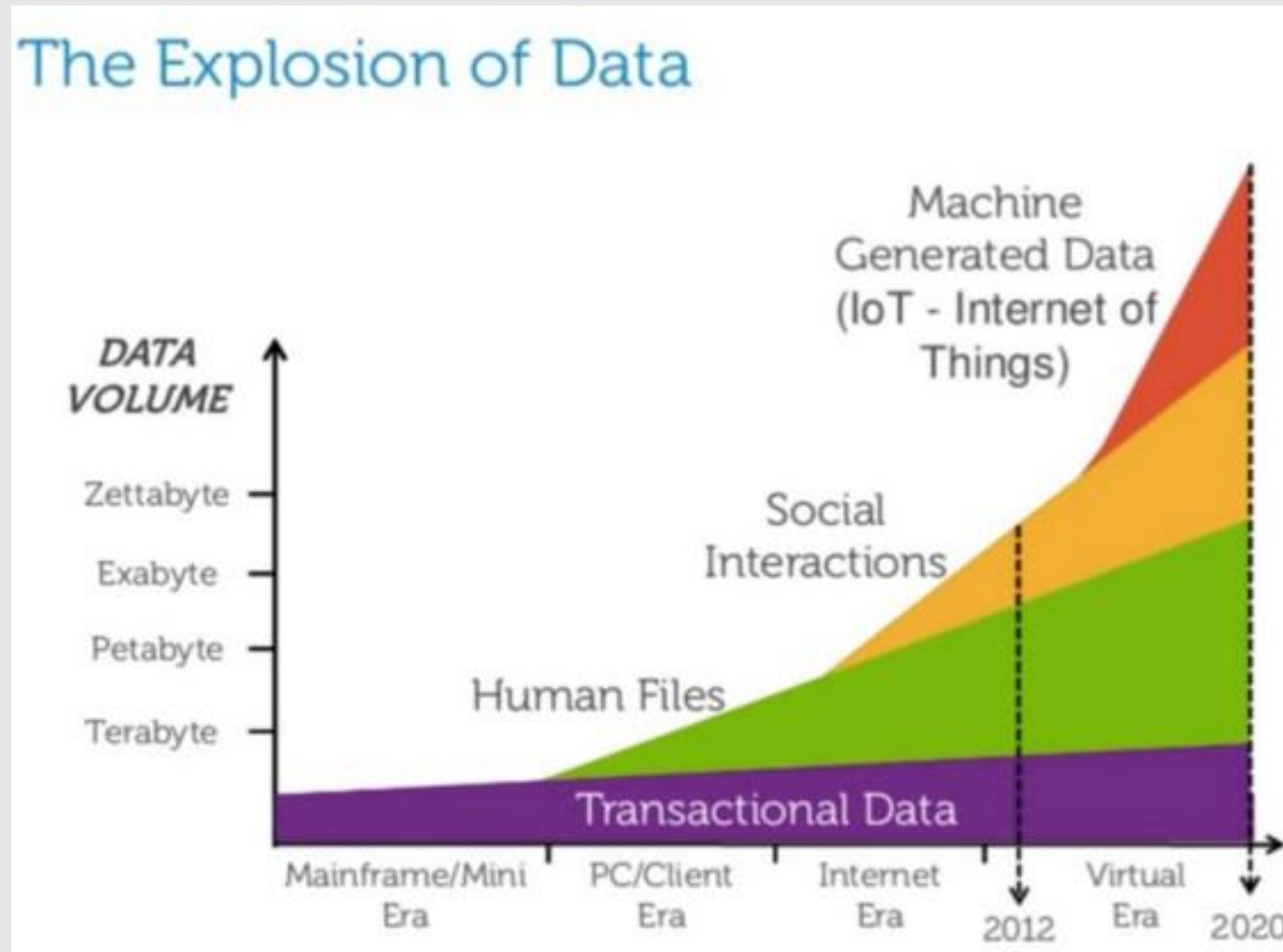
Grading Policies

- Late submissions
 - A 10% deduction per day applies to late assignment submissions.
 - Submissions (including in-class exercises) more than three days after the due date will be refused unless prior permission is obtained.
- Extra credit assignments will not be offered



Introduction to DBMS

Digitalization - Era of Data



Source:
<https://medium.com/@melodyucros/ladyboss-heres-why-you-should-study-big-data-721b04b8a0ca>

Data is Everywhere

- Music, Shows, and Movies
- Healthcare and Medical Services
- Shopping and Marketing
- Travel and Transportation
- Public Policy and Safety
- News and Information
- Education and Employment
- Artificial Intelligence
- ...



Source: <https://www.corporatecomplianceinsights.com/data-data-data-everywhere/>

SILICON VALLEY TECH COMPANIES



Forbes

Customer Data Is The Secret To Silicon Valley's Success

Mike Sands Former Contributor @

I write about the role of customer intelligence in the digital age

Nov 29, 2017, 03:47pm EST

<https://www.forbes.com/sites/mikesands/2017/11/29/customer-data-is-the-secret-to-silicon-valleys-success/?sh=879de296c3ba>



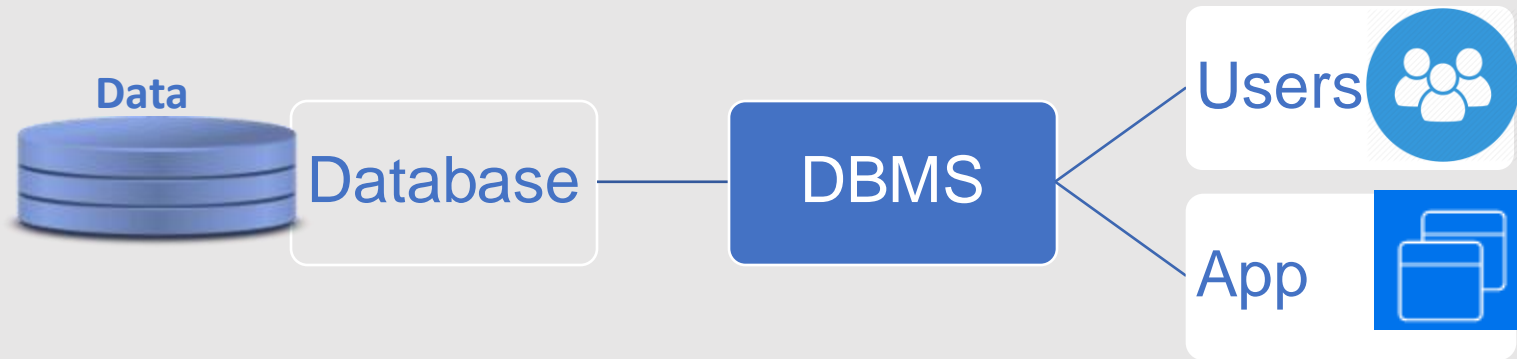
Data Management

- An organization's ability to democratize its data and transform it into valuable insights is a crucial function with a value that cannot be overstated.
- Data-backed decision-making has a measurable positive impact on organizations

"Data is the new oil"

Database Management Systems (DBMS)

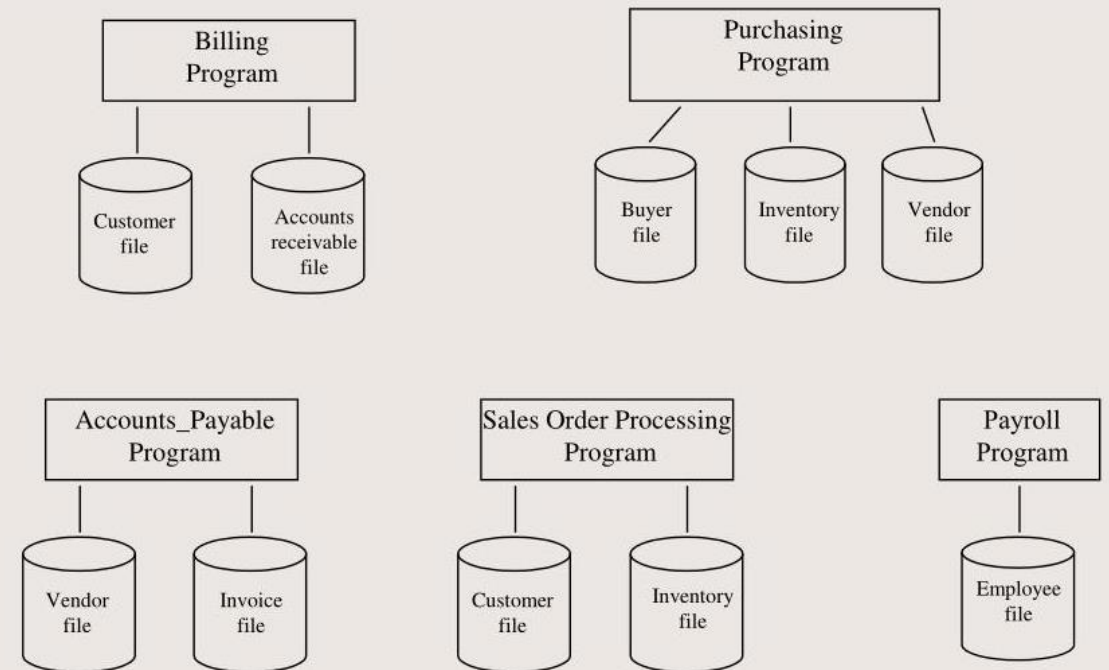
- Database: a collection of data stored in a format that can be easily accessed
- DBMS: A software system that is used to *create, retrieve, update, and delete* (CRUD) the data stored in a database



Limitations of Traditional File Systems

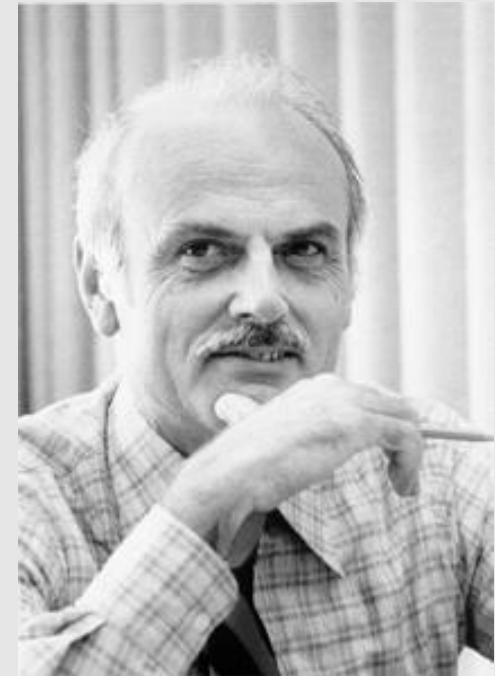
- Program-data dependence
- Duplication of data
- Limited data sharing
- Lengthy development times
- Excessive program maintenance

File Processing Systems



DBMS vs. Traditional File Processing Systems

- Traditional approach to information systems design met needs of individual departments rather than the overall needs of organization
- In the 1960s, Codd, working for IBM, proposed relational data model

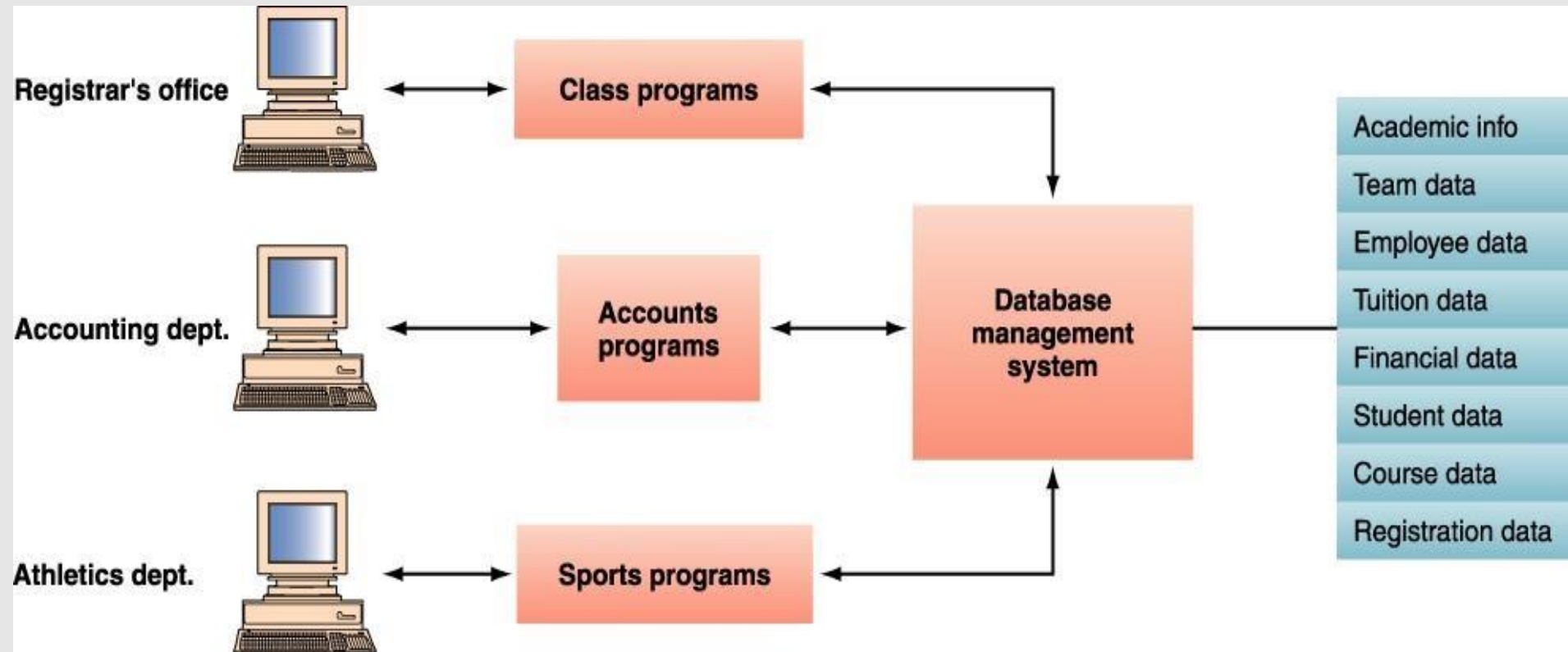


Edgar Codd, Turing Award 1981

Database Management Systems (DBMS)

Entities

Relationships



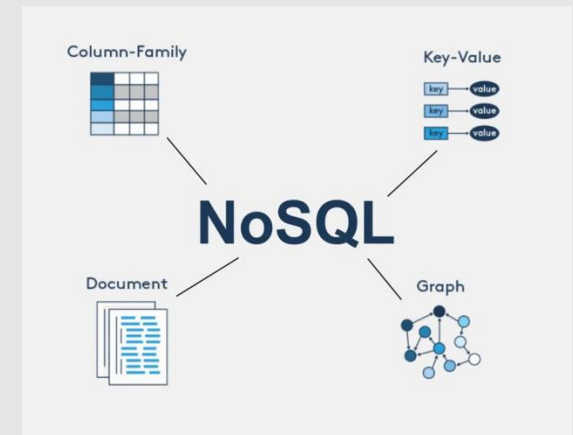


Why Use DBMS?

- Massive
- Persistent
- Safe
- Multi-user (**concurrency control**)
- Convenient
- Efficient
- Reliable
- Reduced application development time
- Uniform data administration

DBMS Types

- **Relational databases** are a collection of data items (entities) with pre-defined relationships between them – **relational data model**
 - organized as a set of tables with columns and rows
- **NoSQL databases** are non-tabular and store data differently than relational tables.
 - NoSQL databases come in a variety of types based on their data model, e.g., key-value, wide-column, and graph.






Relational Database

Relational Database Example

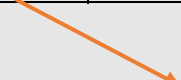
order

order_id	customer_id	item_id	quantity
1	2	1	1
2	2	2	3
3	3	3	5



customer_id	name	email
1	Rosalyn Rivera	rr@adatum.com
2	Jayne Sargen	jayne@test.com
3	Dean Luong	dean@test.com

customer

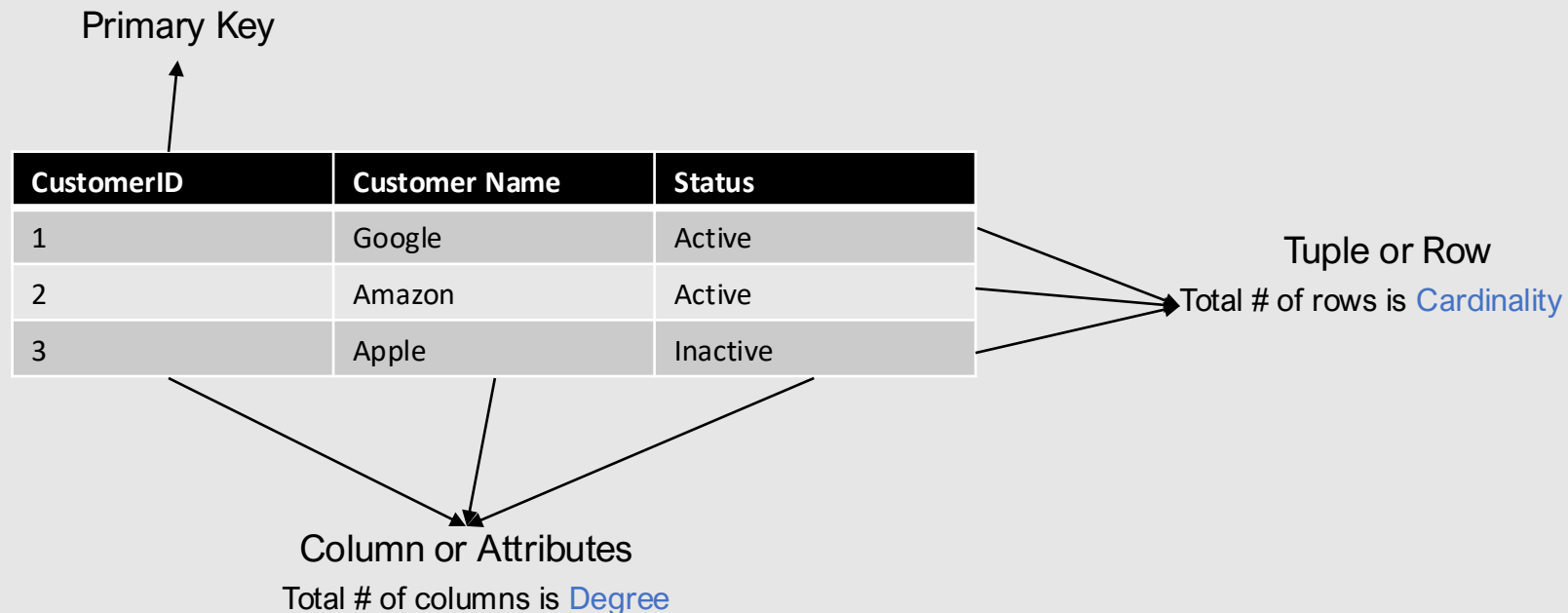


item_id	name	Price
1	Chair	200
2	Table	100
3	Lamp	50

item

Relational Model Concepts

- Relation **schema**: description of data in terms of a *data model* (*representation of data elements and connections between them*)
 - e.g., Customer(*CustomerID*: integer, *Customer_Name*: string, *Status*: string)
- Relation **instance**: a table, also called a relation.





Basic Constructs of Relational Model

- Database = set of **relations**(tables)
- Each relation has a set of named **attributes**(columns)
- Each **tuple**(row) has a value for each attribute
- Each attribute has a **type**(domain)



Relational Integrity Constraints

- Relational integrity constraints are conditions which must be present for a valid relation.
- Constraints on a relational database management system are mostly divided into three main categories:
 - Domain constraints
 - Key constraints
 - Referential integrity constraints

Domain Constraints

- Domain constraints can be defined as the definition of a valid set of values for an attribute.
- In this example, “A” is not allowed for AGE, because AGE is an integer attribute.

ID	NAME	SEMESTER	AGE
1001	Tom	1st	17
1002	Johnson	2nd	24
1003	Leonardo	5th	21
1004	Kate	3rd	19
1005	Morgan	8th	A

Key Constraints

- The entity integrity constraint states that the primary key value must be **unique and cannot be null** because the **primary key** value is used to identify individual rows in relation.
- In this example, “1002” cannot be repeated as an ID because all rows must be unique.

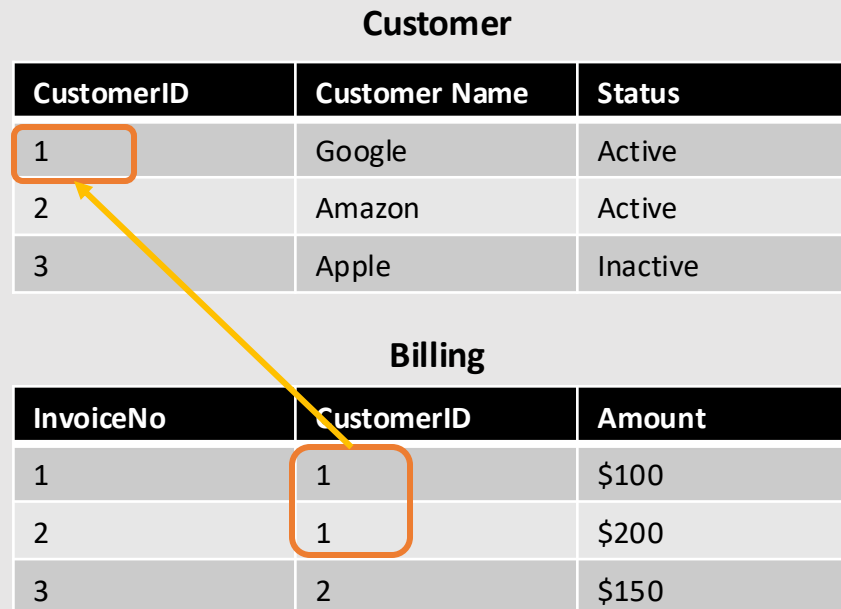
ID	NAME	SEMESTER	AGE
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1004	Kate	3rd	19
1002	Morgan	8th	22

Referential Integrity Constraints

- A referential integrity constraint is specified between two tables.
- With referential integrity constraints, if a foreign key in Table 1 refers to the primary key of Table 2, then every value of the foreign key in Table 1 must be not null or be available in Table 2.

Customer		
CustomerID	Customer Name	Status
1	Google	Active
2	Amazon	Active
3	Apple	Inactive

Billing		
InvoiceNo	CustomerID	Amount
1	1	\$100
2	1	\$200
3	2	\$150



FOREIGN KEY is a field (or collection of fields) in one table, that refers to the PRIMARY KEY in another table.



MySQL



Relational Database Management Systems (RDBMS)



- An RDBMS is a DBMS designed specifically for relational databases.
- RDBMS have been ranked in their popularity by [DB-Engines](#), an initiative that collects information on DBMSs.

Rank			DBMS	Database Model
Dec 2024	Nov 2024	Dec 2023		
1.	1.	1.	Oracle +	Relational, Multi-model ⓘ
2.	2.	2.	MySQL +	Relational, Multi-model ⓘ
3.	3.	3.	Microsoft SQL Server	Relational, Multi-model ⓘ
4.	4.	4.	PostgreSQL +	Relational, Multi-model ⓘ
5.	5.	↑ 7.	Snowflake +	Relational
6.	6.	↓ 5.	IBM Db2	Relational, Multi-model ⓘ
7.	7.	↑ 8.	SQLite	Relational
8.	8.	↓ 6.	Microsoft Access	Relational
9.	9.	↑ 11.	Databricks +	Multi-model ⓘ
10.	10.	↓ 9.	MariaDB +	Relational, Multi-model ⓘ

open-source,
acquired by Oracle

MySQL Customers in Industry

MySQL Customers

TECHNOLOGY: HARDWARE & SOFTWARE	FINANCIAL SERVICES	WEB: ECOMMERCE & SOCIAL
<p>SONY</p> <p>"We embedded MySQL in our optical-disc archive system because it provides the performance and features we required, and it enhanced our product's competitiveness. Oracle's reliable and reputable open-source database also strengthened customer confidence in the quality of Sony products and improved our support capabilities."</p> <p>» LEARN MORE</p>	<p></p> <p>"MySQL Enterprise Edition enabled us to deliver innovative banking services, and also become more competitive by returning the benefits of improved security and reduced IT costs to our customers."</p> <p>» LEARN MORE</p>	<p></p> <p>"We had an unexpected loss of data on nearly every technology we used at one time or another, except MySQL."</p> <p>» LEARN MORE</p>
<p>AEROSPACE, DEFENSE</p> <ul style="list-style-type: none"> » AIRBUS/EADS » Boeing » Northrop Grumman » MORE 	<p>EDUCATION</p> <ul style="list-style-type: none"> » Brown University » WelcomeNext » University of Toronto » MORE 	<p>FINANCIAL SERVICES</p> <ul style="list-style-type: none"> » Square » WePay » BSE Mumbai Stock Exchange » MORE
<p>HEALTHCARE, PHARMA</p> <ul style="list-style-type: none"> » Inpeco » Great HealthWorks » guard.me » MORE 	<p>MANUFACTURING</p> <ul style="list-style-type: none"> » ST Engineering » UL Solutions » Asahimatsu Foods Co., Ltd. » MORE 	<p>MEDIA & ENTERTAINMENT</p> <ul style="list-style-type: none"> » Spotify » YouTube » BBC » MORE
<p>TECHNOLOGY: HARDWARE & SOFTWARE</p> <ul style="list-style-type: none"> » WelcomeNext » GitHub » VRGlass » MORE 	<p>TELECOM</p> <ul style="list-style-type: none"> » Mobitel » KDDI Corporation » Line Corp » MORE 	<p>WEB: ECOMMERCE & SOCIAL</p> <ul style="list-style-type: none"> » Booking.com » GREE » Airbnb » MORE

<https://www.mysql.com/customers/>



What happens next...

Software Installation

➤ Install MySQL server

- <https://dev.mysql.com/downloads/mysql/>

- Version: 8.0.xx
- macOS: ARM or x86(Intel)
- Windows: **Product - MySQL server**

- **password (!!!)**

➤ Install MySQL Workbench

- <https://www.mysql.com/products/workbench/>

