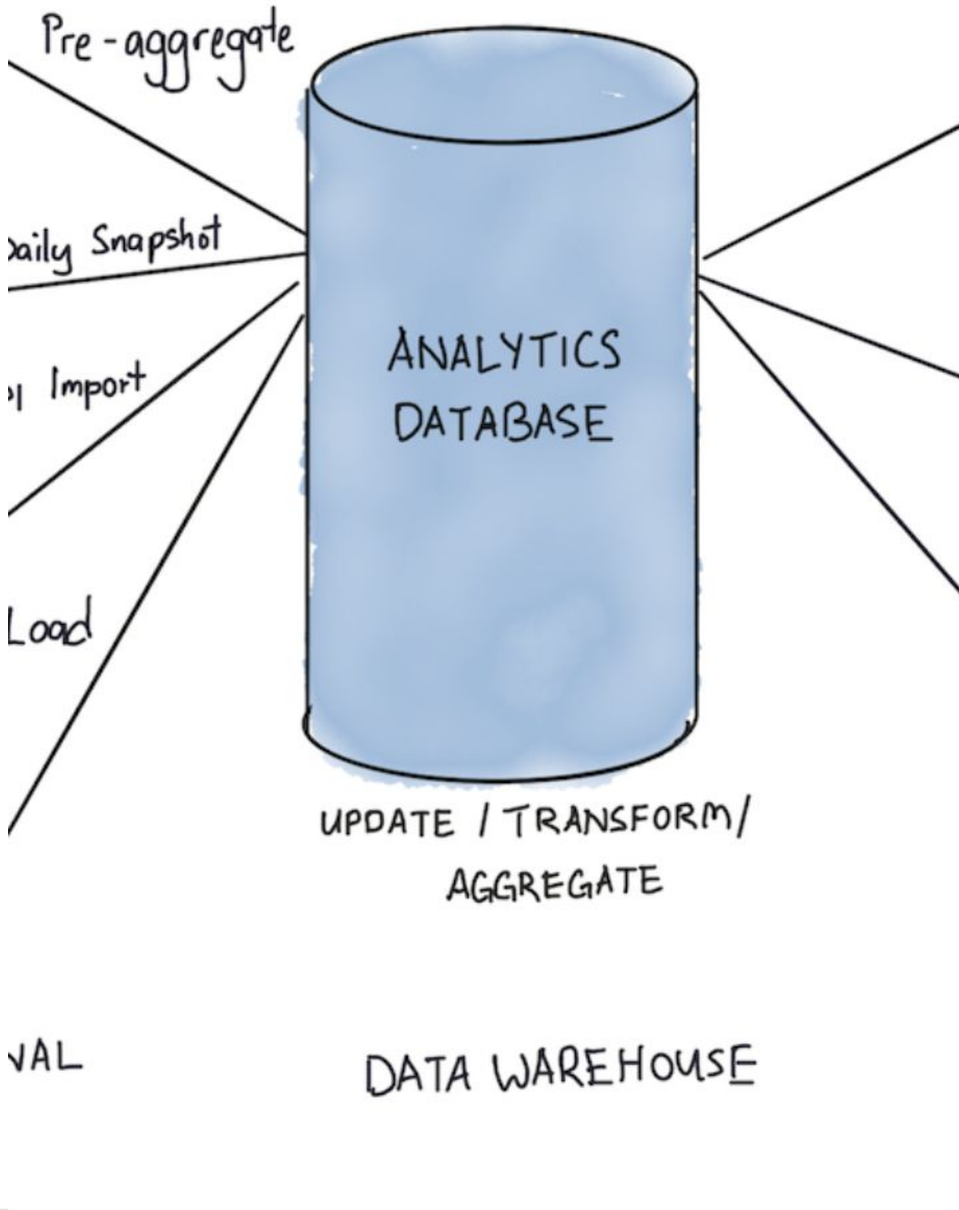
Chapter 5

Databases and Data Analytics

By the end of this lecture, you will be able to:

Discover the world of databases and data analytics. Learn about different types of databases, data analytics techniques, data warehousing, data visualization, and big data analytics.



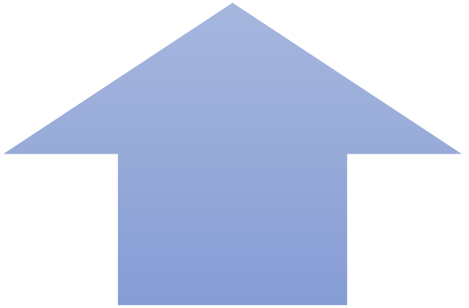
Part 1: Introduction to Databases

- Physical and logical views
- Characters, fields, records, tables, and databases
- Key fields
- Batch processing and real-time processing
- Database models
- Individual, company, distributed and commercial databases
- Database uses and security concerns

Introduction

Like a library, secondary storage is designed **to store information and an organized collection of data**

A database is an electronic system that **allows data to be easily accessed, manipulated and updated**



Data

Examples of data include:

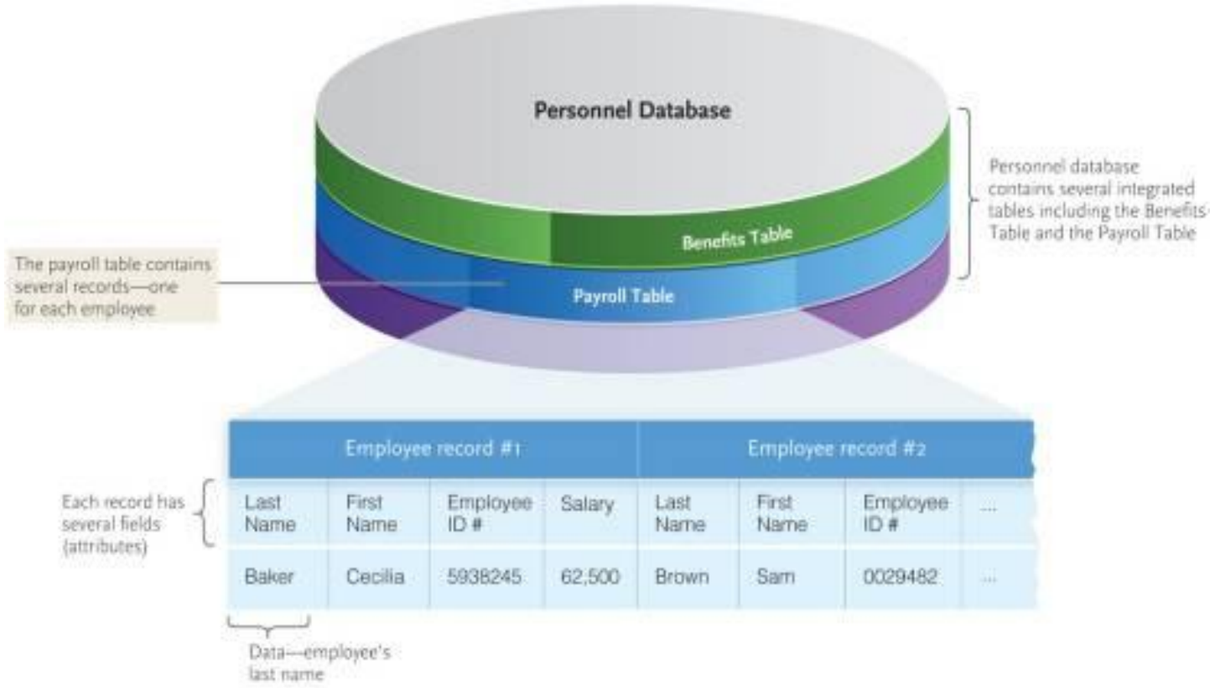
- Facts or observations about people, places, things, and events
- Audio, music, photographs, and video

Type of data

- Structured data
- Semi structured data
- Unstructured data

Data Organization

- Character
- Field
- Record
- Table
- Database



Key Field

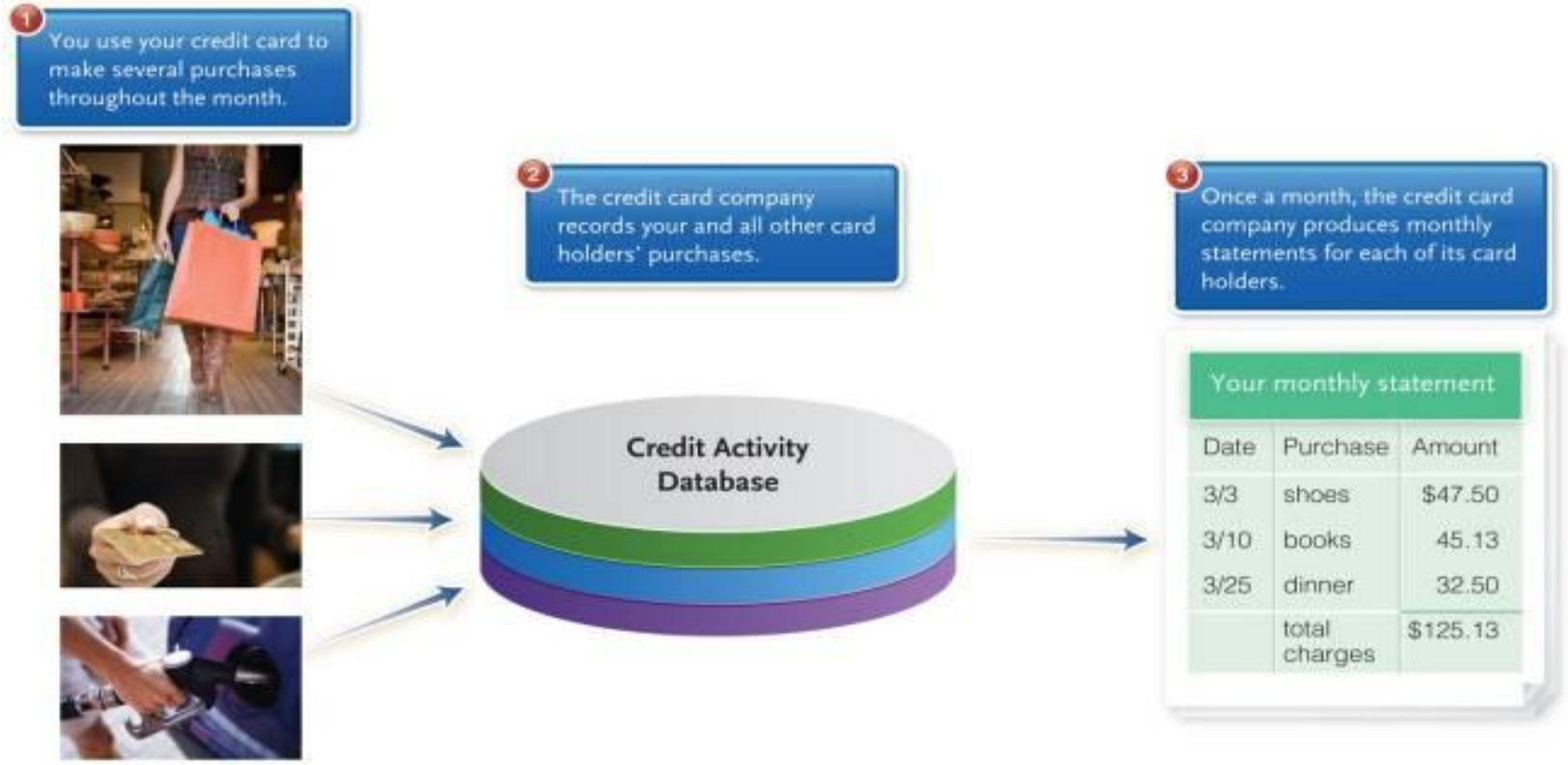
😇 Unique identifier also known as **primary key**

😇 Common examples:

- Social Security Numbers
- Student Identification Numbers
- Employee Identification Numbers
- Part Numbers
- Inventory Numbers

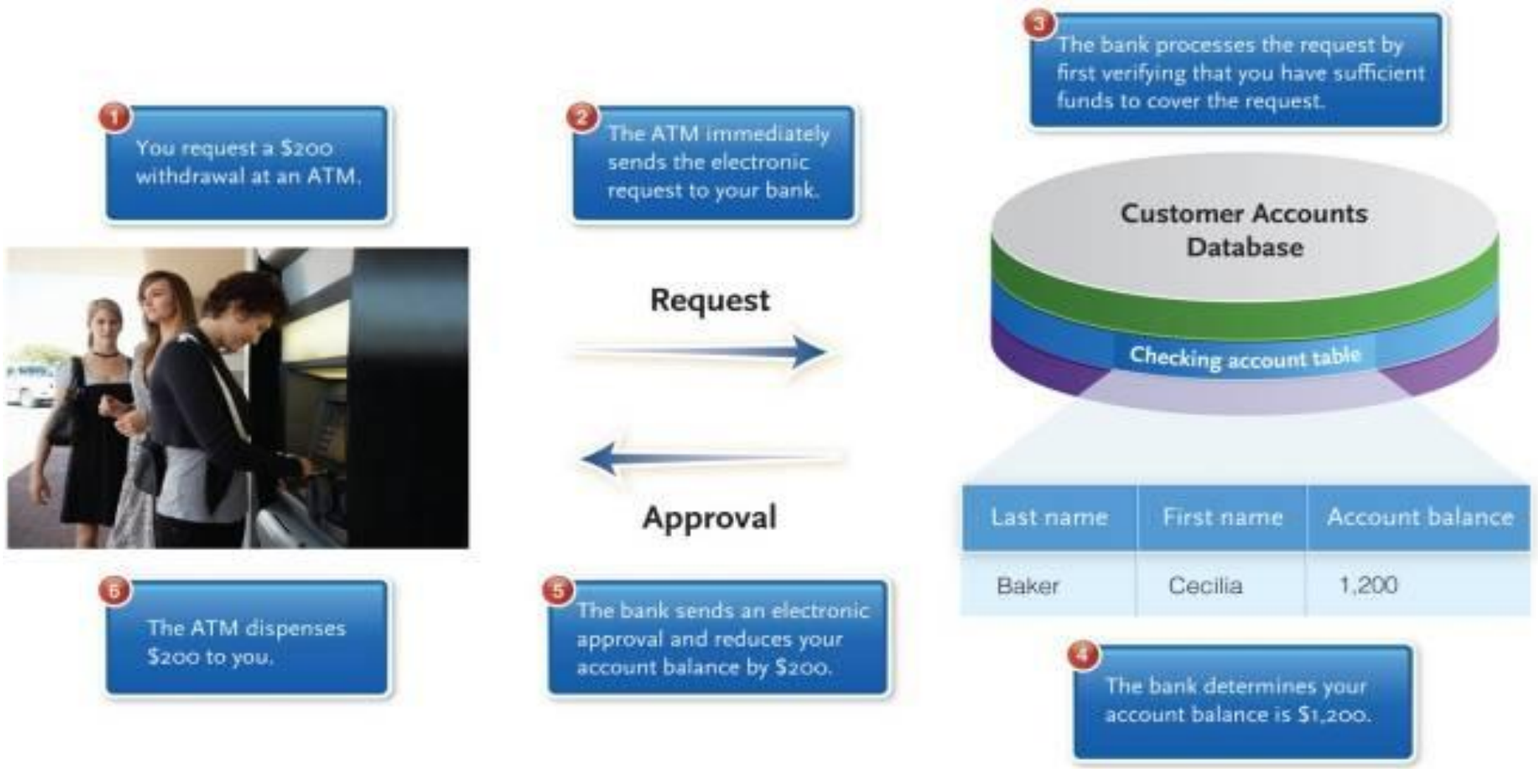
Batch Processing

- Batch processing:
  - Data is collected over a period of time and the processing happens later all at one time



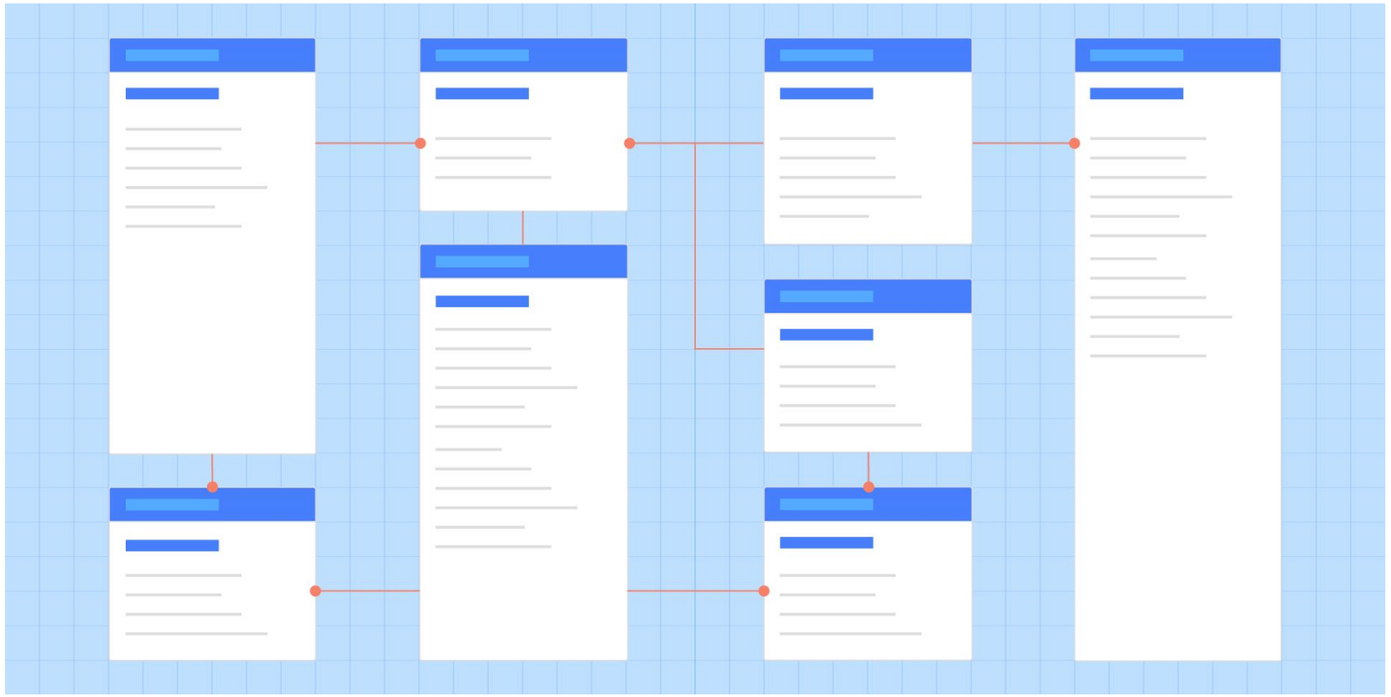
Real-time Processing

- Real-time processing:
  - Also known as online processing because it happens immediately during the transaction



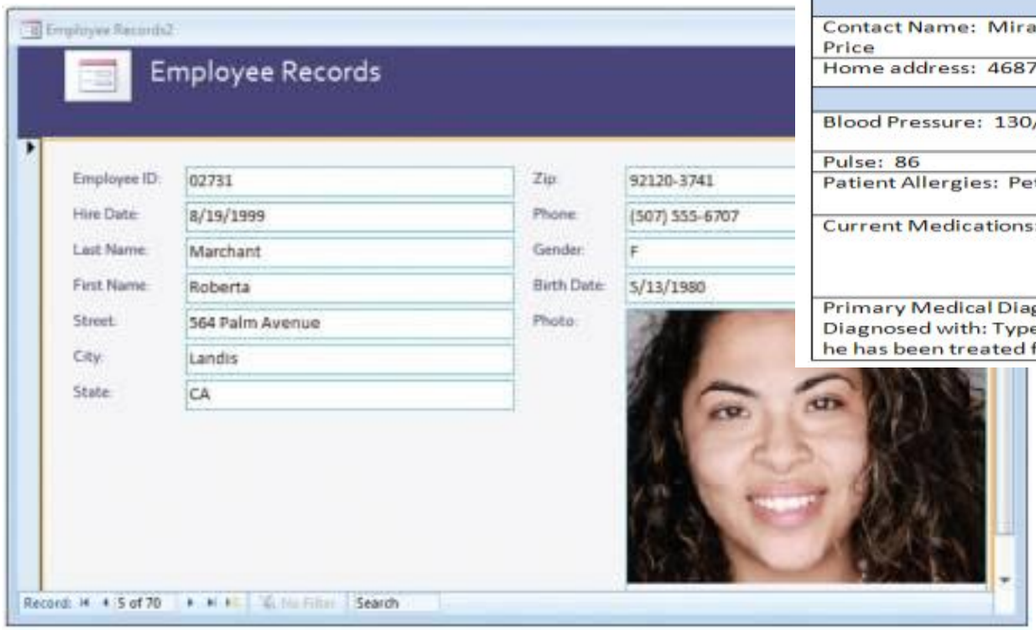
Databases

- Collection of integrated data
  - Logically related files and records
- Databases address data redundancy and data integrity



Need for Databases

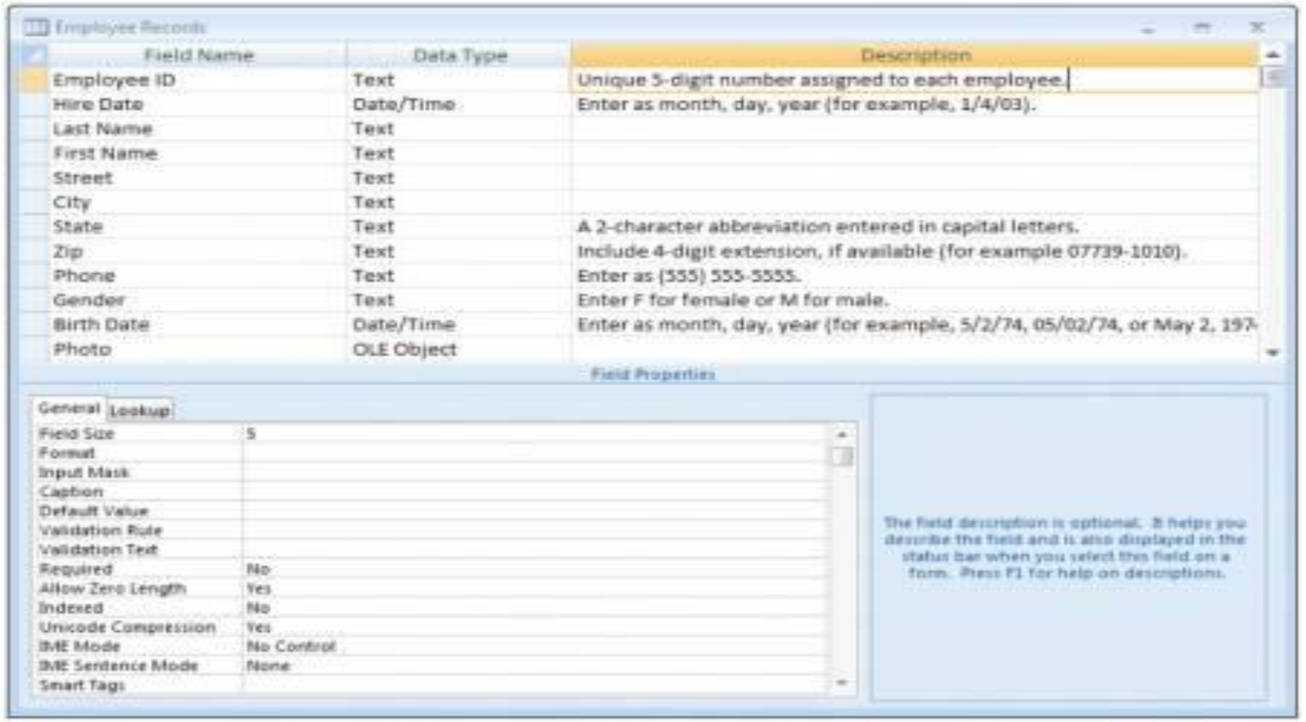
- Sharing
- Security
- Less data redundanc
- Data integrity



Hospital Patient Record		
Patient Number: 1	Date of Assessment: 2/15/2009	
Completed By: Nancy Turner	Physician's Name: Dr. Andrea Wilson	
Basic Patient Information		
Patient Name: Frank Davidson		
Sex: Male	Date of Birth: 8/25/1946	Social Security Number: 995065934
Height: 6'2	Weight: 203	
Street Address: 1276 Antoninus Drive Greenville, SC 29601		
Home Phone: (864) 840-3225	Work Phone: (864) 684-0095	Religion: Christian
Patient Insurance Information		
Primary Insurance: Blue Cross and Blue Shield	Name of Insuree: Frank Davidson	
Group Number: 2289765	Insuree's Date of Birth: 8/25/1946	
Emergency Contact Information		
Contact Name: Miranda Price	Home Phone: (864) 938-2857	Work Phone: (864) 454-7734
Home address: 4687 Stride Drive Greenville, SC 29602		
Vital Signs		
Blood Pressure: 130/83	Respiration: 9	
Pulse: 86	Temperature: 97.9 F	
Patient Allergies: Pet dander, Pollen	Adverse Drug Reactions: Sulfa drugs causes mild skin rash	
Current Medications: Insulin, Diabinese		Self Administrations of Medications: No
Primary Medical Diagnosis: Admitted for: elevated blood sugar levels and dehydration. Diagnosed with: Type II Diabetes. Current status: blood sugar levels have decreased and he has been treated for his dehydration.		

Database Management

- DBMS engine
- Data definition subsystem
- Data dictionary or schema



Database Management (Continue)

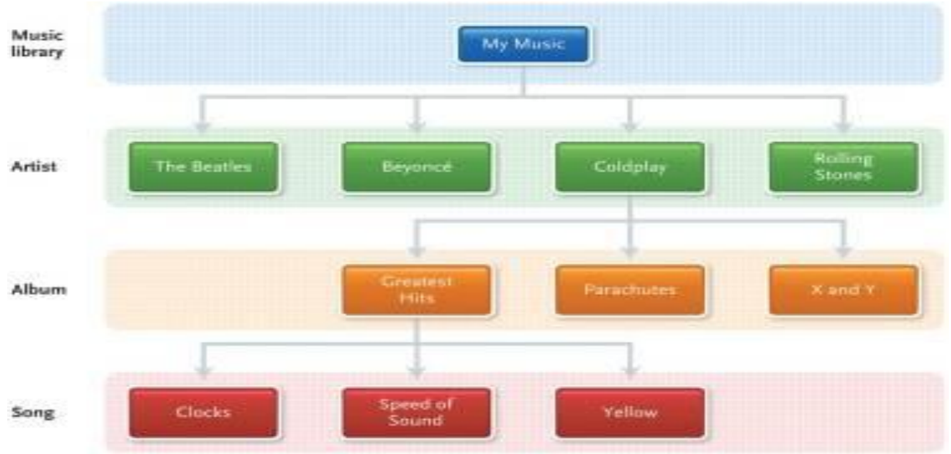
- Data manipulation subsystem
  - Query-by-example
  - Structured Query Language (SQL)
- Application generation subsystem
- Data administration subsystem
  - Database Administrators (DBAs)
  - Processing rights

DBMS Structure

- Database model:
  - DBMS programs work with data that is logically structured or arranged
  - Model defined rules and standards for data in a database
- Five common data models:
  - Hierarchical database
  - Network database
  - Relational database
  - Multidimensional database
  - Object-oriented database

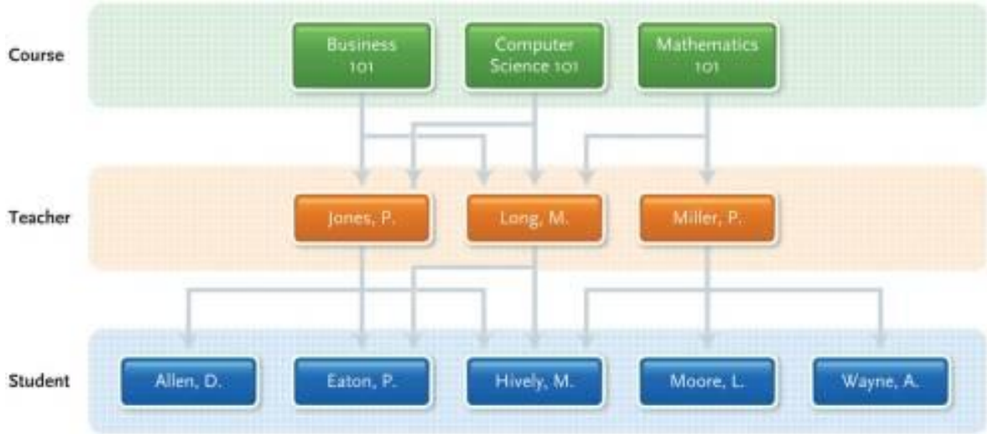
Hierarchical Database

- Fields or records structured in nodes
- Nodes
  - Points connected like branches of an upside-down tree
- One parent per node
- Parent can have several child nodes
  - One-to-many relationship



Network Database

- Hierarchical node arrangement
- Each child node may have more than one parent node (many-to-many relationship)
- Pointers
  - Additional connections between parent and child
  - Nodes can be reached through multiple paths

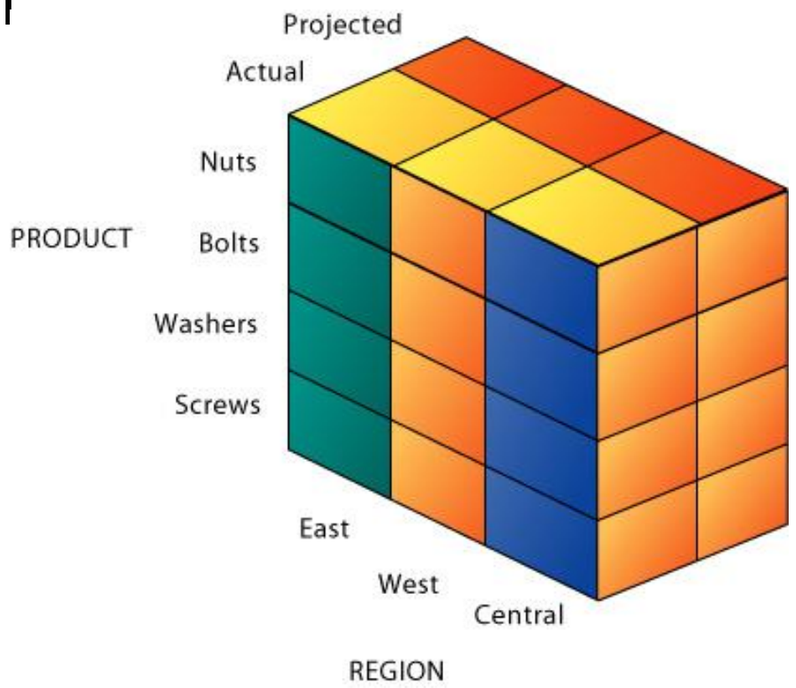


Relational Database

- More flexible
- Data stored in table called a relation
- Tables consist of rows and columns
- Tables related via a common data item / key field

Multidimensional Database

- A variation and an extension of the relational model to include additional dimensions, sometimes called a data cube
- Good for representing complex relationships
- Advantages over relational
  - Conceptualization
  - Processing speed



Object-oriented Database

- Works with unstructured data
  - Photographs
  - Audio
  - Video
- Objects contain both data and instructions
- Organize using objects, classes, entities, attributes, and methods

Types of Databases

- Individual
- Company or shared
- Distributed
- Commercial

Type	Description
Individual	Integrated files used by just one person
Company	Common operational or commonly used files shared in an organization
Distributed	Database spread geographically and accessed using database server
Commercial	Information utilities or data banks available to users on a wide range of topics

Types of Databases (Continue)

Relational Databases

The most popular type of database, used for storing structured data. Examples include MySQL, Oracle, and Microsoft SQL Server.

NoSQL Databases

Used for storing semi-structured and unstructured data. Examples include MongoDB, Cassandra, and Amazon DynamoDB.

Graph Databases

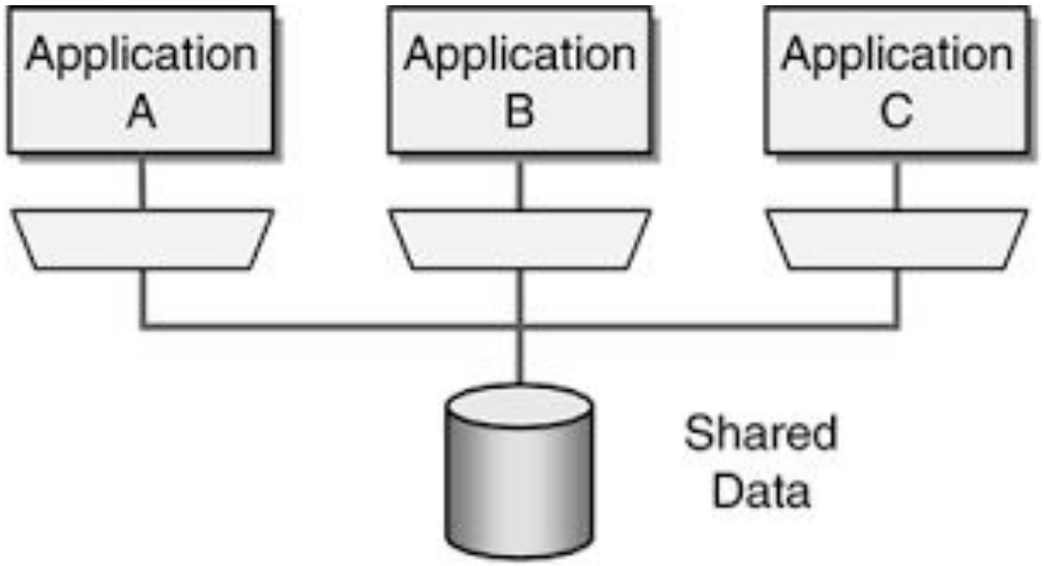
Used for storing interconnected data, such as social networks, recommendation engines, and fraud detection systems. Examples include Neo4j and Amazon Neptune.

Individual Databases

- Also called a **microcomputer database**
- Integrated file collection for one person usually under the person's direct control
- Generally stored on the user's hard-disk drive or on a LAN file server

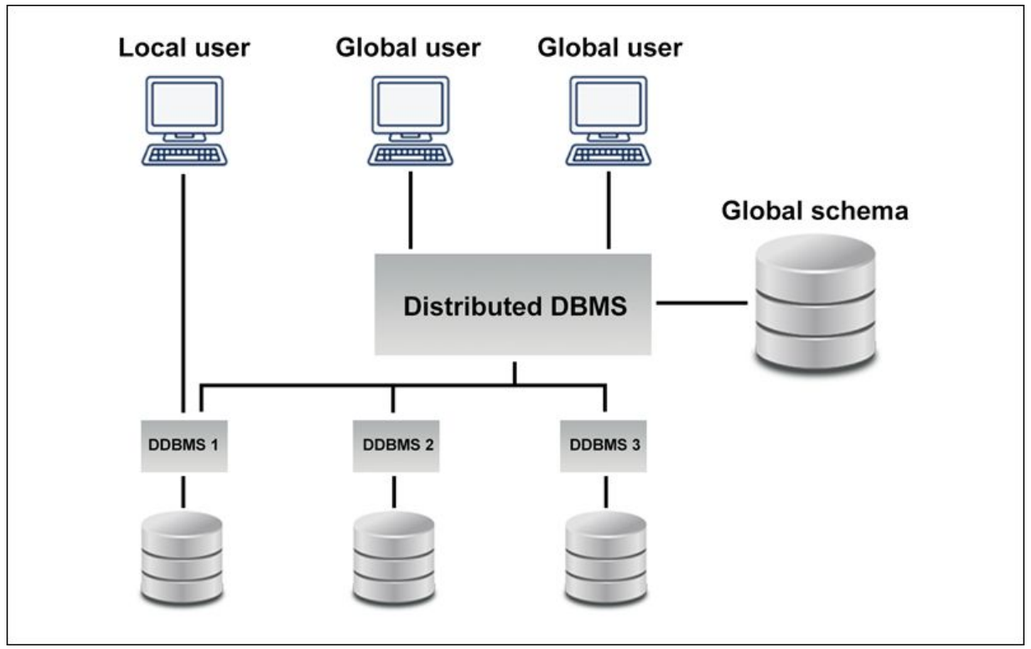
Company or Shared Databases

- Usually stored on a central database server and managed by a database administrator
- Users throughout a company can access the database through the company's networks



Distributed Databases

- Database is located in a place or places other than where users are located
- Typically, database servers on a client/server network provide the link between users and the distant data



Commercial Databases

- Enormous database developed by an organization to cover particular subjects
- Access is offered to the public or selected individuals for a fee
- Most designed for
- organizational and individual use
- Also referred to as **information utilities** or **data banks**

Database Uses and Issues

- Strategic uses
  - Special type of database called data warehouse
  - Data mining is used to search databases for information and patterns
- Security
  - Databases are valuable
  - Protection necessary

Security: Electronic fingerprint scanner

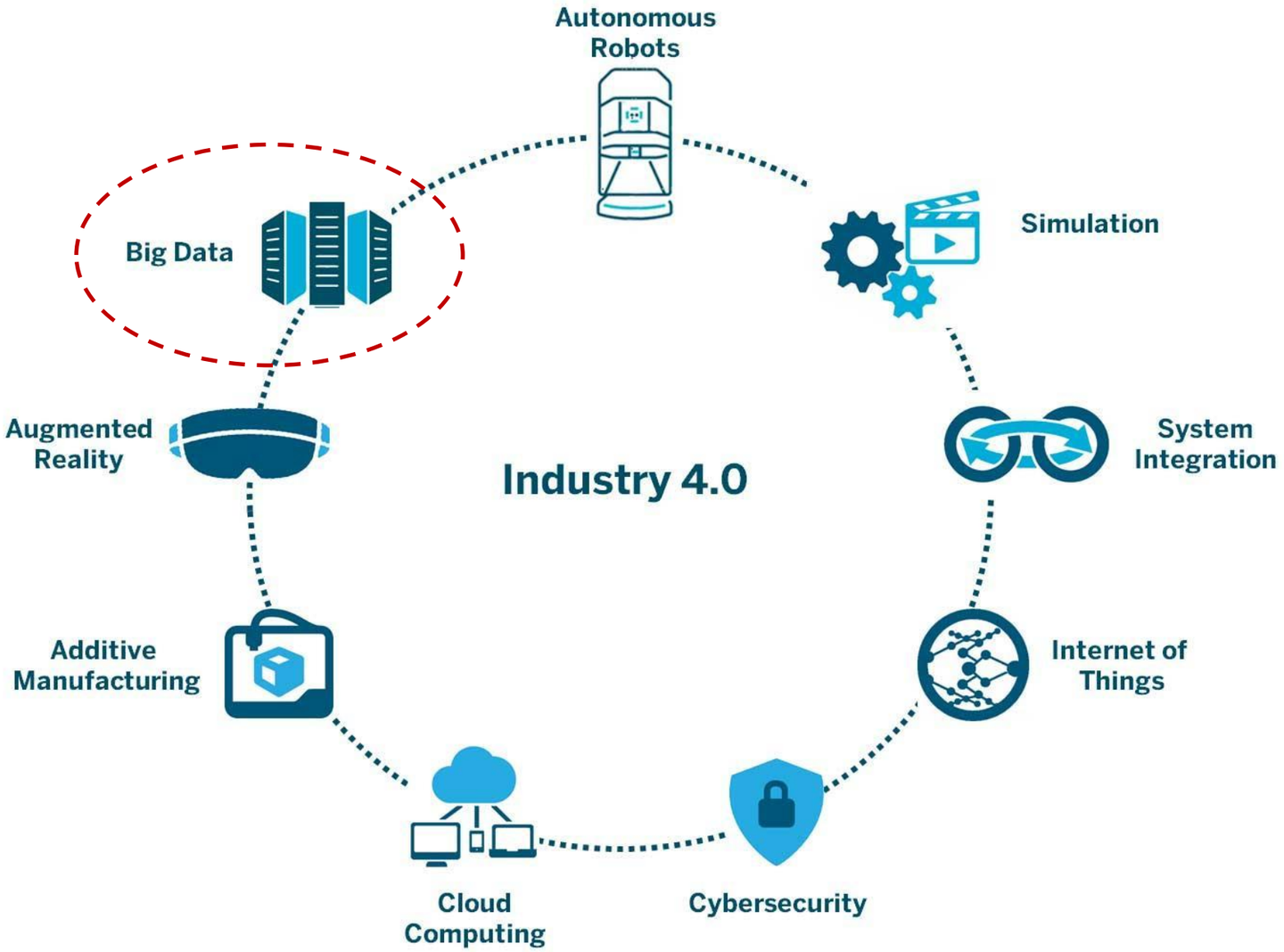
Careers in IT

- Database administrators
  - Determine the most efficient ways to organize and access a company's data
  - Responsible for database security and backing up the system
- Employers look for
  - Bachelors degree in Computer Science
  - Technical experience
- Database administrators can expect to earn $48,500 to $85,000 annually

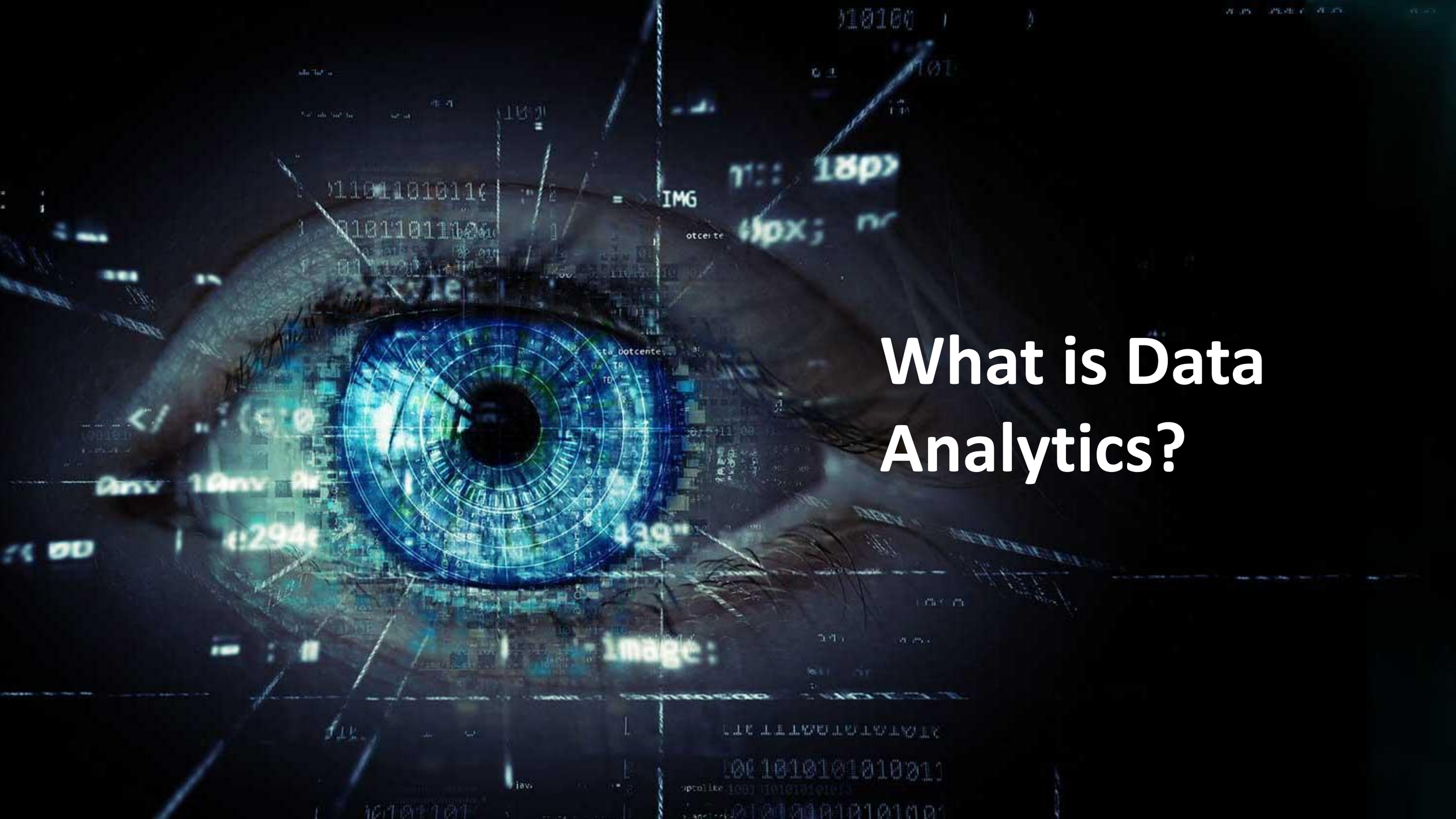
Part 2: Introduction to Data Analytics

- What is Data Analytics?
- Data Analysis vs. Data Analytics vs. Data Science
- Use of Big Data in Data Analytics
- Data Analytics Types
- Data Analytics Techniques
- Process of Data Analytics
- Data Visualization & Data Warehousing
- Role of Data Analyst in the Business

Where are Big Data Analytics in IR4.0 Technologies?



Source: https://aethon.com/mobile-robots-and-industry4-0/



What is Data Analytics?

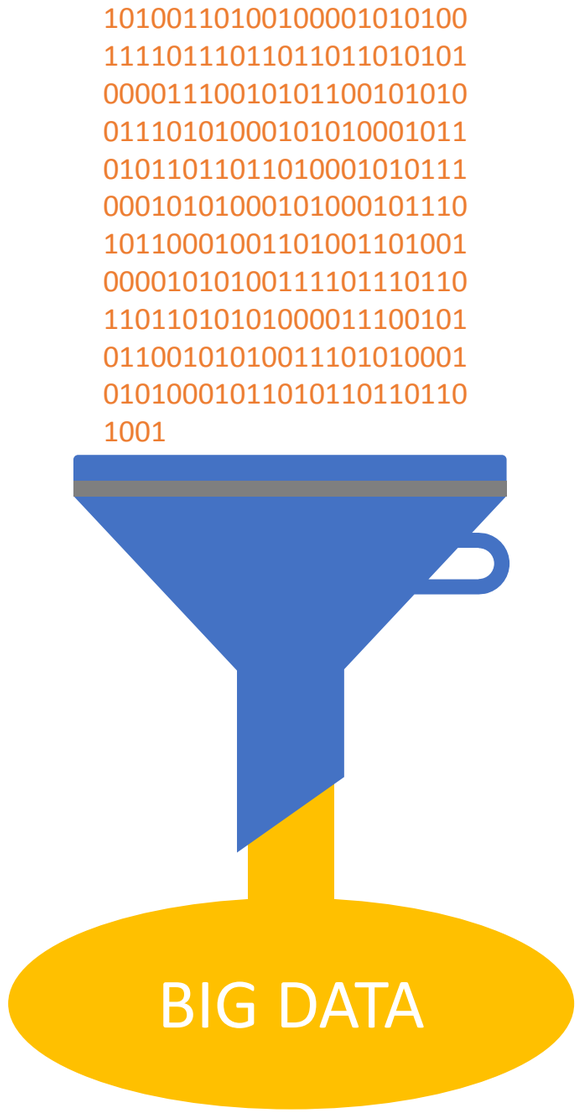
BIG DATA ANALYTICS

WHAT IS Data Analytics?

A series of techniques aimed at extracting relevant and valuable information from extensive and diverse sets of data gathered from different sources and varying in sizes

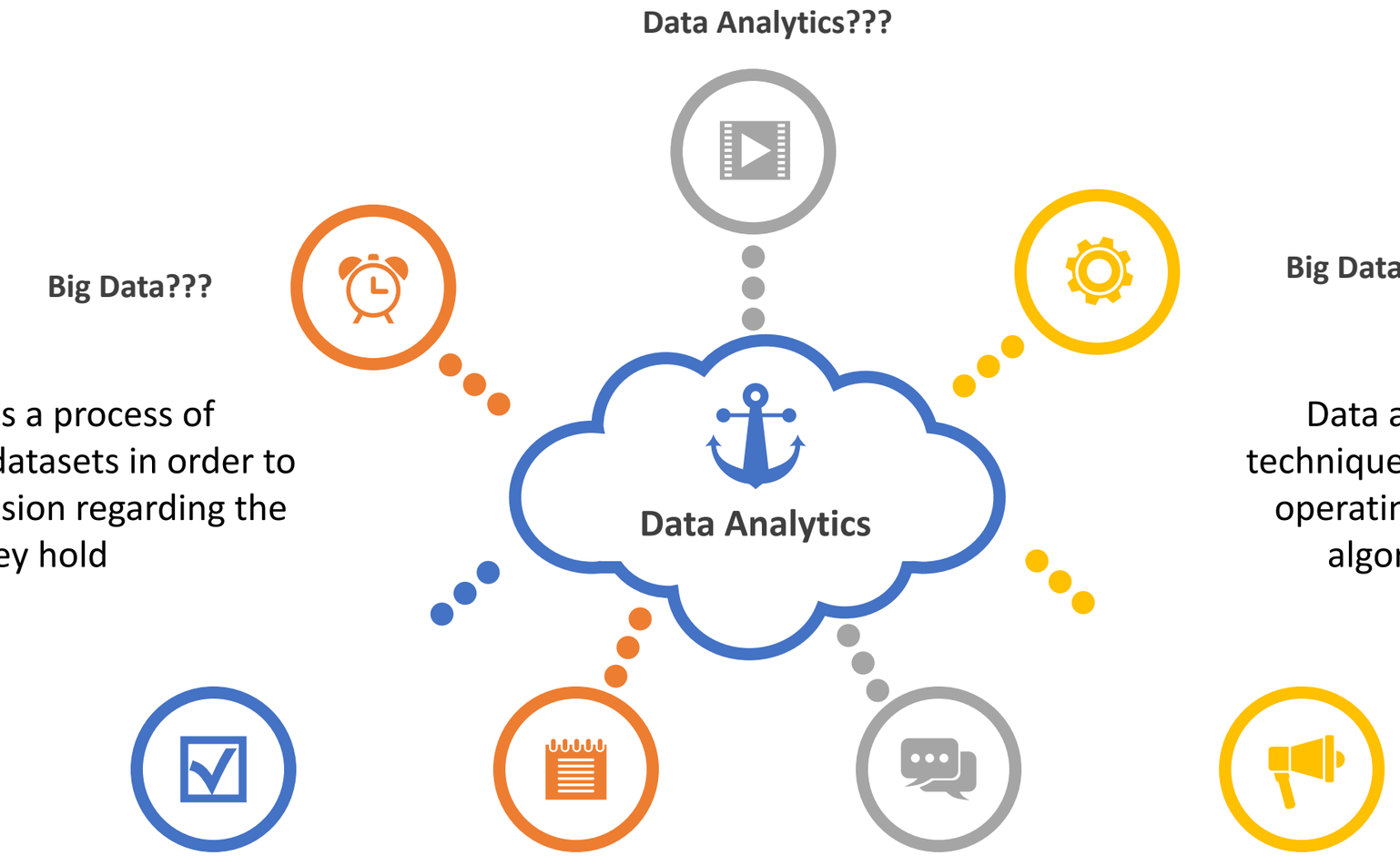
For examples:

- content preferences
- different types of interactions with certain kinds of content or ads
- use of certain features in the applications
- search requests
- browsing activity
- online purchases



Source: https://theappsolutions.com/blog/development/what-is-big-data-analytics/

What is Data Analytics?



Data analytics is a process of analyzing raw datasets in order to derive a conclusion regarding the information they hold

Data analytics processes and techniques may use applications operating on machine learning algorithms, simulation, and automated systems

They help organizations understand their clients better, analyze their promotional campaigns, customize content, create content strategies, and develop products

Source: https://corporatefinanceinstitute.com/resources/knowledge/other/data-analytics/

Data Analysis vs. Data Analytics vs. Data Science

Data Analysis vs. Data Analytics vs. Data Science

DATA ANALYSIS

The **data analysis** primarily focuses on processes and functions

DATA SCIENCE

The **data science** includes data analysis but also has elements of data cleaning and preparation (for further investigation)

DATA ANALYTICS

The **data analytics** deal with information, dashboards, and reporting

Big Data and Data Analytics

1 Introduction

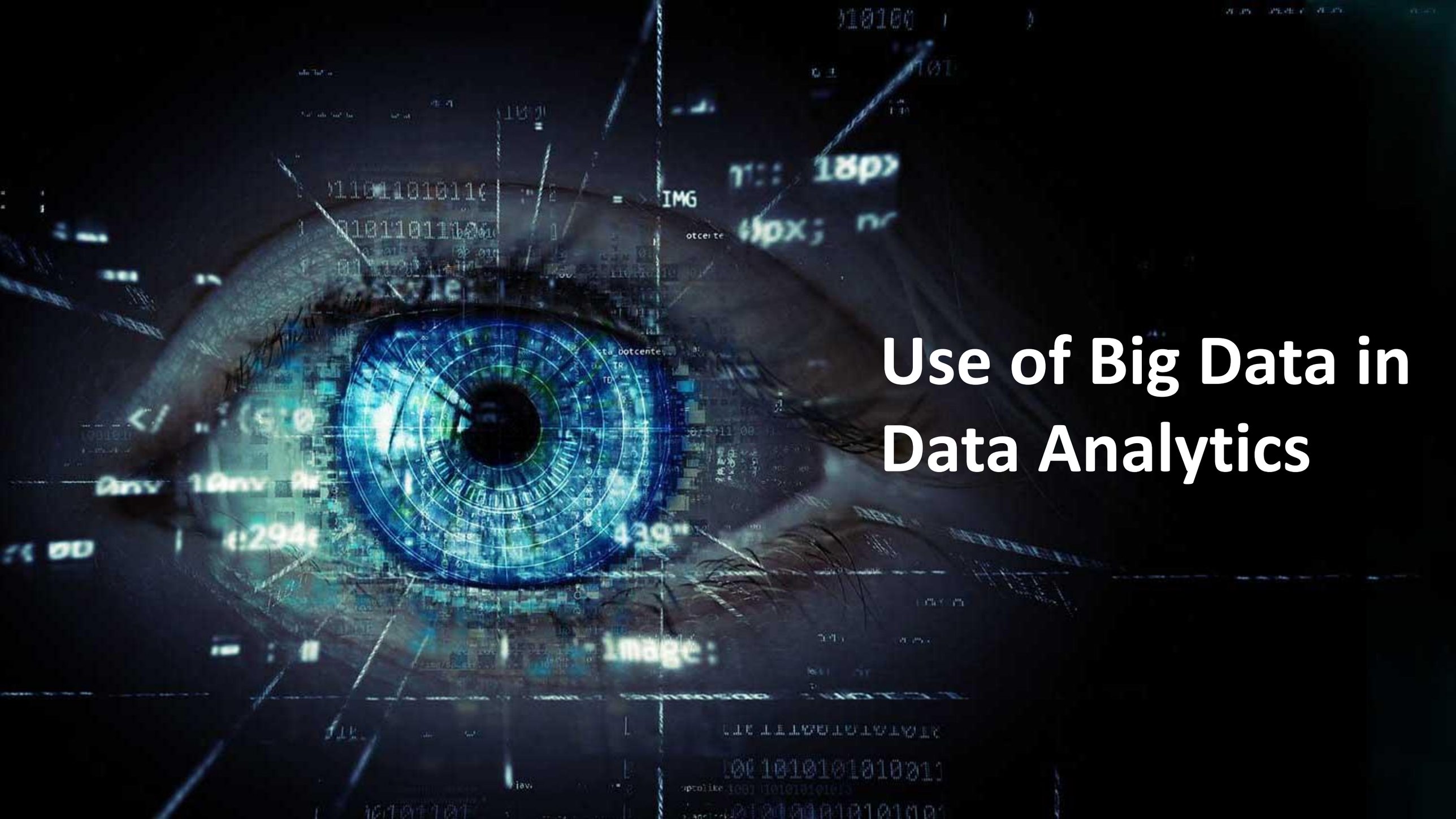
Big data refers to large volumes of structured and unstructured data that cannot be processed using traditional database and analytics tools.

2 Challenges and Opportunities

Big data comes with challenges such as data quality, privacy, security, and scalability, but also provides opportunities for innovation and competitive advantage.

3 Technology and Tools

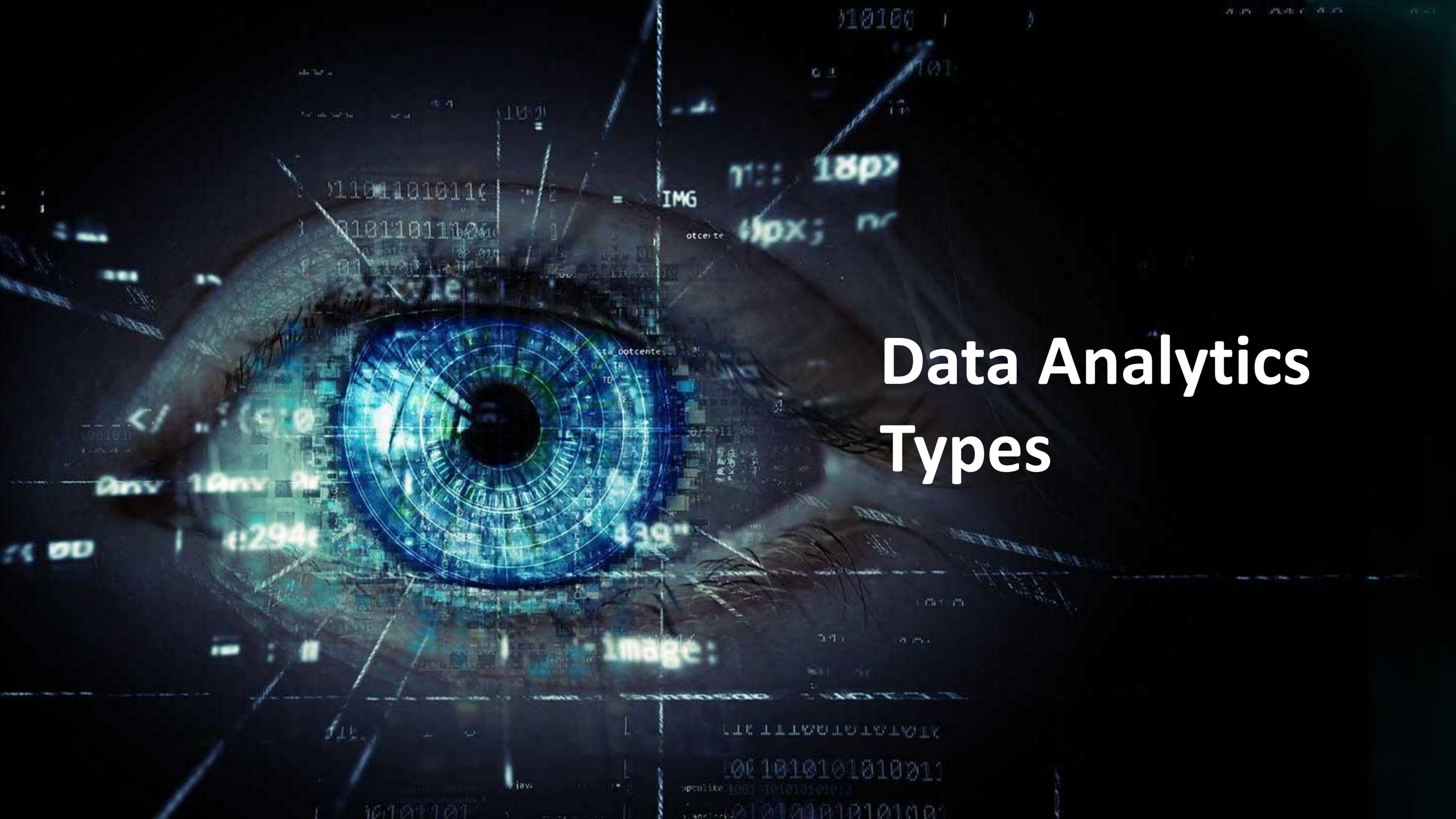
Big data technologies and tools include Hadoop, Spark, NoSQL databases, data lakes, and cloud services such as AWS and Azure.



Use of Big Data in Data Analytics

Use of Big Data in Data Analytics

Source: https://images.xenonstack.com/blog/10-vs-of-big-data.png

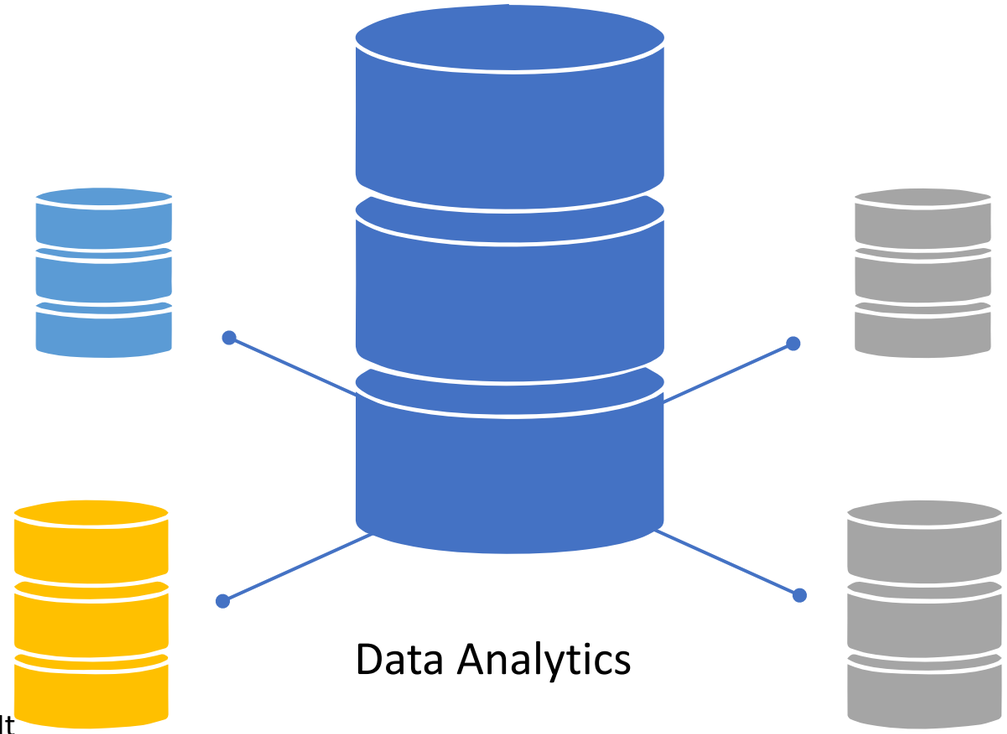


Data Analytics Types

Data Analytics Types

Descriptive Analytics

describes the happenings over time, such as whether the number of views increased or decreased and whether the current month's sales are better than the last one



Predictive Analytics

focuses on the events that are expected to occur in the immediate future. Predictive analytics tries to find answers to questions like, what happened to the sales in the last hot summer season? How many weather forecasts expect this year's hot summer?

Diagnostic Analytics

focuses on the reason for the occurrence of any event. It requires hypothesizing and involves a much diverse dataset. It examines data to answer questions, such as "Did the weather impact the selling of umbrella?" or "Did the new ad strategy affect sales?"

Prescriptive Analytics

indicates a plan of action. If the chance of a hot summer calculated as the average of the five weather models is above 58%, other than an umbrella, a rain coat should be considered to maximize the production

Source: https://corporatefinanceinstitute.com/resources/knowledge/other/data-analytics/

Process of Data Analytics

Process of Data Analytics

Step 1

Determine the criteria for grouping the data

Data can be divided by a range of different criteria such as age, population, income, or gender. The values of the data can be numerical or categorical data

Step 2

Collecting the data

Data can be collected through several sources, including online sources, computers, personnel, and sources from the community

Step 3

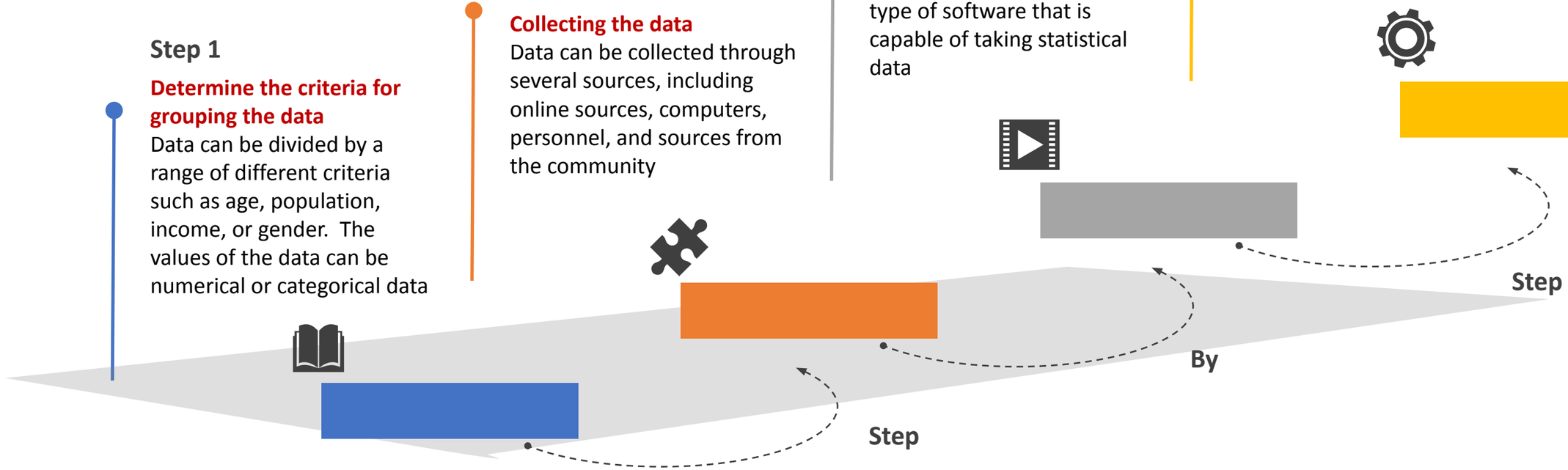
Organizing the data

The data must be organized after it is collected so that it can be examined. Data organization can take place on a spreadsheet or other type of software that is capable of taking statistical data

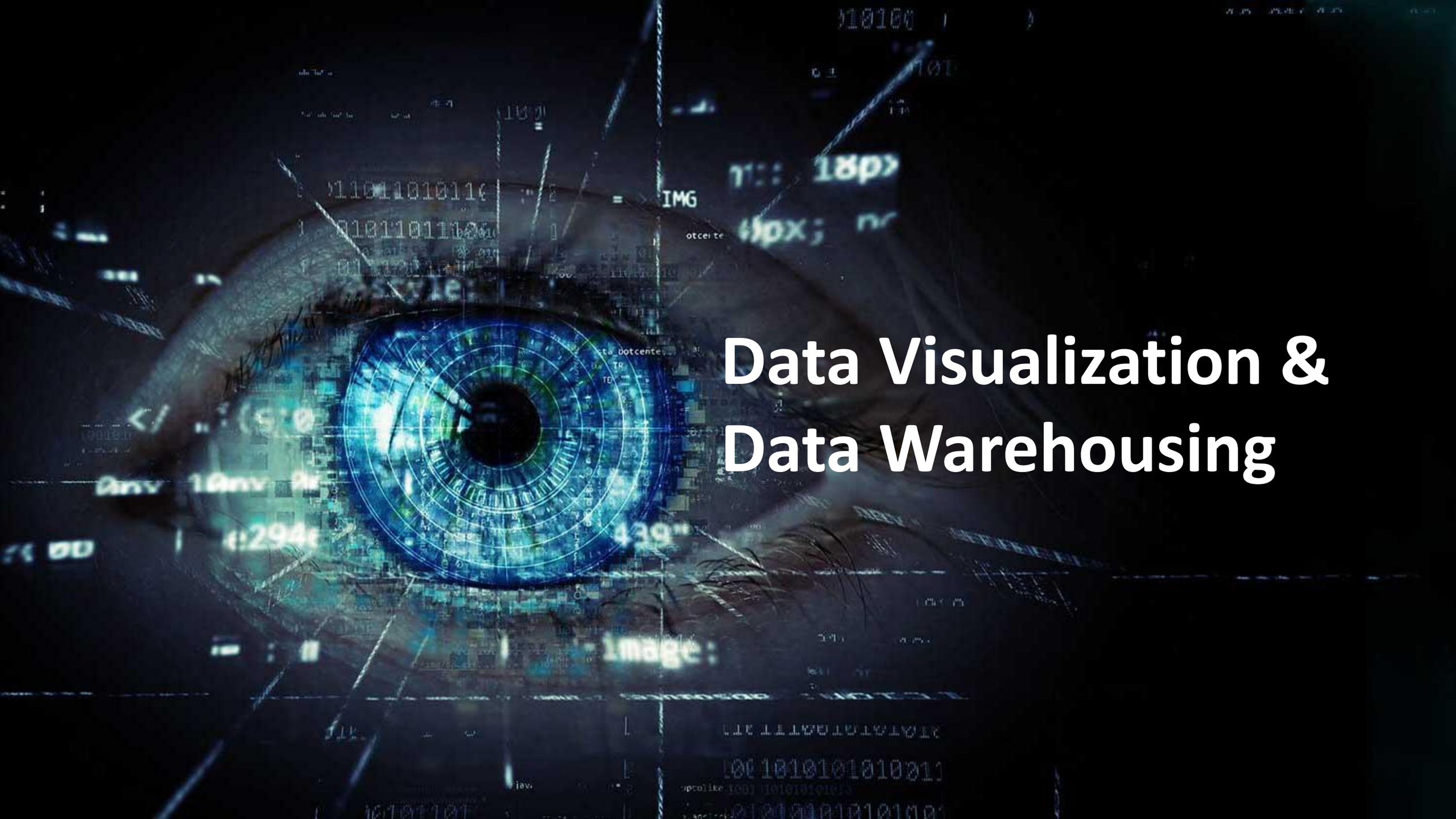
Step 4

Cleaning the data

The data is first cleaned up to ensure that there is no overlap or mistake. Then, it is reviewed to make sure that it is not incomplete. Cleaning the data helps to fix or eliminate any mistakes before the data goes to a data analyst for analysis



Source: https://corporatefinanceinstitute.com/resources/knowledge/other/data-analytics/


Data Visualization &
Data Warehousing

Data Visualization

Importance

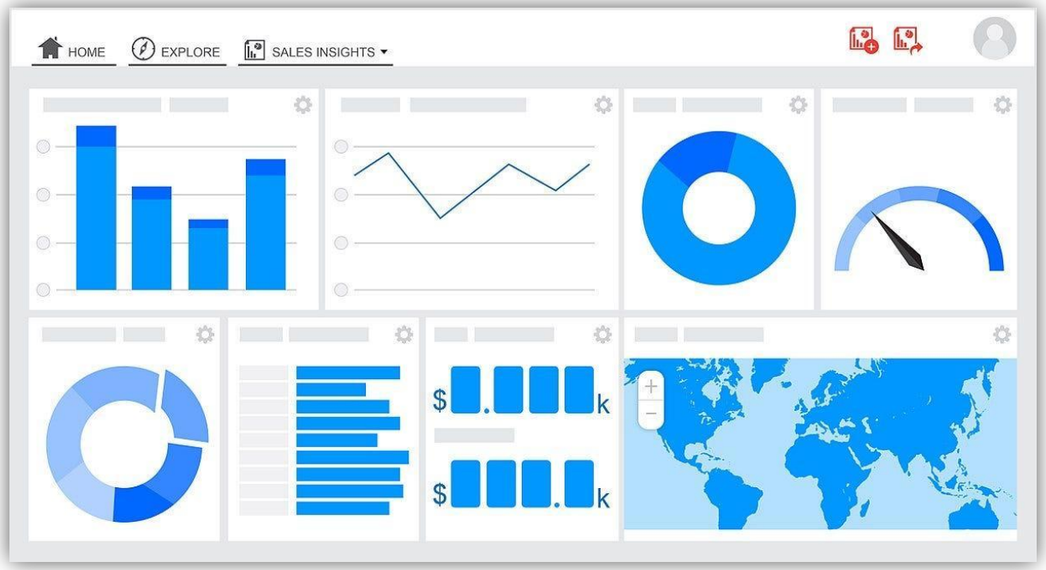
Data visualization helps turn complex data into insights and communicate them effectively to stakeholders.

Types of Tools

Data visualization tools can range from simple charting libraries to more advanced tools that allow for interactive dashboards and storytelling.

Best Practices

Effective data visualization requires understanding your audience, choosing the right type of visualization, using appropriate colors and labels, and avoiding clutter and complexity.



Data Warehousing

Definition and Purpose

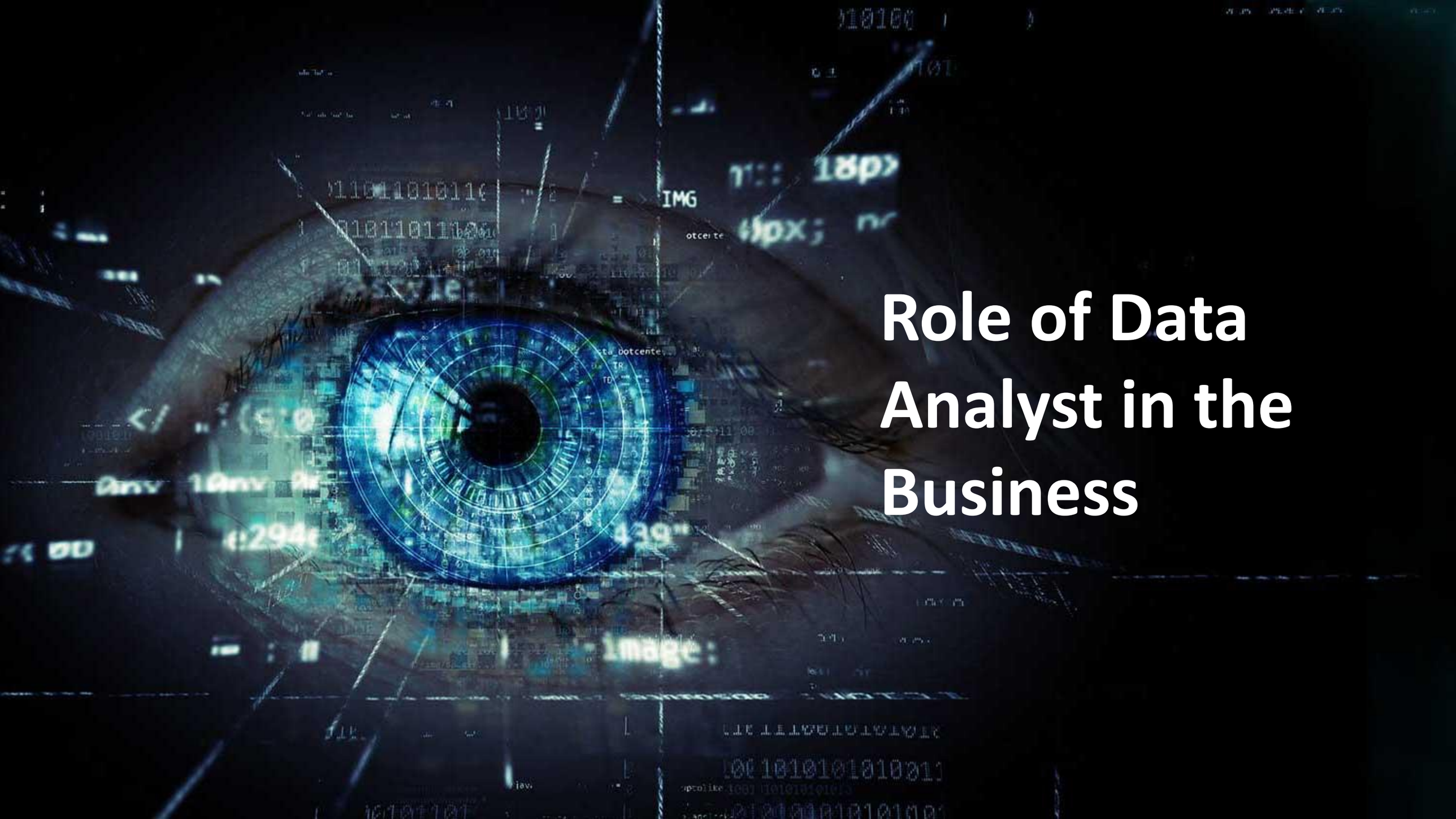
Data warehousing is the process of storing and managing large volumes of data from different sources to support business decision-making.

Extract, Transform, and Load (ETL) Process

The ETL process involves extracting data from various sources, transforming it into a consistent format, and loading it into a data warehouse.

Benefits and Challenges

Data warehousing provides a centralized repository of information that can be used for analytics and reporting, but it also comes with challenges such as cost, complexity, and data integration.



Role of Data Analyst in the Business

Role of Data Analyst in the Business

Role 1
Study the information

Role 2
Clean it from noise

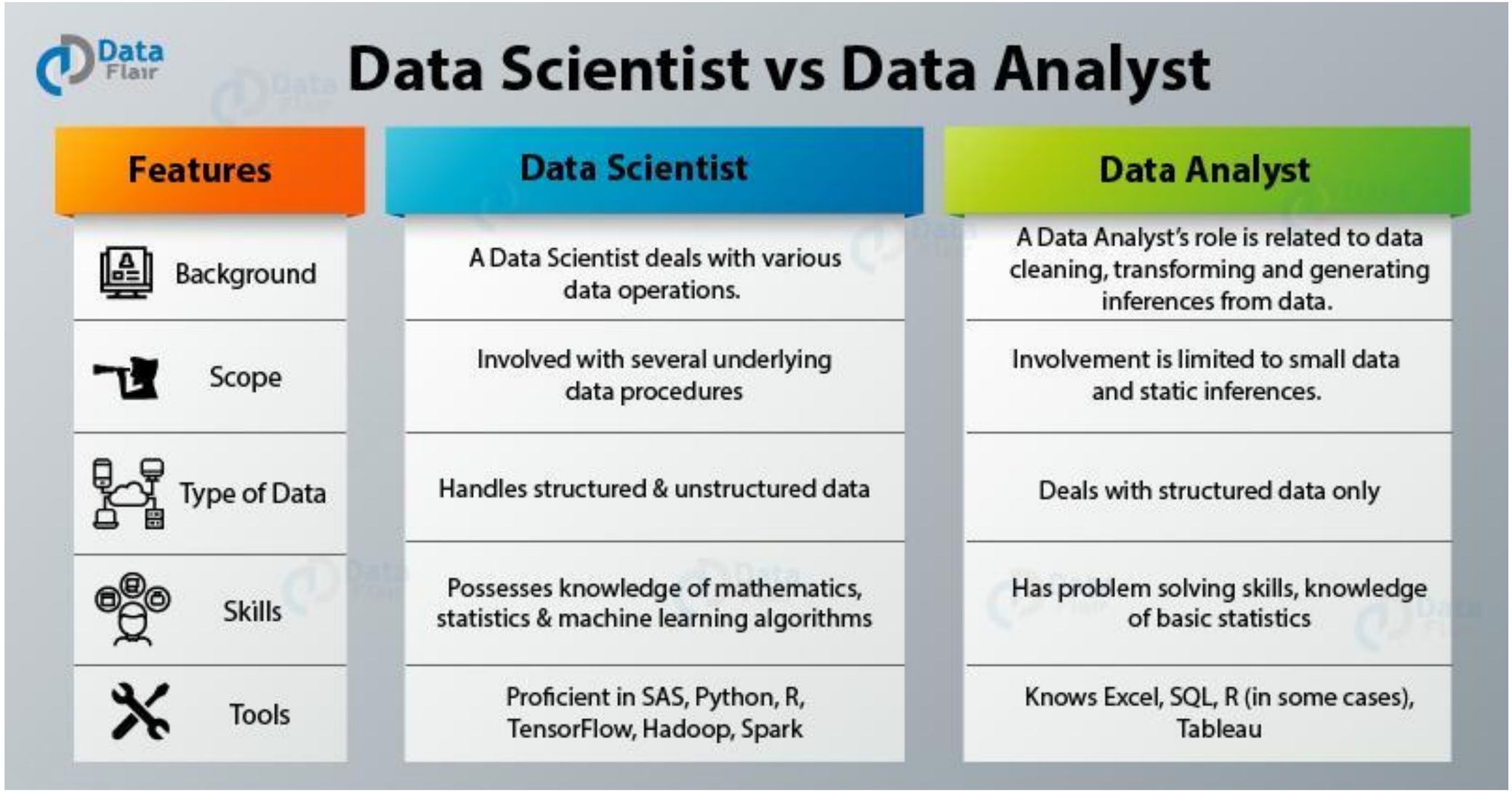
Role 3
Assess the quality of data and its sources

Role 4
Develop the scenarios for automation and machine learning

Role 5
Oversee the proceedings

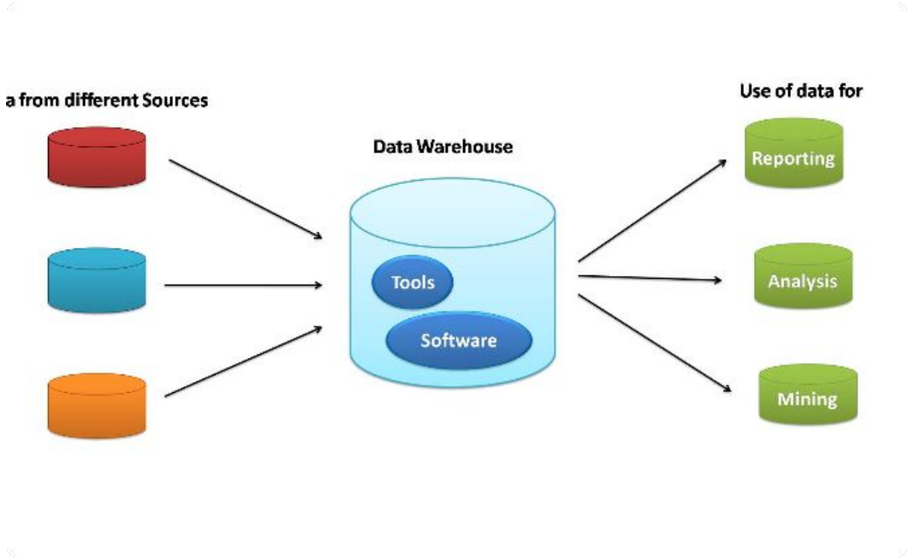
Source: https://corporatefinanceinstitute.com/resources/knowledge/other/data-analytics/

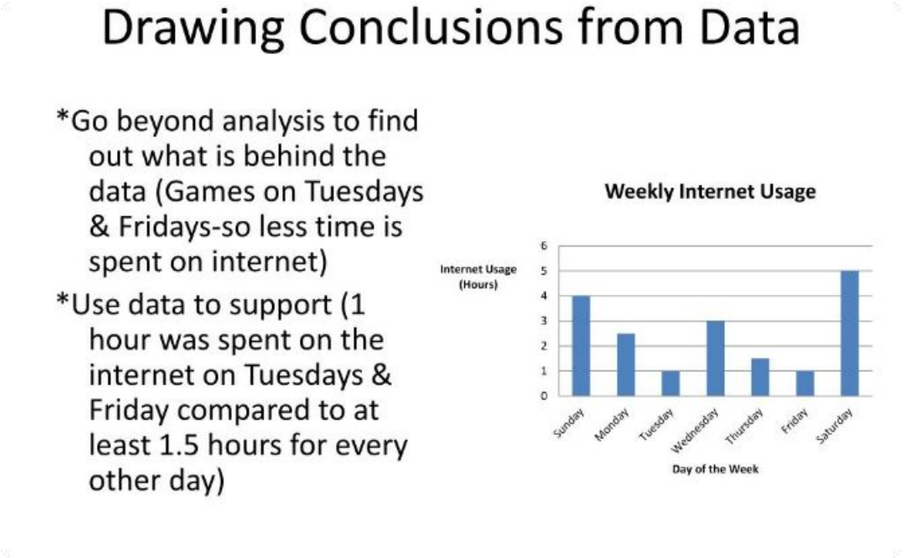
Data Scientist vs Data Analyst



Source: https://data-flair.training/blogs/data-scientist-vs-data-analyst/

Conclusion





Key Points

Databases and data analytics are essential for modern businesses to make informed decisions. Data warehousing, visualization, and big data analytics are important components of data analytics.

Importance

The ability to effectively manage and analyze data is critical for success in today's world of information overload.