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Database Foundations

1-2
Introduction to Databases

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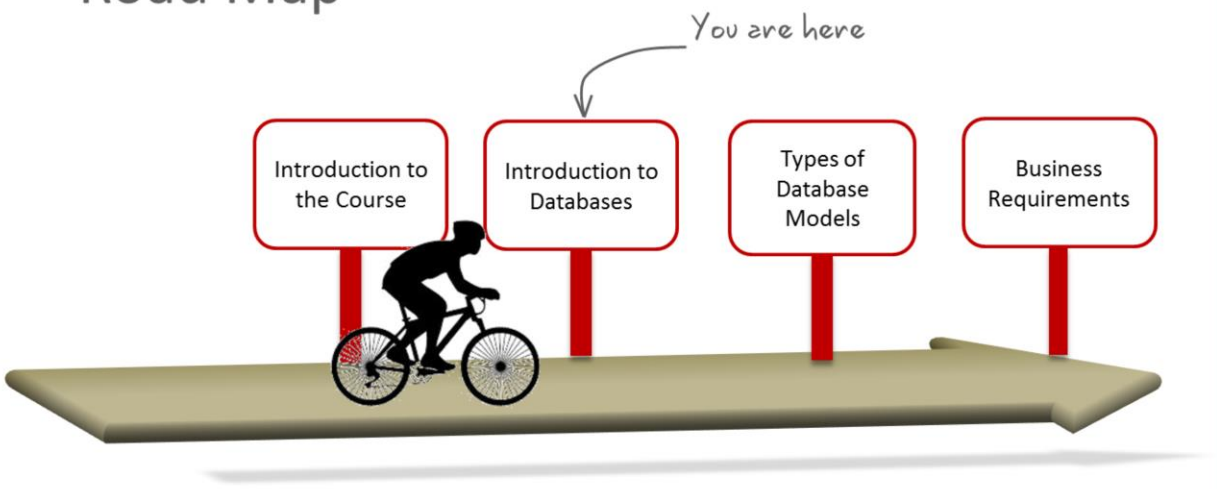
Road Map

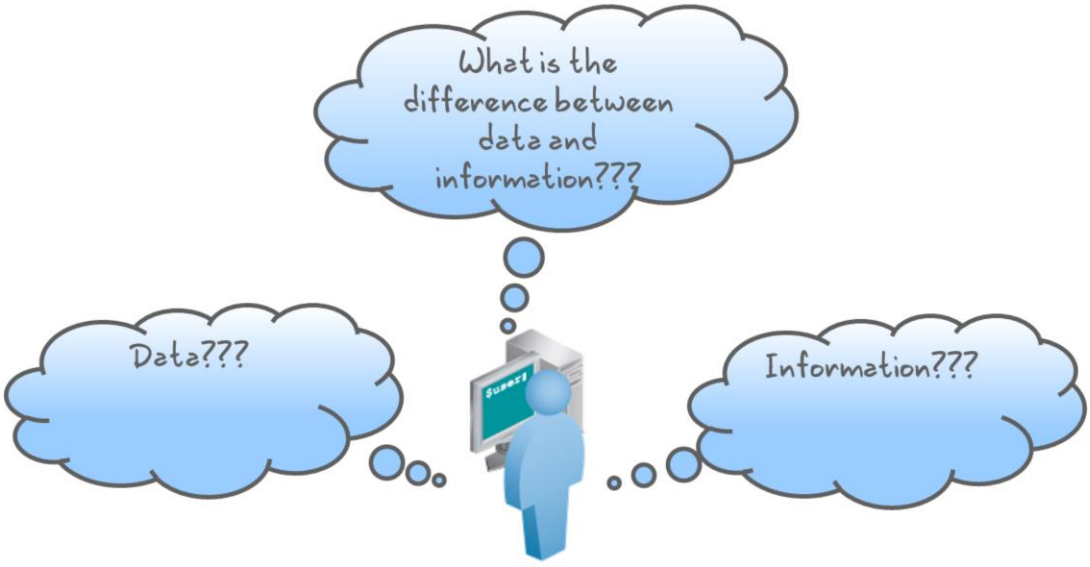


Objectives

This lesson covers the following objectives:

- Differentiate between data and information
- Define database
- Describe the elements of a database management system (DBMS)
- Identify the transformations in computing
- Identify business and industry examples where database applications are used

Case Scenario: Data Versus Information



Data Versus Information

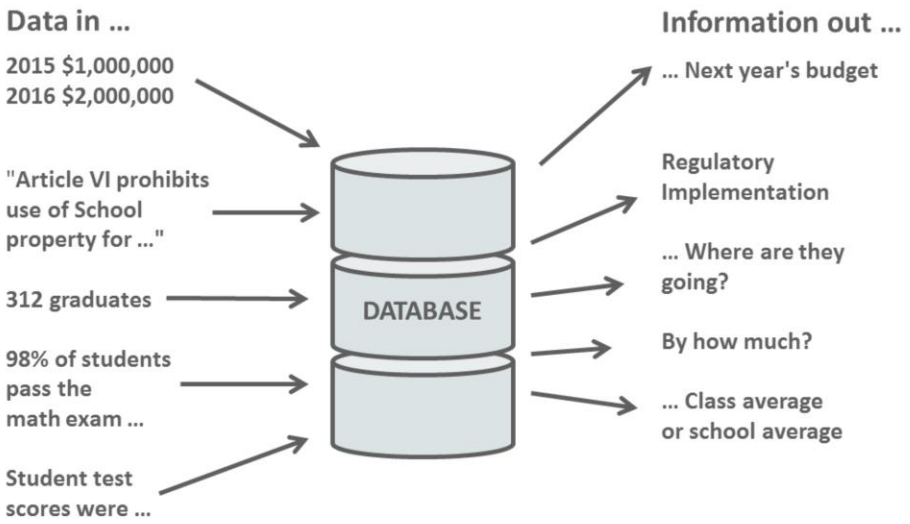
- *Data:*
  - Collected facts about a topic or item

- *Information*:
  - The result of combining, comparing, and performing calculations on data.

The words "data" and "information" are often used as if they are synonyms. Nevertheless, they have different meanings.

- Data is raw material from which you can draw conclusions; facts from which you can deduce new facts.
- Information is knowledge, intelligence, a particular piece of data with a special meaning or function. Information is often the result of combining, comparing, and performing calculations on data.

Data Versus Information: An Example



The difference between data and information can be explained by using an example such as test scores. In one class, if every student receives a numbered score, the scores can be calculated to determine a class average. The class averages can be calculated to determine the school average. So in this scenario, how can you differentiate between data and information?

- For data, each student's test score is one piece of data.
- Information is the class's average score or the school's average score.

Database Definition

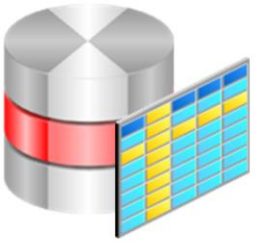
A database:

- Is a centralized and structured set of data stored on a computer system.
- Provides facilities for retrieving, adding, modifying, and deleting the data when required.
- Provides facilities for transforming retrieved data into useful information.

Every organization needs to collect and maintain data to meet its requirements. An information system can be defined as a formal system for storing and processing data. Most organizations today use a database to automate their information systems. A database is an organized collection of data put together as a unit. The rationale of a database is to collect, store, and retrieve related data for use by database applications. A database application is a software program that interacts with a database to access and manipulate data. A database is usually managed by a database administrator (DBA).

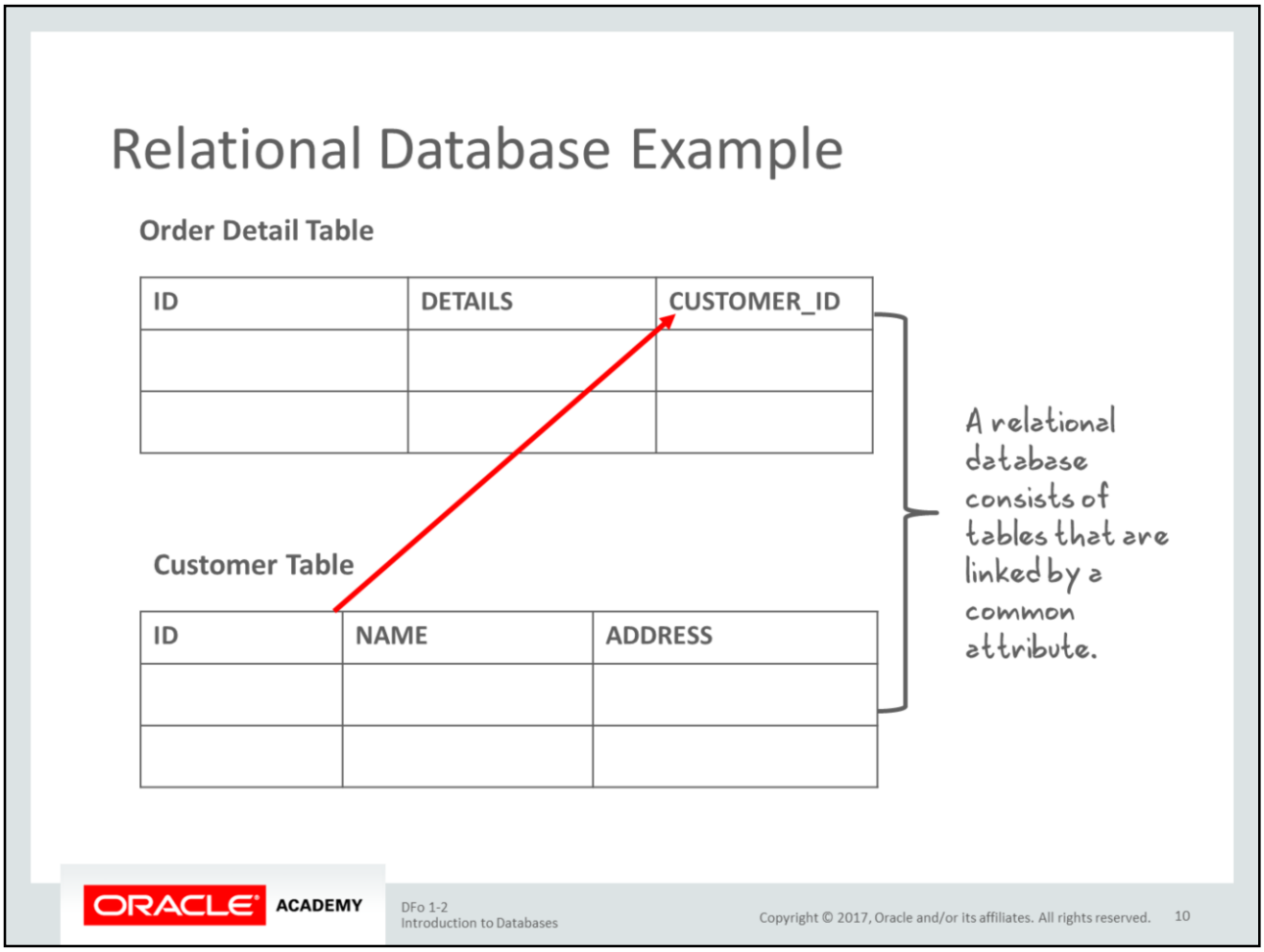
Introduction to Relational Databases

- A relational database stores information in tables with rows and columns.
- A table is a collection of records.
- A row is called a record (or instance).
- A column is referred to as a field (or attribute).



A relational database is a collection of records that are stored in tables. Each relational database table contains rows of records and columns containing fields of information about each record. A table in a relational database can also be referred to as an entity. A row in a relational database can also be referred to as an instance.

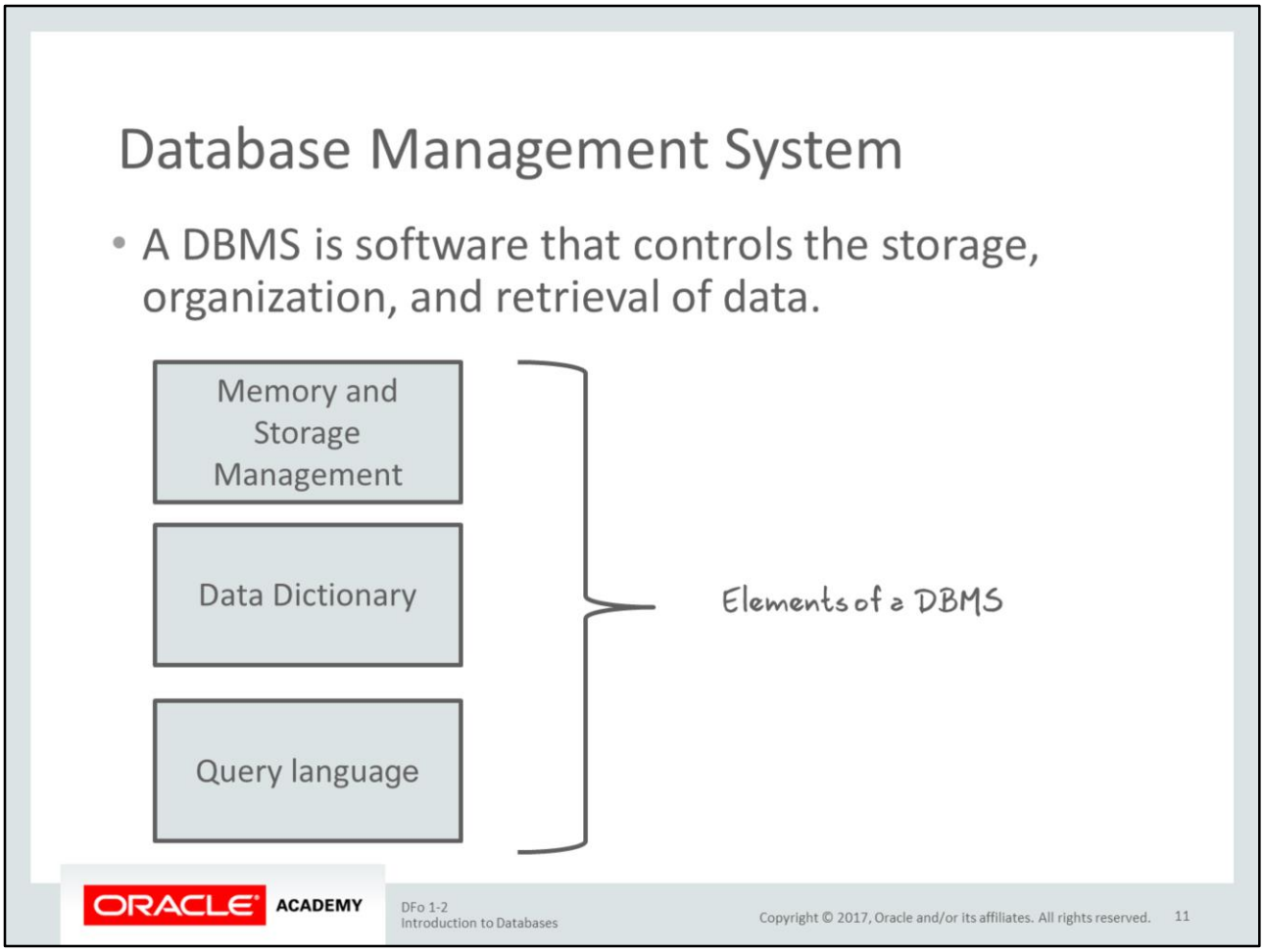
Each table of records will have a relationship to another table of records when the two tables share a field (or column).



The slide depicts two tables: Order Details and Customer. The tables are related to each other by a common attribute, ID and Customer ID.

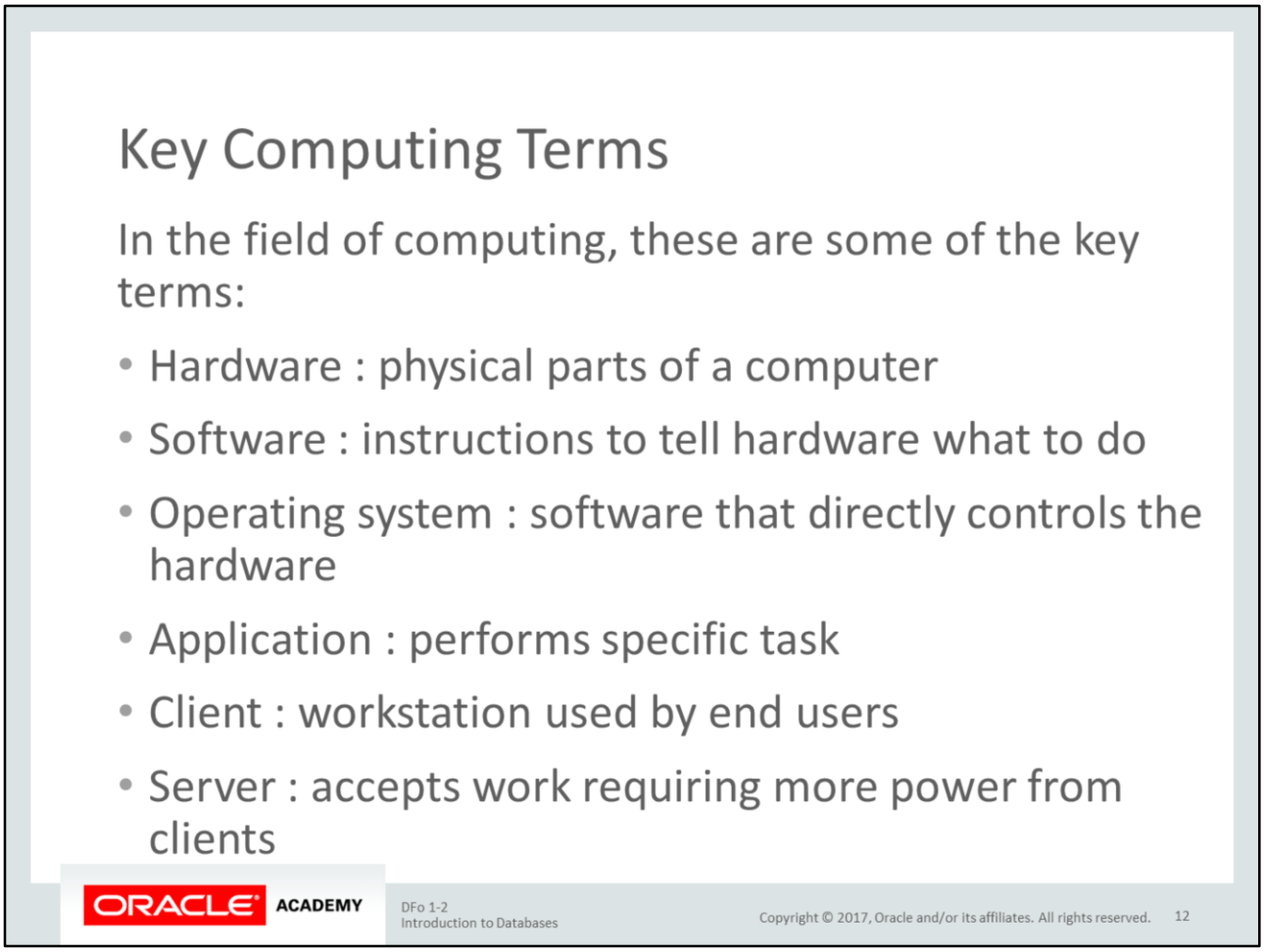
Imagine a single order placed by a customer. Each order will contain one or more order details. Each detail will be related to one customer.

The data provides information about the details of orders placed by customers. For example, the company could gather information about products that are commonly purchased together. Bundles of products could then be offered to better market the products to customers.



A DBMS has the following elements:

- The kernel code manages memory and storage for the DBMS.
- The repository of metadata is called a data dictionary.
- The query language enables applications to access the data.



Hardware: The physical "bits and pieces" of a computer; for example, keyboard, screen, mouse, disk drive, memory.

Software: Programs (sets of instructions) that tell the hardware what to do.

Operating system: A software program that directly controls and manages the hardware; for example, Microsoft Windows.

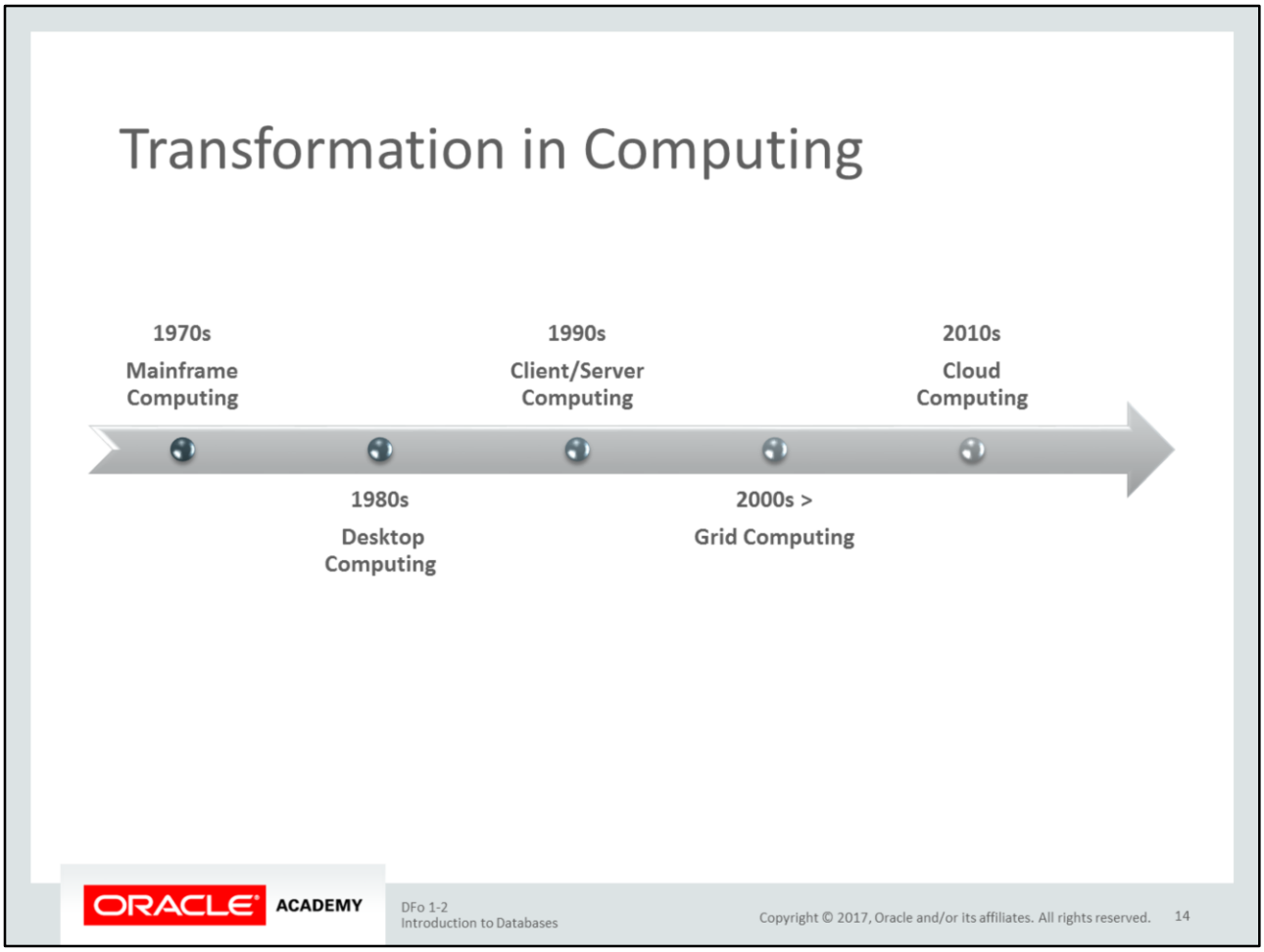
Application: A software program that carries out specific tasks on behalf of computer users – Microsoft Word or Excel for example.

Client: A workstation or desktop computer, including a screen, a keyboard, and a mouse. Clients communicate directly with human computer users.

Server: A more powerful computer that accepts work requests from clients, does the work, and sends results back to the client.

Every time you request information from a web page, your client computer sends the request to a database on the server. The server retrieves the data from the database, converts it into useful information, and sends the information back to the client.

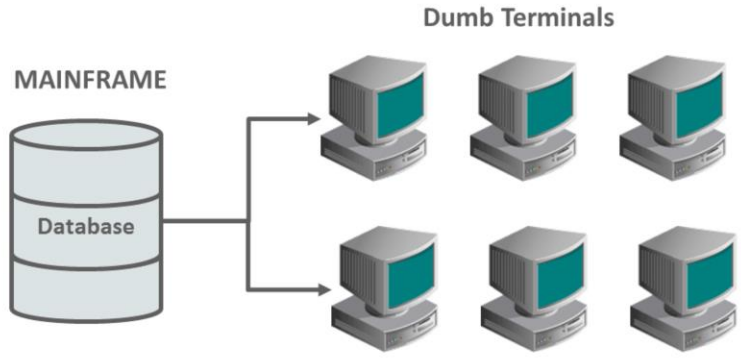
Case Scenario: Transformation in Computing



Early computer applications focused on tasks that were clerical in nature; for example, payroll, accounting, and inventory. These applications accessed data stored in computer files, converted the data into meaningful information, and generated reports to fulfill the organization's requirements. These systems were called file-based systems.

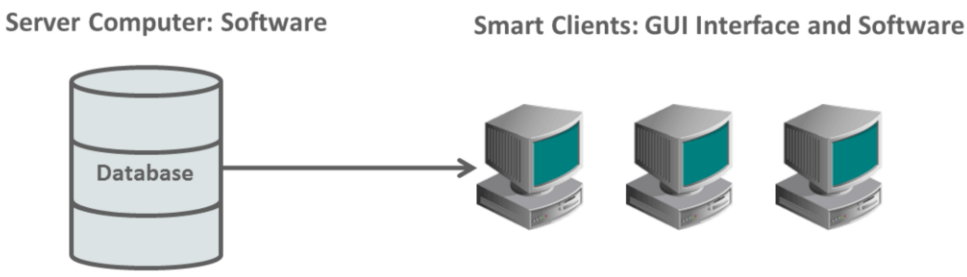
The decades-long evolution in computer technology, coupled with the needs and demands of organizations, has resulted in the development of a database technology from the primitive file-based systems to the robust, integrated database systems of today.

1970s: Mainframe Computing (Centralized Processing)



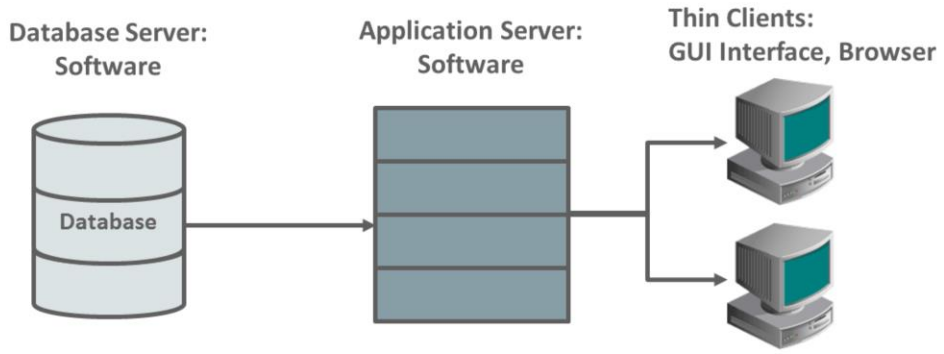
- In the 1970s, attempts were made to build database systems with integrated hardware and software.
- Smaller computers, or "dumb terminals," were used to access the large mainframe and execute commands.
- The terminals depended on the mainframe and displayed the results only after the processing was completed in the mainframe.
- They were not capable of much processing on their own.

1980s: Desktop Computing (Localized Processing)



- As PCs became faster and widely available, processing moved from mainframes to clients.
- PCs had their own software and were capable of doing some processing on their own, they came to be known as "smart clients" or "workstations."
- Having the processing power within the client machine ushered in a wave of graphical user interface (GUI) applications. Many of today's common applications (Word, Excel, PowerPoint) were created during this era.

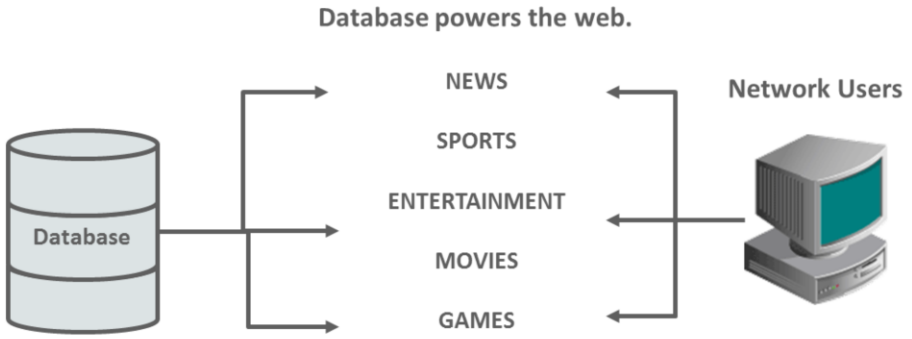
1990s: Client/Server Computing (Centalized and Local Processing)



- Client/Server computing uses the Internet and fast processing servers to meet the needs of organizations in storing data and producing information.
- The software that manages the data is on the database server, it performs processing for storage and retrieval.
- Applications for business operations sit on the application server, it performs processing for document creation, developing, interacting, or manipulating the data.
- Clients can have applications of their own, but the essential business applications are accessed from the clients by using an Internet browser.

Upgradation was one of the issues with multiple applications on multiple client workstations. An upgrade made to a software application warranted that each and every server plus each and every client had to be upgraded this paved the path to grid computing.

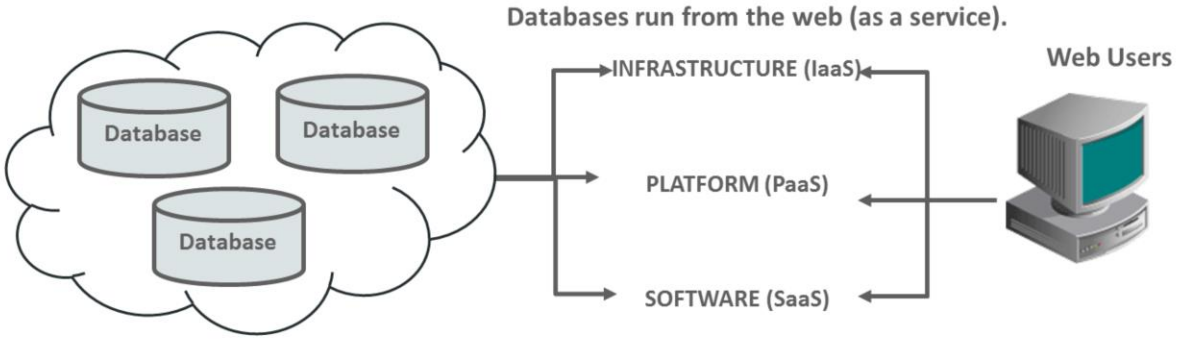
2000s: Grid Computing (Shared Processing)



- In the grid-computing model, all of an organization's computers in different locations can be utilized just like a pool of computing resources.
- Grid computing builds a software infrastructure that can run on a large number of networked servers.
- A user makes a request for information or computation from his or her workstation and that request is processed somewhere in the grid as efficiently as possible.

Grid computing treats computing as a utility, like the electric company. You don't know where the generator is or how the electric grid is wired. You just ask for electricity and you get it.

2010s: Cloud Computing (Internet Based Processing)



- Cloud computing allows the delivery of computing services over the Internet.
- The three main categories of cloud services are:
  - IaaS – Allows you to rent cloud based servers, storage, operating systems etc.
  - PaaS – Gives access to an online environment for developing and testing software without any setup or management costs.
  - SaaS – Delivers software direct from the Internet. Users normally access it through a web browser.

Most people use cloud (web based) services all the time without even realising it. Storing files online such as photographs, using movie subscription services or online game playing are all examples of cloud computing.

History of the Database Timeline

Year	Description
1960s	Computers become cost-effective for private companies along with increased storage capability.
1970-72	E.F. Codd proposes the relational model for databases, disconnecting the logical organization from the physical storage.
1976	P. Chen proposes the entity relationship model (ERM) for database design.
Early 1980s	The first commercially available relational database systems start to appear at the beginning of the 1980s with Oracle Version 2.
Mid-1980s	SQL (structured query language) becomes widely used.
1990s	The large investment in Internet companies helps create a tools market boom for web/internet/DB connectors.
2000s	Solid growth of DB applications continues. Examples: commercial websites (yahoo.com, amazon.com), government systems (Bureau of Citizenship and Immigration Services, Bureau of the Census), art museums, hospitals, schools.
2010s	Cloud based services from companies such as Oracle, Apple and Microsoft as well as Amazon's AWS have turned Cloud Computing into a multi billion dollar industry.

Examples

- Schools and colleges use databases to maintain details about courses, students, and faculty.
- Banks use databases for storing information on customers, accounts, loans, and transactions.
- Airlines and railways use online databases for reservations and for displaying information on the schedule.

Examples



- Telecommunication departments store information about the communication network, telephone numbers, call details, and monthly bills in databases .
- In finance and trading, databases are used for storing information pertaining to sales, purchases of stocks and bonds, or online trading.
- Organizations use databases for storing information about their employees, salaries, benefits, taxes, and for generating paychecks.

- Can you think of more uses for databases?

- Databases are used:
  - For keeping track of purchases on credit and debit cards, which helps generate monthly statements.
  - For integrating heterogeneous information sources for business-related activities, such as online shopping, booking of holiday packages, and doctor consultations.
  - In the health-care industry to maintain and track patient health care details.
  - In the area of digital publishing and digital libraries to manage and deliver textual and multimedia data.

Summary

In this lesson, you should have learned how to:

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- Define database
- Describe the elements of a database management system (DBMS)
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- Identify business and industry examples where database applications are used


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