信息系统分析与设计
系统设计 System Design

信息系统系　刘冠男

系统设计是什么？

系统设计是说明一个详细的计算机系统方案的任务

界线模糊

| 系统分析 | 系统设计 | 系统开发 |

时间：前期
抽象：概念
角色：分析师
成果：分析模型
强调业务问题

时间：中期
抽象：概念&实际
角色：设计师
成果：设计类
专注于技术&实现

时间：后期
抽象：落地
角色：程序员
成果：程序包
专注于实现&优化
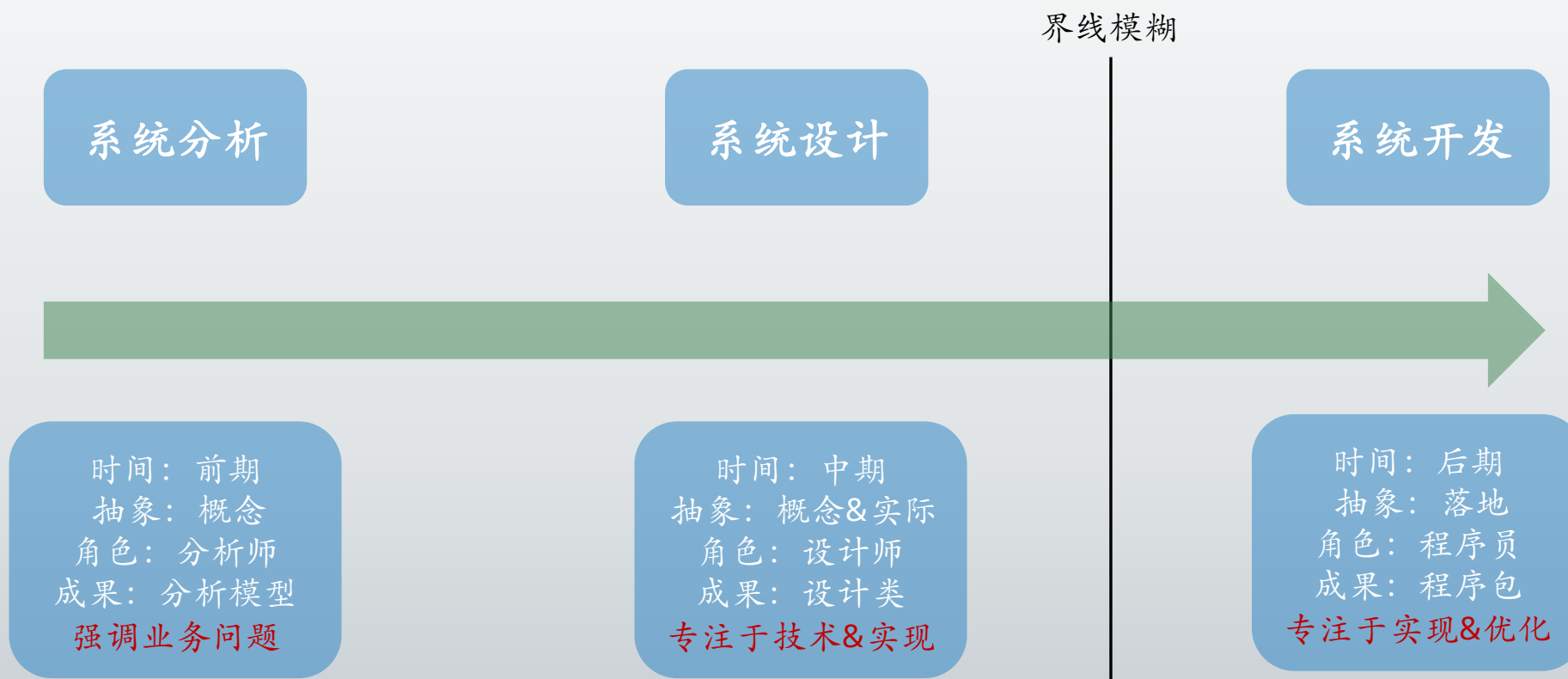
系统设计的目标

- **Goal of systems design is to <u>build</u> a system that is <u>effective, reliable,</u> and <u>maintainable</u>**

  - Effective if it supports **business requirements** and meets user needs

  - Reliable if it handles input errors, processing errors, hardware failures, or human mistakes

  - Maintainable if it is flexible, scalable, and easily modified

系统设计与系统分析

- **工作任务上：分析是计算机概念化，设计是计算机概念实例化**

- **抽象层次上：分析高于实现语言、实现方式，设计师基于特定的语言和实现方式**
  - 高于实现语言和实现方式的好处？需要维护设计与需求的一致很困难，设计包含很多需求不需要而系统必需的信息

- **角色上：系统分析师与系统设计师**

- **工作成果：分析模型 vs. 设计类、程序包**

Suggestions for Successful Design

- **Think like a user**
  - Carefully examine any point where users provide input or receive output
  - The user interface must be easy to learn
  - Input processes should be easy to follow, intuitive, and forgiving of errors
  - Predesigned output should be attractive and easy to understand, with an appropriate level of detail

- **Anticipate future needs**
  - Anticipate possible expansion

- **Provide flexibility**
  - Best design strategy is to offer several alternatives, so users can decide what will work best for them
  - Start with a default value that displays automatically

- **Manage data effectively**
  - The system should enter and verify data as soon as possible
  - Each data item should have a specific type, such as alphabetic, numeric, or alphanumeric, and a range of acceptable values
  - Collect input data as close to its source as possible

设计类：**What Are Design Classes?**

- **Design classes are classes whose specifications have been completed to such a degree that they can be implemented.**

- **Design classes come from**
  - the problem domain via a refinement of analysis classes.
  - the solution domain containing utility class libraries, reusable components, middleware, component frameworks, etc.

- **A design class consists of**
  - a complete set of attributes with full specifications
  - a complete set of methods with full specifications

Analysis Class vs. Design Class
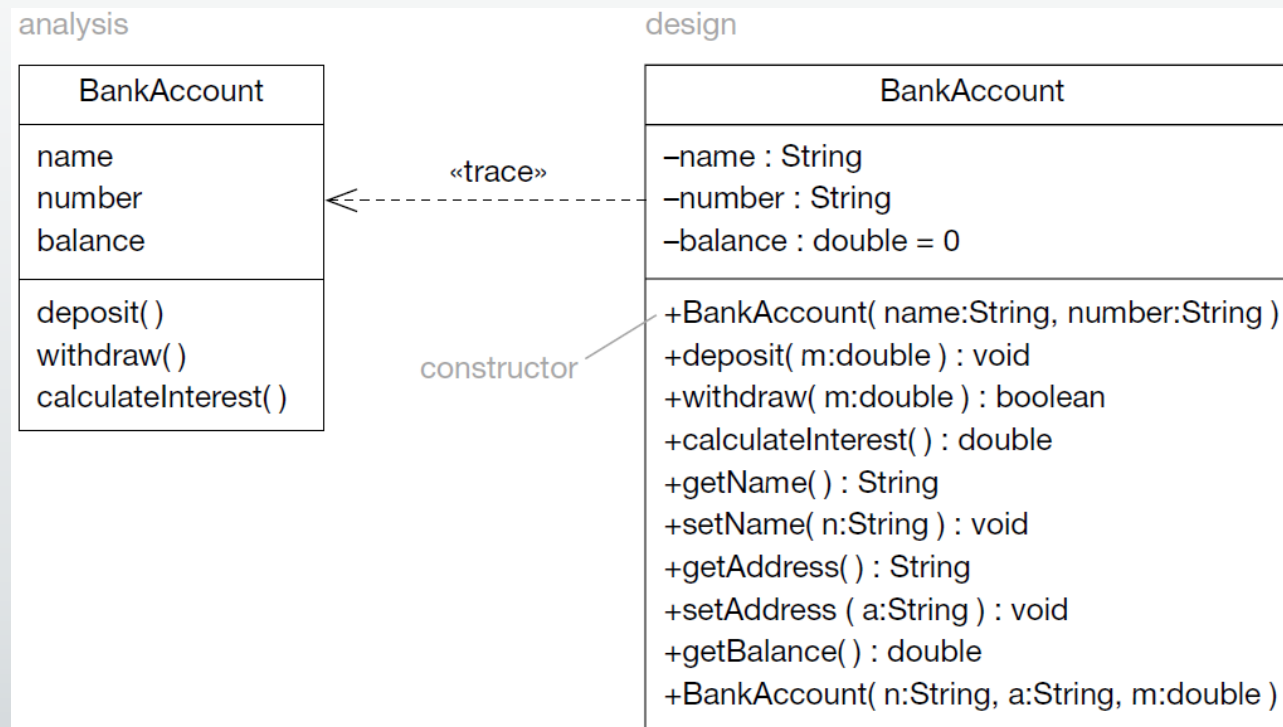
System Architecture
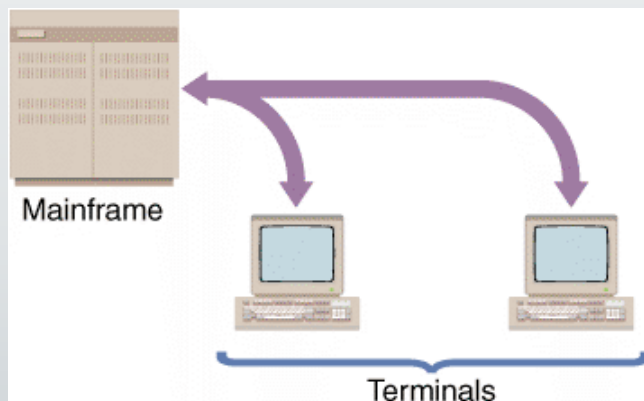
Application Architecture

- **Application architecture – a specification of the technologies to be used to implement information systems. The blueprint to communicate the following design decisions:**

  - The degree to which the information system will be centralized or distributed.

  - The distribution of stored data.

  - The implementation technology for software developed in-house.

  - The integration of commercial off-the-shelf software.

  - The technology to be used to implement the user interface.

  - The technology to be used to interface with other systems

Application Architecture: Then and Now

- **Mainframe Architecture**

  - A server is a computer that supplies data, processing services, or other support to one or more computers

  - The earliest servers were mainframe computers, and a system design where the server performs all the processing sometimes is described as mainframe architecture

In a centralized design, the remote user's keystrokes are transmitted to the mainframe, which responds by sending screen output back to the user's screen

Application Architecture: Then and Now

- **Impact of the Personal Computer**
  - Stand-alone computing: Users can run their own word processing, spreadsheet, and database applications without assistance from the IT group
  - Companies **linked the stand-alone computers into networks** that enabled the user clients to exchange data and perform local processing
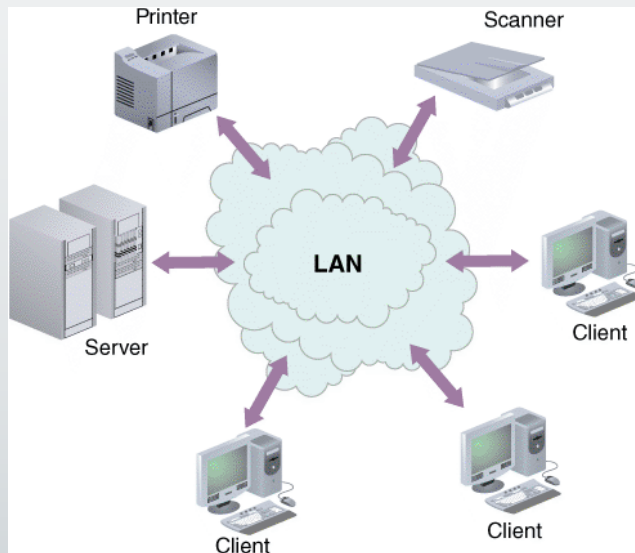

Internet-based retail operations such as Amazon.com use customer service centers to fulfill online sales
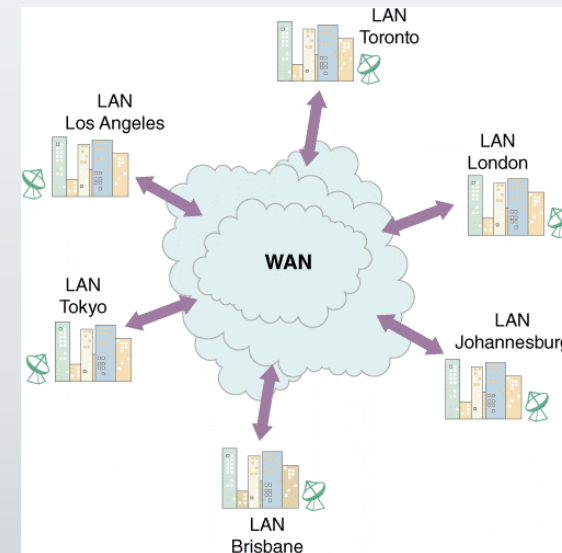
Application Architecture: Then and Now

- **Network Evolution**
  - A local area network (LAN) allows sharing of data and hardware resources
  - A wide area network (WAN) **spans long distances and can connect LANs that are continents apart**

A LAN allows sharing of data and hardware, such as printers and scanners

A WAN can connect many LANs and link users who are continents apart

Distributed versus Centralized Systems

Centralized systems – a system in which all components are hosted by a central, multi-user computer.

- Users interact with the system via terminals (or a PC emulating a terminal).

- Virtually all the actual processing and work is done on the host computer.

Distributed system – a system in which components are distributed across multiple locations and computer networks.

- Accordingly, the processing workload is distributed across multiple computers on the network.

Why the Trend Toward Distributed Systems?

- **Modern businesses are already decentralized (distributed).**

- **Distributed computing moves information and services closer to the customers and users who need them.**

- **Distributed computing consolidates the power of personal computers across the enterprise.**

- **Distributed computing solutions are in general more user-friendly because they use the PC as the user interface processor.**

- **Personal computers and network servers are less expensive than mainframe computers**

  - Though total cost of ownership is at least as expensive

Application Architecture

- **Every management information system must carry out three main functions:**

  - Handle data storage and access (Data Layer)

  - Manage applications that perform the processing logic (Process Layer)

  - Provide an interface that allows users to interact with the system (Interface Layer)
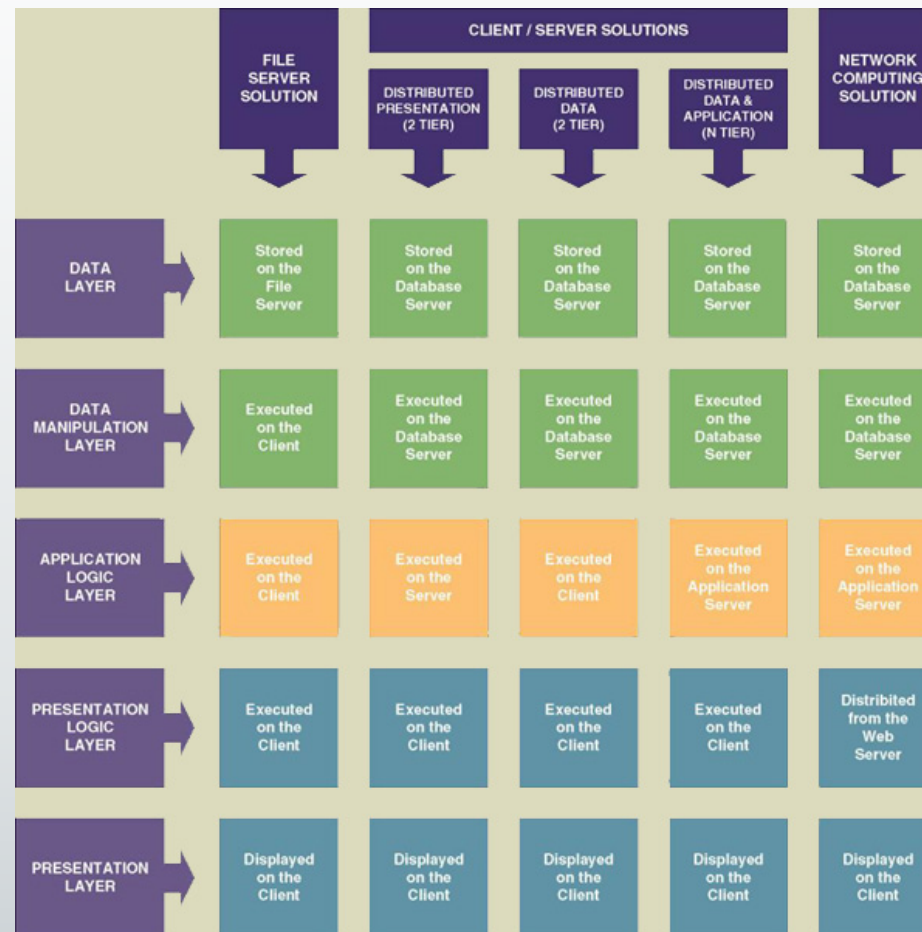
Fine-grained Layers

- **Presentation layer**—the user interface

- **Presentation logic layer**—processing that must be done to generate the presentation, such as editing input data or formatting output data.

- **Application logic layer**—the logic and processing to support business rules, policies, and procedures

- **Data manipulation layer**—to store and retrieve data to and from the database

- **Data layer**—the actual business data

Types of Distributed Computing

	FILE SERVER SOLUTION	CLIENT / SERVER SOLUTIONS			NETWORK COMPUTING SOLUTION
		DISTRIBUTED PRESENTATION (2 TIER)	DISTRIBUTED DATA (2 TIER)	DISTRIBUTED DATA & APPLICATION (N TIER)	
DATA LAYER	Stored on the File Server	Stored on the Database Server	Stored on the Database Server	Stored on the Database Server	Stored on the Database Server
DATA MANIPULATION LAYER	Executed on the Client	Executed on the Database Server	Executed on the Database Server	Executed on the Database Server	Executed on the Database Server
APPLICATION LOGIC LAYER	Executed on the Client	Executed on the Server	Executed on the Client	Executed on the Application Server	Executed on the Application Server
PRESENTATION LOGIC LAYER	Executed on the Client	Executed on the Client	Executed on the Client	Executed on the Client	Distributed from the Web Server
PRESENTATION LAYER	Displayed on the Client	Displayed on the Client	Displayed on the Client	Displayed on the Client	Displayed on the Client

File Server Architecture

Local area network (LAN) – a set of client computers (PCs) connected over a relatively short distance to one or more servers.

File server system – a LAN in which a server hosts the data of an information system.

- All other layers are implemented on the client computers.

- Frequently excessive network traffic to transport data between servers and clients.

- Client must be fairly robust（"fat"）because it does most of the work.

- Database integrity can be compromised.

Client/Server Architecture — Clients

- **Client/server system** – a distributed computing solution in which the presentation, presentation logic, application logic, data manipulation, and data layers are distributed between client PCs and one or more servers.
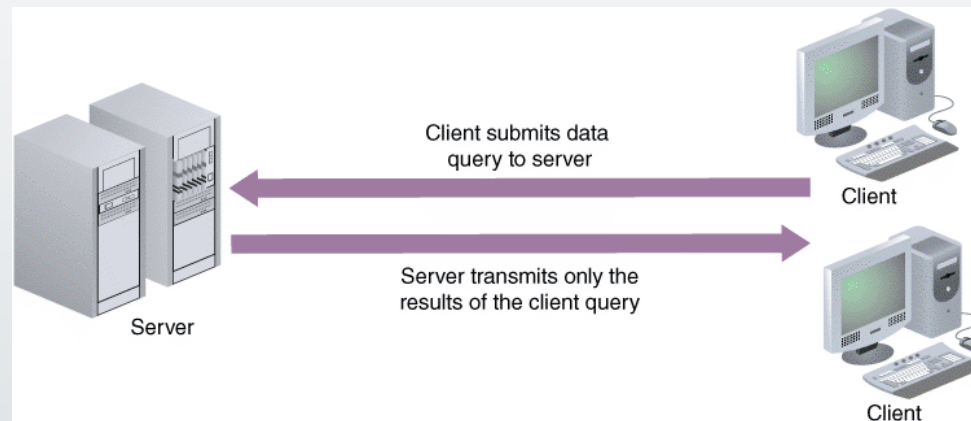
- **Thin client** – a personal computer that does not have to be very powerful because it only presents the user interface to the user.

- **Fat client** – a personal computer, notebook computer, or workstation that is typically powerful.

Client/Server Architecture — Servers

- **Database server** – a server that hosts one or more databases.
    - Executing all data manipulation commands at the server.

- **Transaction server** – a server that hosts services which ensure that all database updates for a transaction succeed or fail as a whole.

- **Application server** – a server that hosts application logic and services for an information system.

- **Messaging or groupware server** – a server that hosts services for e-mail, calendaring, and other work group functionality.

- **Web server** – a server that hosts Internet or intranet websites.

Client/Server—Distributed Presentation

Distributed presentation – a client/server system in which the presentation and presentation logic layers are shifted from the server to reside on the client.

- The application logic, data manipulation, and data layers remain on the server (frequently a mainframe).

- Character user interface (CUI)

- Graphical user interface (GUI)

Client/Server—Distributed Data

Distributed data – a client/server system in which the data and data manipulation layers are placed on the server(s), and other layers are placed on the clients.

- Sometimes called two-tiered client/server computing.

- Difference to file server systems is where the data manipulation commands are executed.

- Much less network traffic than file server systems because only the database requests and the results of those requests are transported across the network.

- Database integrity is easier to maintain.

# Client/Server—Distributed Data and Application

Distributed data and application – a client/server system in which:

1. The data and data manipulation layers are placed on their own server(s),
2. The application logic is placed on its own server,
3. The presentation logic and presentation layers are placed on the clients.

- Sometimes called **three-tiered or n-tiered client/server computing**.
- Requires design partitioning.

Partitioning – the art of determining how to best distribute or duplicate application components across the network.

Two-tier and Three-tier Systems
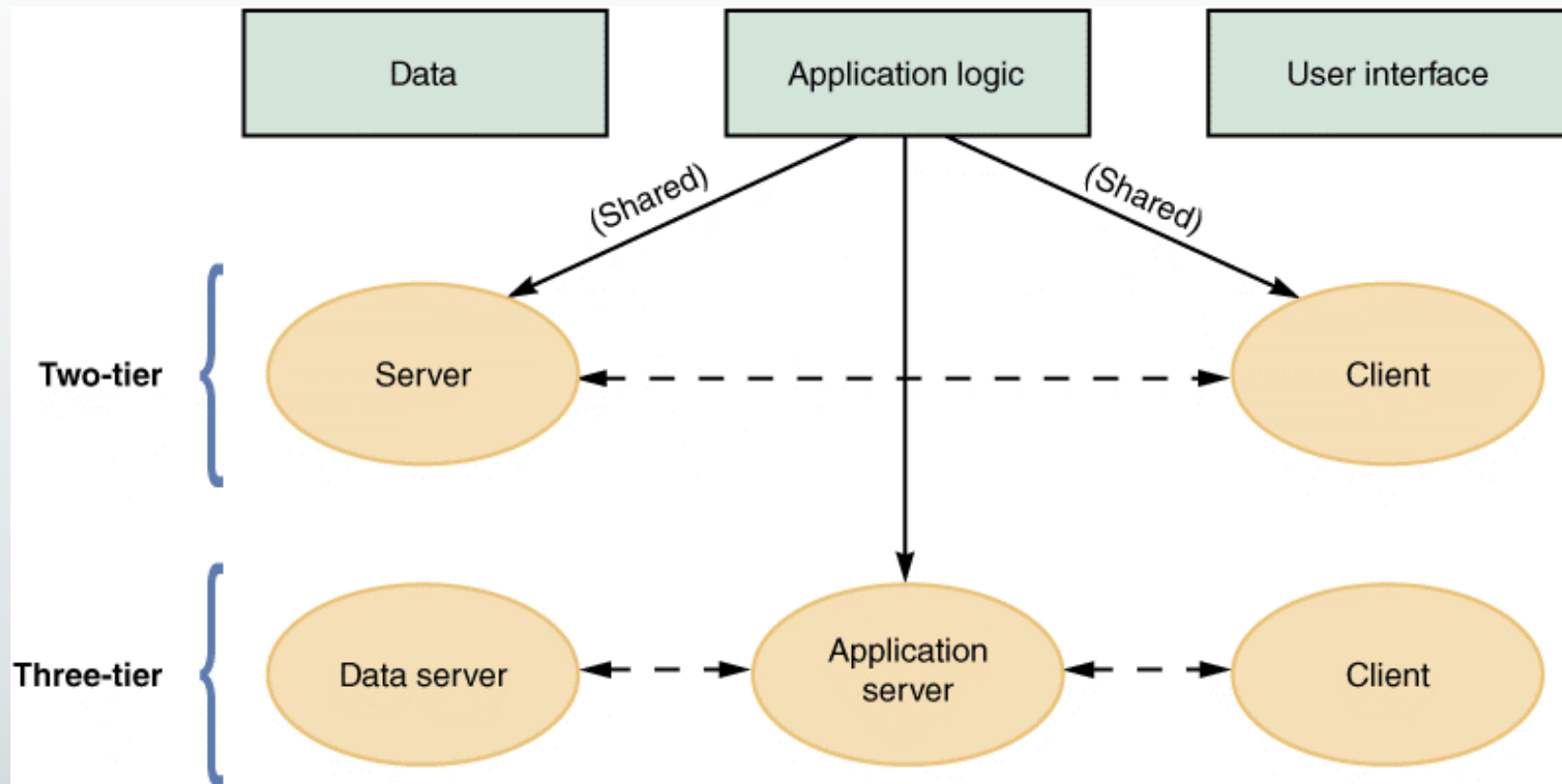
Characteristics of two-tier versus three-tier client/server design

Internet- and Intranet-based Architectures

Network computing system – a multi-tiered solution in which the presentation and presentation logic layers are implemented in client-side Web browsers using content downloaded from a Web server.

- The presentation logic layer connects to the application logic layer that runs on the application server, which connects to the database servers on the backside of the system.
- The greatest potential of this approach is its applicability to redesign of traditional information systems to run on an intranet.

Intranet – a secure network that uses Internet technology to integrate desktop, work group, and enterprise computing into a cohesive framework.

Internet- and Intranet Technologies

- **Java**
  - Mostly for programming server-side application logic called "servlets"
  - Occasionally for programming client-side application logic called "applets"

- **HTML (HyperText Markup Language)**
  - Mostly for programming the presentation layer

- **XML (Extensible Markup Language)**
  - Mostly for programming data content to be transported across the web

- **SQL (Structured Query Language)**
  - Universal standard language for database manipulation

- **Web Browsers**

Data Architectures

Relational database stores data in tabular form. Each file is implemented as a table. Each field is a column in the table. Related records between two tables are implemented by intentionally duplicated columns in the two tables.

Distributed relational database – A database system that duplicates tables to multiple database servers located in geographically important locations.

Distributed relational database management system – a software program that controls access to and maintenance of stored data in the relational format.

Types of Data(base) Distribution

Data partitioning truly distributes rows and columns of tables to specific database servers with little or no duplication between servers.

- Vertical partitioning assigns different columns to different servers.

- Horizontal partitioning assigns different rows to different servers.

Data replication duplicates some or all tables on more than one database server.

- Propagates updates on one database server to any other database server where the data is duplicated.

Data Partitioning versus Data Replication

Logical Data Store	Physical Data Stores using Partitioning	Physical Data Stores using Replication
1 CUSTOMERS	**1P.#** Oracle 7: REGION 1 CUSTOMERS **1P.#** Oracle 7: REGION 2 CUSTOMERS	Not necessary. Branch offices do not need access to data about customers outside of their own sales region.
2 PRODUCTS	Not applicable. All branch offices need access to data for all products, regardless of sales region.	**2M** Oracle 8i: PRODUCTS (Master) **2R** Oracle 8i: PRODUCTS (Replicated Copy)