

# COMP1140: Database and Information Management



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Lecture Note – Week 2

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# Notice

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- Assignment 1 starts now, due 10am Tuesday, August 22
- Discussion forums have been created on BB
- Lab starts this week – SQL server & T-SQL etc.



# Last lecture

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- Introduction to course
- Introduction to DBMSs
- Databases in Perspective
- Database Design Process
- Requirements Gathering
- Any questions?



# This lecture

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- Database and DBMS architectures
  - **Three-level database architecture**
  - **Multi-User DBMS architectures**
- Assignment discussion:
  - **Clarify any requirements and scope**
- Reference: Chapters 2, 3, 10, 11, Appendices A & B

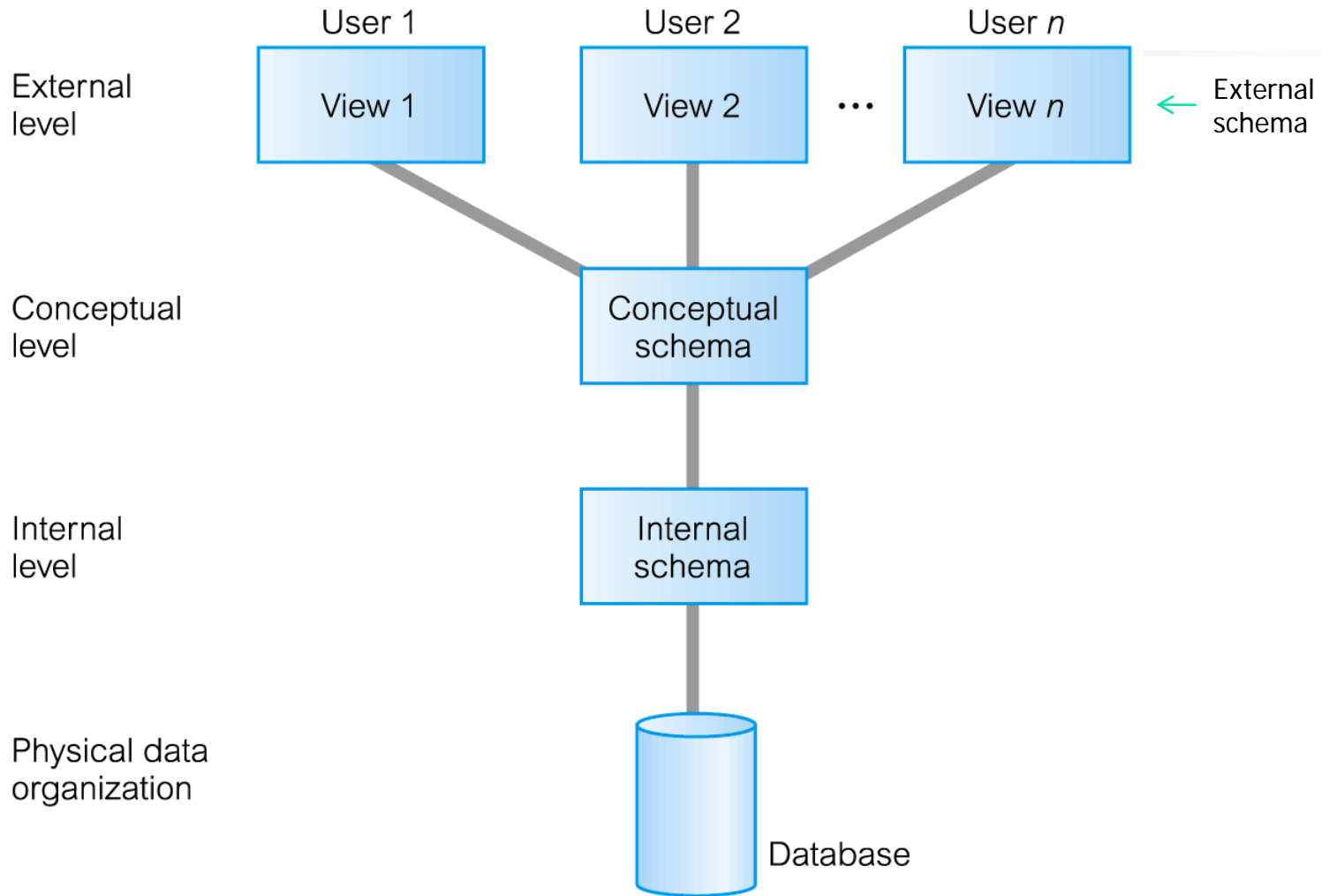


# Three-level database architecture

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- **Purpose of three-level database architecture**
  - All users should be able to access same data.
  - A user's view is immune to changes made in other views.
  - Users should not need to know physical DB storage details.
  - DBA should be able to change database storage structures without affecting the users' views.
  - Internal structure of database should be unaffected by changes to physical aspects of storage.
  - DBA should be able to change conceptual structure of database without affecting all users.

# ANSI-SPARC Three-Level Architecture





# ANSI-SPARC Three-Level Architecture

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- **External Level**
  - Users' view of the database.
  - Describes that part of database that is relevant to a particular user.
- **Conceptual Level**
  - Community view of the database.
  - Describes what data is stored in database and relationships among the data.
- **Internal Level**
  - Physical representation of the database on the computer.
  - Describes how the data is stored in the database.

# Differences Among Three Levels of ANSI-SPARC Architecture

External view 1

sNo	fName	lName	age	salary
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External view 2

staffNo	lName	branchNo
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Conceptual level

staffNo	fName	lName	DOB	salary	branchNo
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Internal level

```
struct STAFF {  
    int staffNo;  
    int branchNo;  
    char fName [15];  
    char lName [15];  
    struct date dateOfBirth;  
    float salary;  
    struct STAFF *next;  
};  
index staffNo; index branchNo;
```

/\* pointer to next Staff record \*/  
/\* define indexes for staff \*/





# Multi-User DBMS Architectures

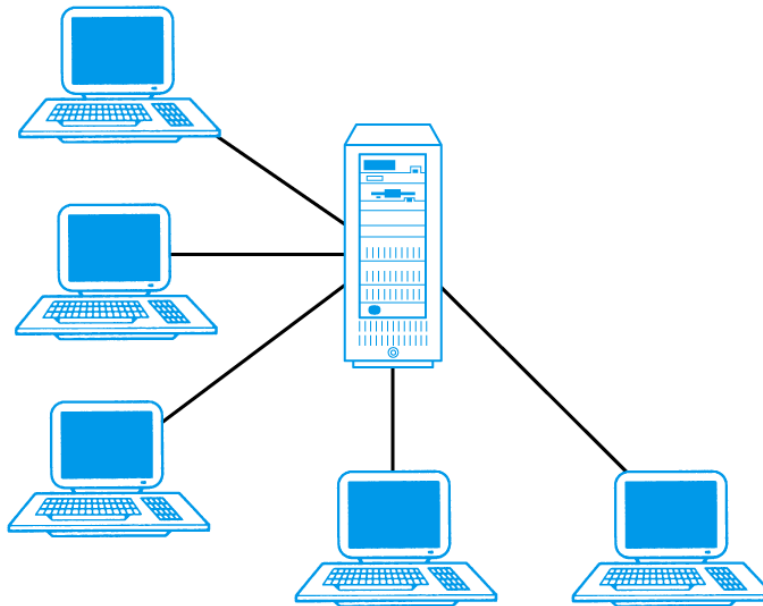
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- **Teleprocessing**
- **File server**
- **Client-server**

# Teleprocessing

## Traditional architecture.

- Single mainframe with a number of terminals attached.
- Trend is now towards downsizing.





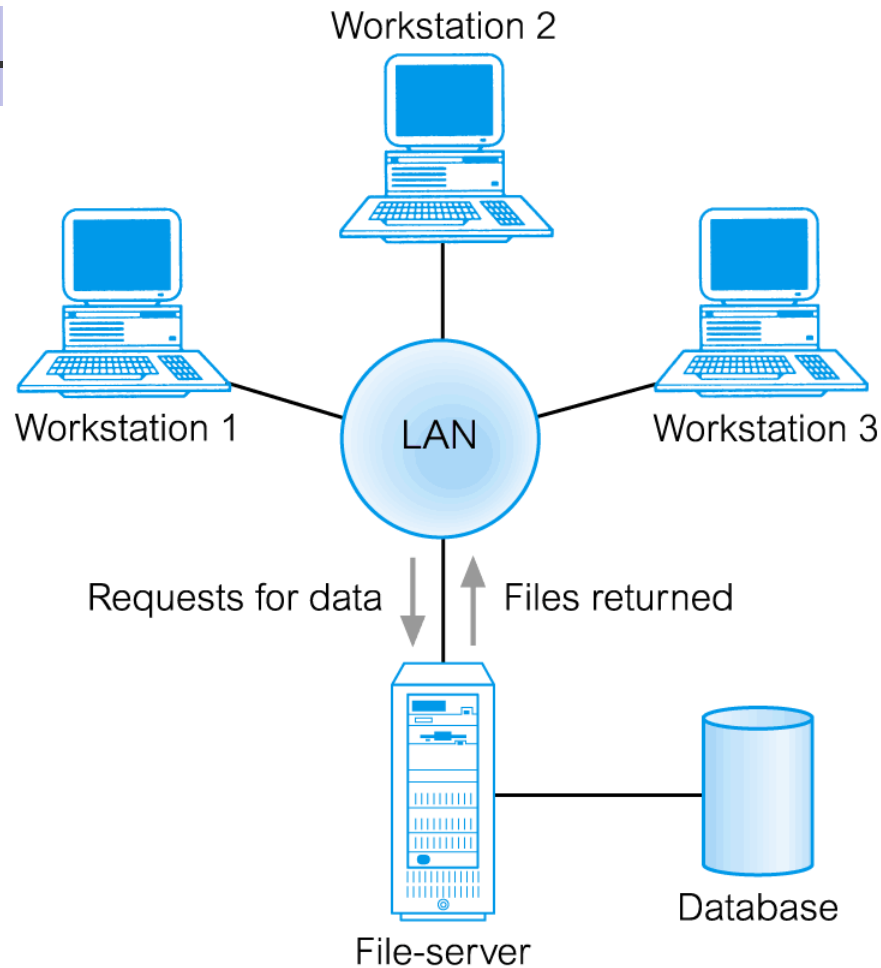
# File Server

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- **File server is connected to several workstations across a network.**
- **Database resides on file server.**
- **DBMS and applications run on each workstation.**



# File Server Architecture





# File Server

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- **Disadvantages include:**
  - **Significant network traffic.**
  - **Copy of DBMS on each workstation.**
  - **Concurrency, recovery and integrity control more complex.**

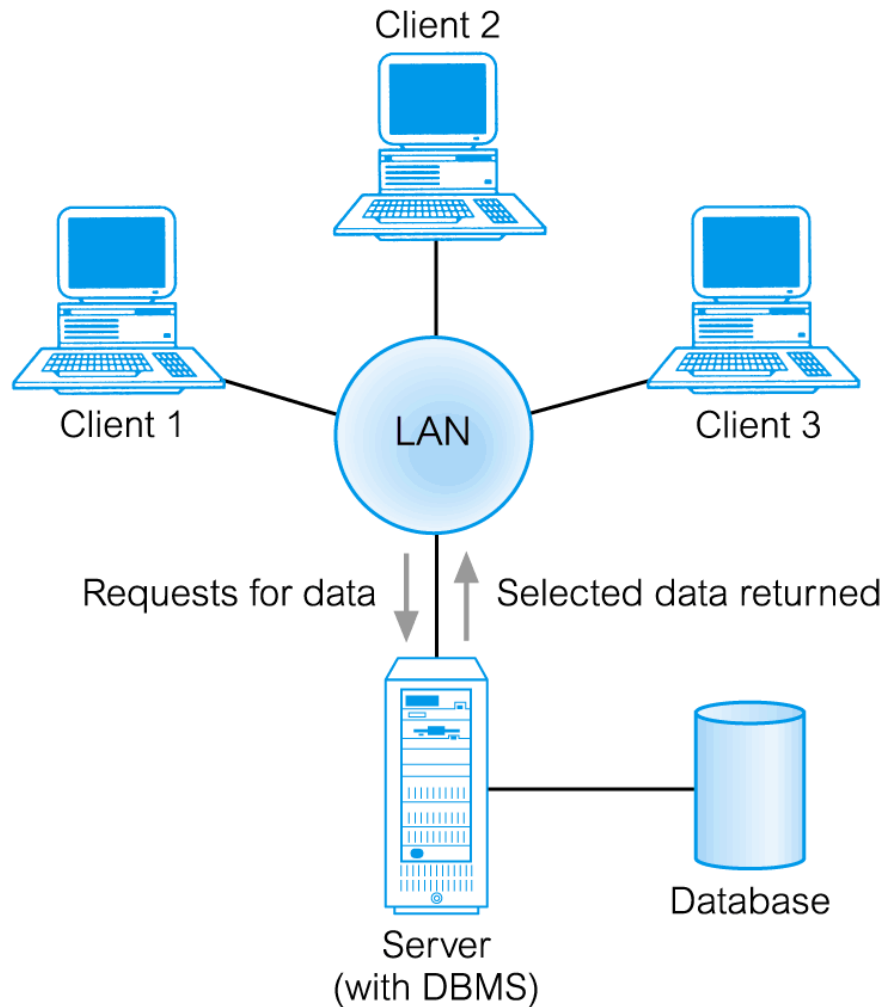


# Traditional Two-Tier Client-Server

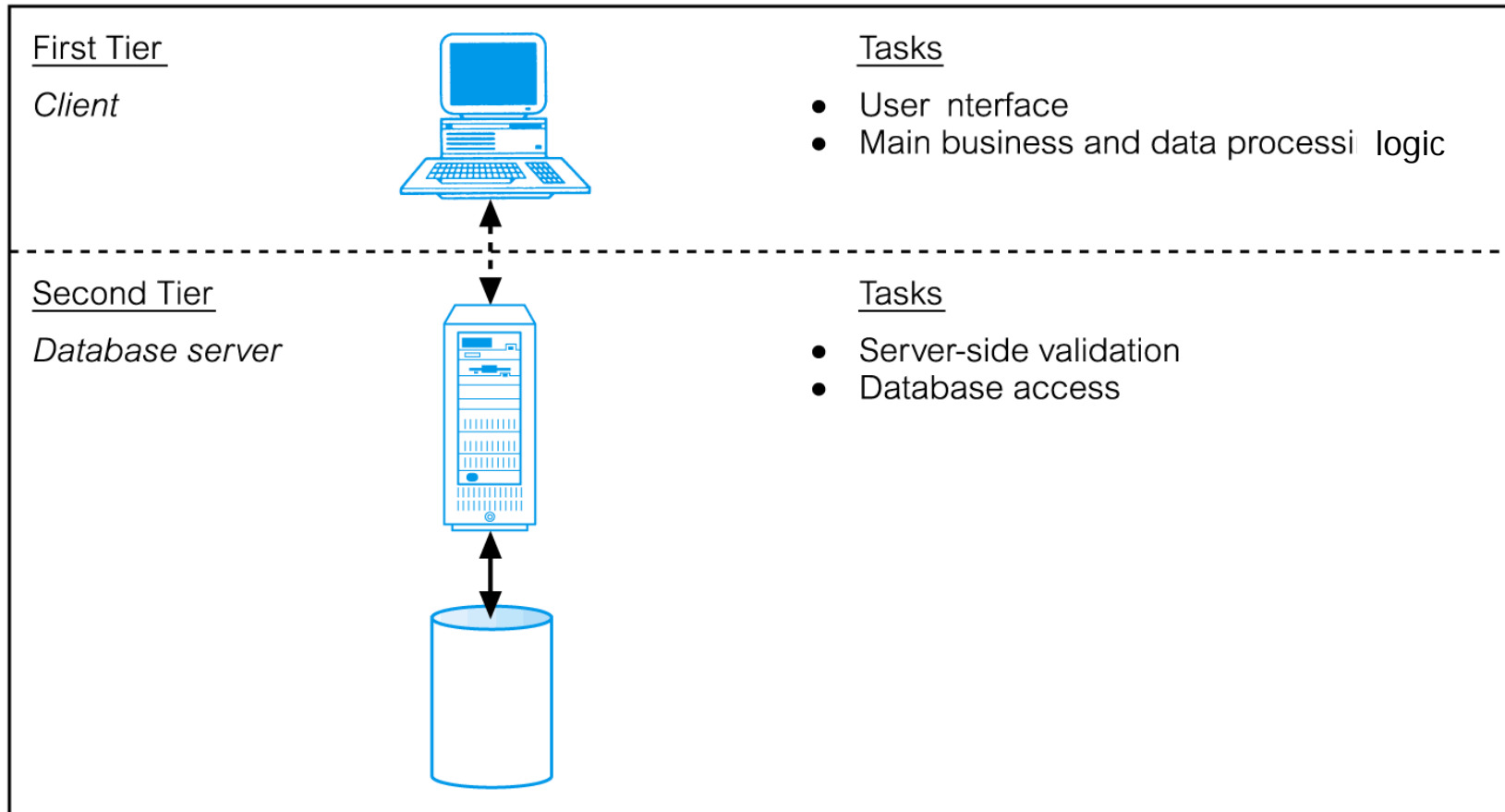
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- **Client (tier 1) manages user interface and runs applications.**
- **Server (tier 2) holds database and DBMS.**

# Traditional Two-Tier Client-Server



# Traditional Two-Tier Client-Server







# Traditional Two-Tier Client-Server

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- **Advantages include:**
  - **wider access to existing databases;**
  - **increased performance;**
  - **possible reduction in hardware costs;**
  - **reduction in communication costs;**
  - **increased consistency.**

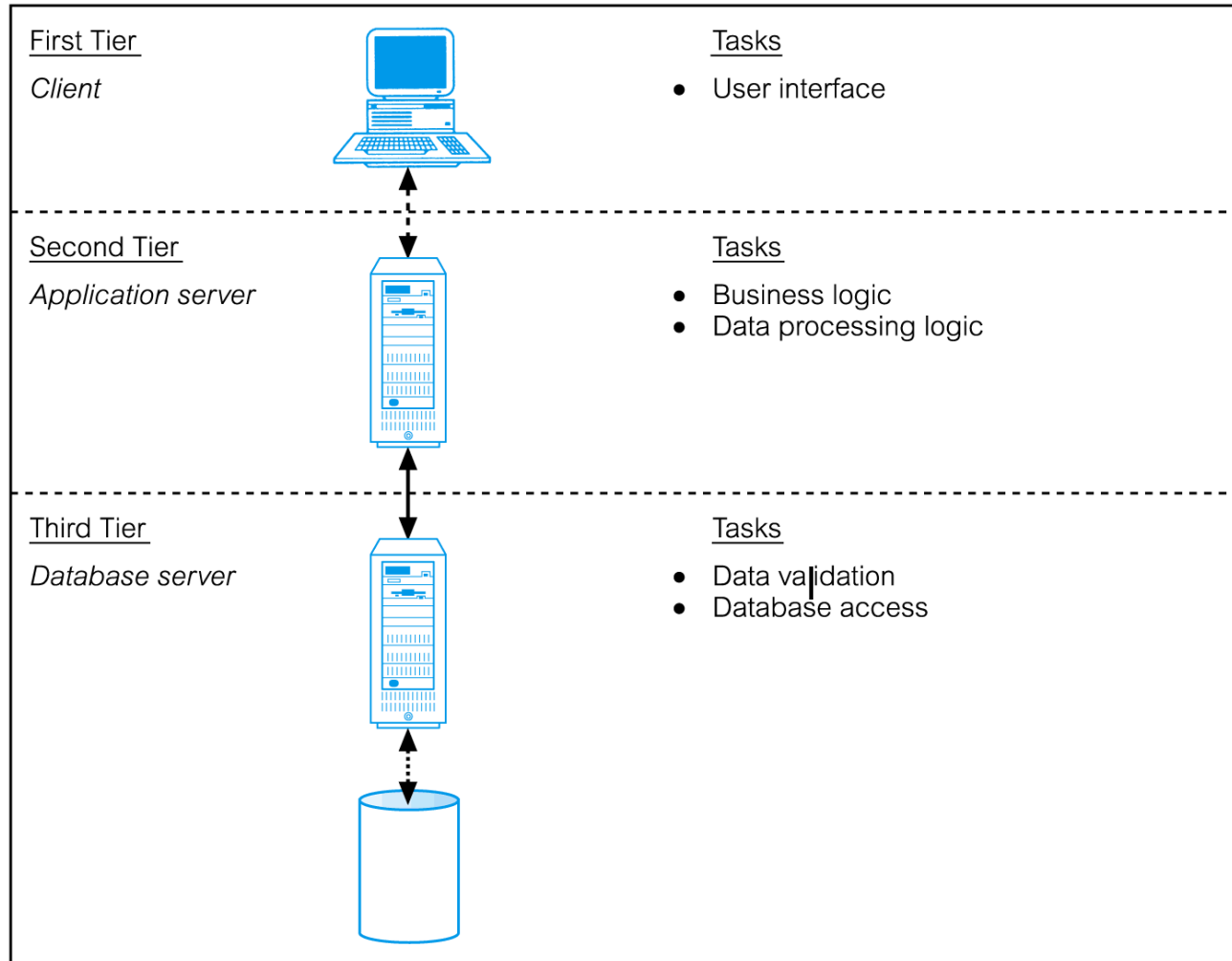


# Three-Tier Client-Server

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- In 2-tier, client side presented two problems preventing true scalability:
  - 'Fat' client, requiring considerable resources on client's computer to run effectively.
  - Significant client side administration overhead.
- By 1995, three layers were proposed, each potentially running on a different platform.

# Three-Tier Client-Server





# Three-Tier Client-Server

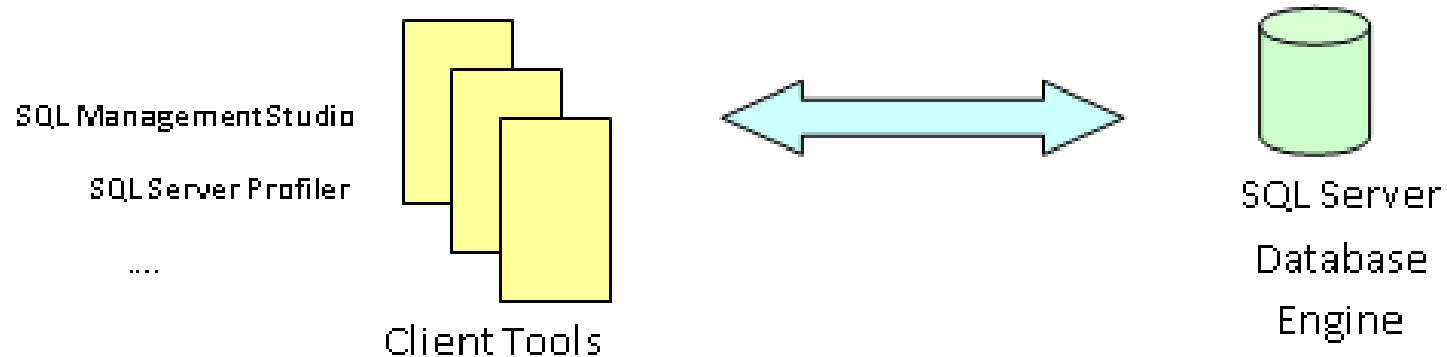
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## ■ Advantages:

- 'Thin' client, requiring less expensive hardware.
- Application maintenance centralized.
- Easier to modify or replace one tier without affecting others.
- Separating business logic from database functions makes it easier to implement load balancing.
- Maps quite naturally to Web environment.
- Makes new technology possible. E.g., cloud computing

# Our lab's Client-Server

- You'll work with MS SQL Server in a client-server environment





# Database Design Process

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- Database design process consists of the following main steps:
  - Requirements Analysis
  - Conceptual Database Design
  - Logical Database Design
  - Physical Database Design

# Requirements Analysis

## Background



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- Requirements Analysis is the start of any information system.
- It is based on Mission Statement for the DB which has many objectives
- Gathering data requirements is an important process.
- Need to understand the organisation, its operation, processes, procedures and people, and then extract DATA and TRANSACTION requirements. ->



## Background (contd.)

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- The result of this process is a requirements document outlining
  - What data to store in the database?
  - What are the frequent operations (i.e. transactions)?
  - Identified business rules





# A Sample Format

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## Data Requirements

- **Book:** Information on books maintained by the library include authors (principle author and other authors if any), title of the book, publisher information, edition, physical description (which include number of pages, size, etc.), notes of the book,  
....

## Transaction Requirements

### ■ **Data Manipulation Operations**

Insert/update/delete a book in the library

### ■ **Queries**

Search a book based on call number, keyword, author, title, subject and journal title

## Business rules

- A member can have up to 10 holds at any one time

\* Sample Requirements Specifications exists in Appendices A & B of text



# Assignment – Popular Pizza Requirements/Main Features

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- Order Processing
- Employees
- MenuItems, Ingredients and Suppliers
- A1 Specification



# Order Processing

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- Pizzas takes orders by phone and walk-in customers.
- Pizzas provides both delivery and pickup services.
- Data required:
  - Order, Customer, DiscountProgram



# Order Processing (cont'd)

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- Order Info



# Order Processing (cont'd)

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## ■ Order data

- OrderNo
- Date
- CustomerInfo
- StaffInfo
- ItemsOrdered (ItemName&Numbers&Price)
- TypeOfOrder (phone or walkin)
- TotalAmount
- PaymentMethod
- Status



# Order Processing (cont'd)

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- Customer data

- CusId
- fName
- lName
- Address
- Status



# Order Processing (cont'd)

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- DiscountProgram data

- DiscountCode
- Description
- StartDate
- EndDate
- Percentage
- Requirements



# Employee

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- Employees at the store can be divided into two types: instore, and delivery.
- Data required:
  - Staff





# Employee (cont'd)

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- Staff info



# Employee (cont'd)

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## ■ Staff data

- employee number
- Firstname
- Lastname
- postal address
- contact number
- tax file number
- bank details (bank code, bank name, account number)
- payment rate
- status
- description.
- drivers - driver's license number



# MenuItems, Ingredients and Suppliers

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- MenuItems: the menu of available pizza
- Ingredients: the ingredients of each pizza
- Suppliers: details of suppliers supplying the ingredients
- Data required:
  - MenuItems
  - Ingredients
  - Suppliers
  - IngredientOrders



# MenuItems, Ingredients and Suppliers (cont'd)

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- MenuItems, Ingredients & Suppliers Info



# MenuItems, Ingredients and Suppliers (cont'd)

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- MenuItems data

- ItemNo
- Name
- Size
- CurrentSellingPrice



# MenuItems, Ingredients and Suppliers (cont'd)

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- Ingredients data
  - code
  - Name
  - type
  - Description
  - StockLevelAtCurrentPeriod
  - DateLastStocktakeWasTaken
  - StockLevelAtLastStocktake
  - SuggestedStockLevel
  - SupplierNo



# MenuItems, Ingredients and Suppliers (cont'd)

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- Suppliers data

- SupplierNo
- Name
- Address
- phone
- ContactPerson



# MenuItems, Ingredients and Suppliers (cont'd)

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- IngredientOrders data

- OrderNo
- DateOrdered
- DateReceived
- TotalAmount
- Status
- Description
- SupplierNo
- IngredientCode





# Summary

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Order

Customer

DiscountPro  
gram

Staff

MenuItems

Ingredients

Suppliers

IngredientOr  
ders



# Business rules

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- The amount of each ingredient remaining must be updated every time some is used.
- The results of the weekly stocktake must be input into the database.
- When an ingredients stock level decreases below its reorder level an order for the ingredient must be placed.
- A new customer must be marked as un-verified until the verification process is successfully completed.
  - No customer with an un-verified status shall be able to make an order by phone.
  - If the name and address a customer gives do not match an existing record a new record must be created and the verification process must take place.



# Business rules (contd.)

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- Employees must record each shift they work in the database.
- An employee can only be either an in-store worker or a delivery driver.
- Employees cannot delete data from the database.
- An Employees' status can only be either:
  - Full time
  - Part time



# Business rules (contd.)

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- Payments can only be added by accounting staff
- An orders payment method can only have one of the following values:
  - Credit card
  - Debit card
  - Cash
- An orders type can only be either:
  - Pick up
  - Delivery
- If an order is paid for using a card the approval number must be stored in the order's paymentApprovalNo
- Only one discount program can be used on an order.
- Discount Programs can only be added/updated by an administrator



# Points to note...

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- You may extend requirements that you may consider appropriate for the system
- Points mentioned today should be included in the requirements document
- State any assumptions
- Q?



# Lab This Week

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- Get familiar with Microsoft's SQL Server 2014, and practice on T-SQL
  - SQL Server 2014 Enterprise Edition
  - Client Server Environment
  - SQL Server Management Studio
  - Transact SQL (T-SQL)



# Summary Qs

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- Q: what are the four main steps of database design process?
- Q: what are the three-level database architecture specified in the ANSI-SPARC model?
- Q: what are the three Multi-User DBMS Architectures?