CS 457 – Data modeling and Implementation Techniques

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Homework 1B: (Due: Sep. 18, 2021 before 9 am)

1) Provide an example for each of the following types of data models:

a. Conceptual data models

Conceptual data model does not include how the data is stored or how the operations. By using logical concepts, such as objects, their properties, and their interrelationships, it makes most users to understand than computer storage concepts.

b. Physical data models

low-level or physical data models describes the details of how data is stored on the computer storage media, typically magnetic disk, generally meant for computer specialists, not for end users.

c. Representational data models

representational (or implementation) data models provide concepts that may be easily understood by end users. This model hides many details of data storage on disk but can be implemented on a computer system directly.

2) Draw the diagram of a client-server DBMS architecture and mention its main attributes.
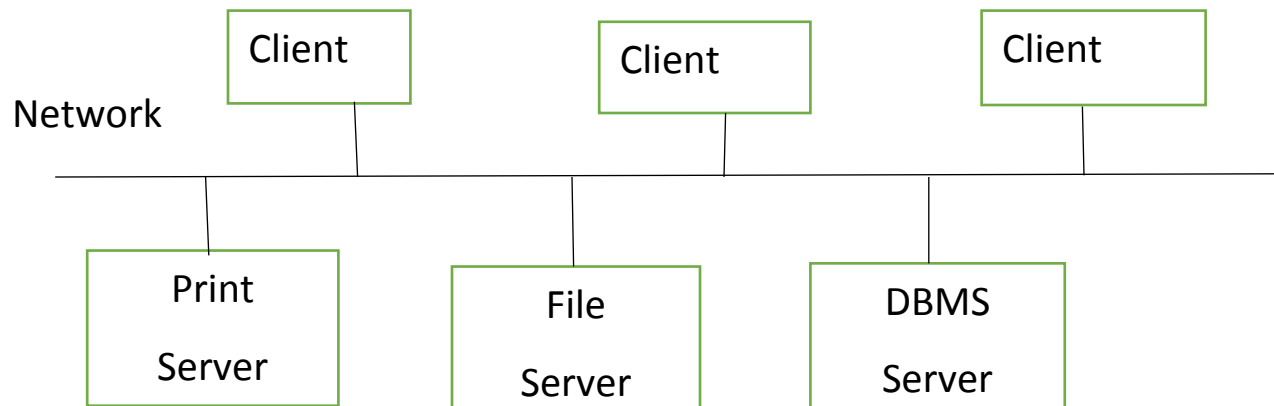
Main Attributes =>

1) The client/server architecture deal with computing environments in which a large number of PCs, workstations, file servers, printers, database servers, Web servers, e-mail servers, and other software and equipment are connected via a network

2) file server that maintains the files of the client machines.

3) printer server where all print requests by the clients are forwarded to this machine.

4) The client machines provide the user with the appropriate interfaces to utilize these servers, as well as with local processing power to run local applications.

3) Differentiate between Relational data model and Object data model with an example.

Relational data model =>

The relational data model also introduced high-level query languages that provided an alternative to programming language interfaces, making it much faster to write new queries.

e.g.

Customer_ID	Customer_Name	Product_Purchased	Amount
1	Smith	Toy	$70
2	Cameron	School Supplies	$100
3	Luke	Food	$150

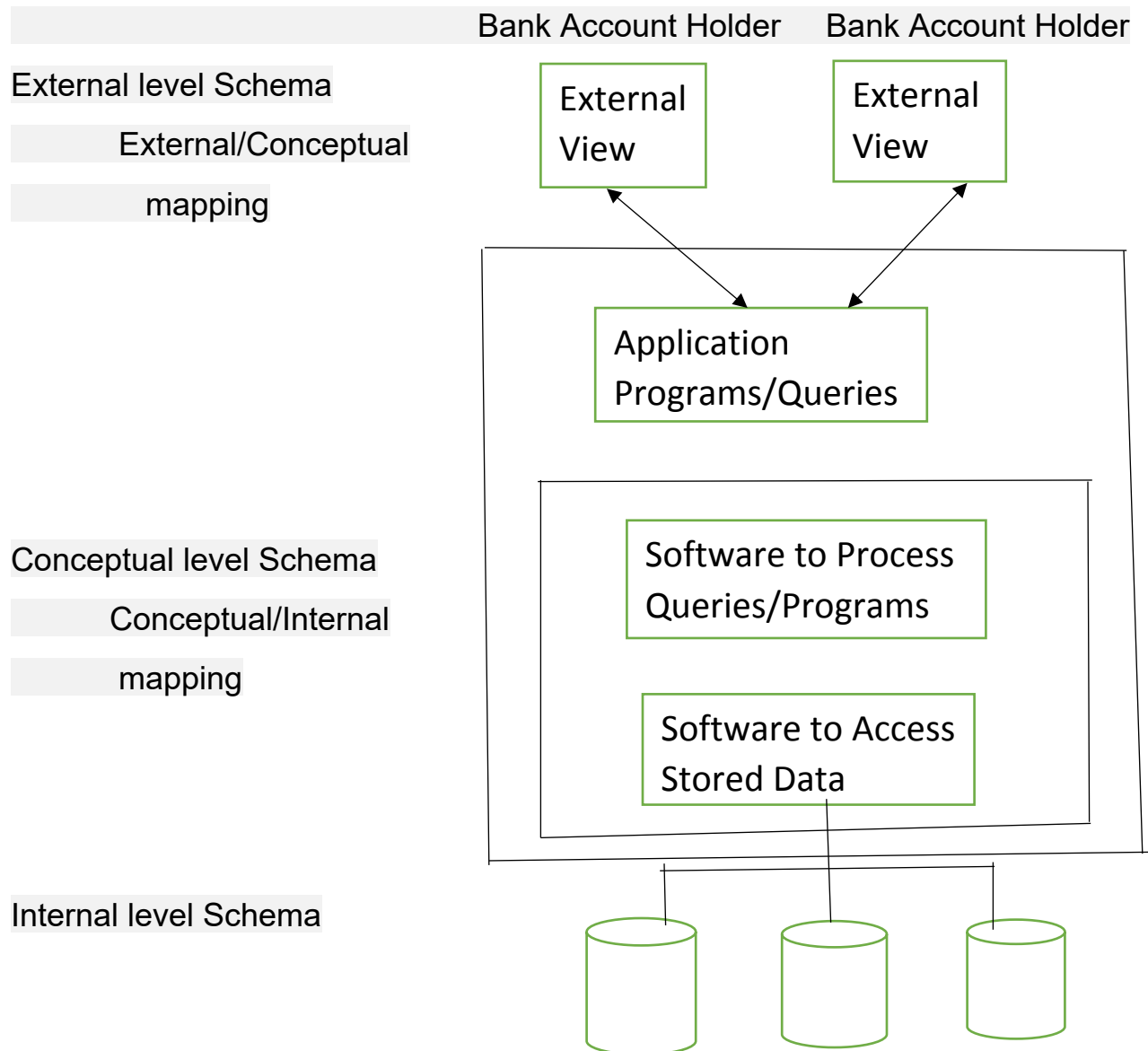Using Customer_ID as key you can fetch related Amount.

SQL Server and Access from Microsoft is a popular relational database management system.

Object data model=>

The object data model defines a database in terms of objects, their properties, and their operations. Objects with the same structure and behavior belong to a class, and classes are organized into hierarchies (or acyclic graphs).

e.g. The key-value data model associates a unique key with each value (which can be a record or object) and provides very fast access to a value given its key

4) Draw and explain the schema diagram for the database in a bank account holder system.

Bank Account Holder   Bank Account Holder

External level Schema

    External/Conceptual

    mapping

External View

External View

Application Programs/Queries

Conceptual level Schema

    Conceptual/Internal

    mapping

Software to Process Queries/Programs

Software to Access Stored Data

Internal level Schema

a) External level=>
   Bank Account Holder can have External view of user interface to accept and display information such as
   = Personal info
   = Account info
   = Request transactions like withdrawal, deposit
b) Conceptual level=>
   Conceptual level is a collection of logical records of the data file. The DBMS uses the conceptual schema to create the logical record interface, which defines and creates the working environment for the conceptual level to present data to end users.

   Software

   - Print Server
   - Web Server
   - DBMS Server
   - File Server
   - Email server

   Internal level=>
   Internal schema contains multiple types of internal record.

It works with operating system and DBMS for storing
and retrieving data to and from the storage devices.
internal schema which defines how data is
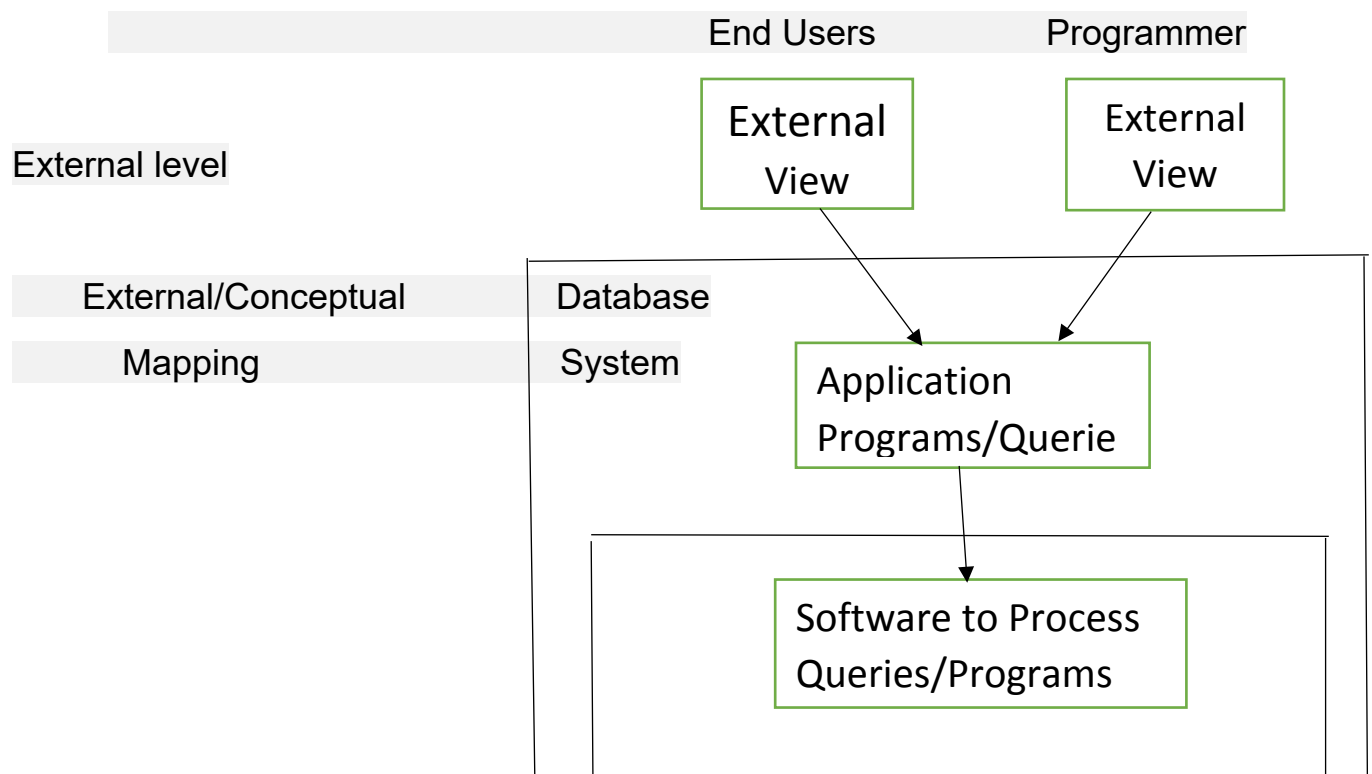represented, how record are sequenced what indexes
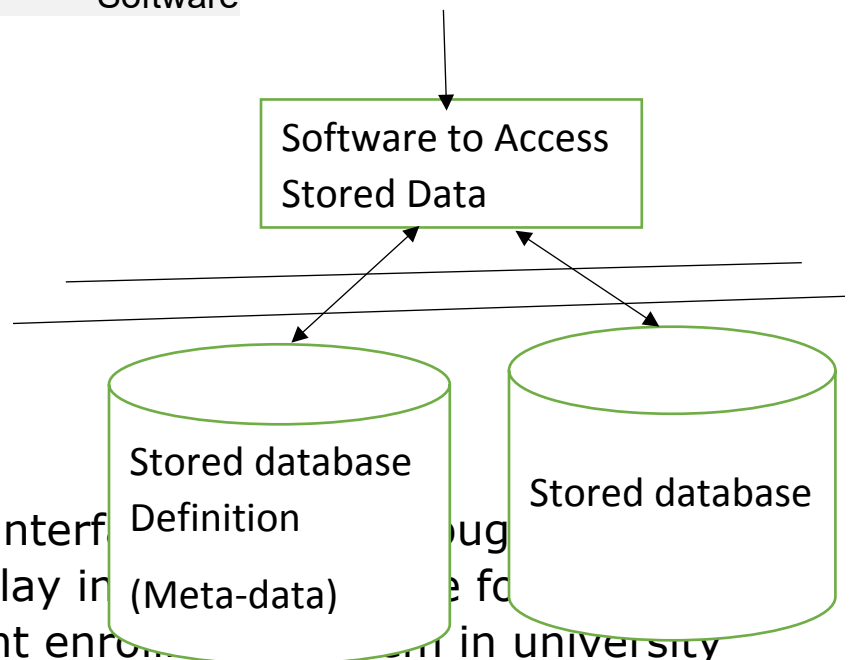exist etc.
Bank Account Holder's
 =Personal info file
 =Account info file
 = File allocated to store transaction data

5) Draw and explain the Three Schema architecture for a Student
Enrolment system in a University.

End Users   Programmer

External level

```
                                    ┌──────────┐      ┌──────────┐
                                    │ External │      │ External │
                                    │   View   │      │   View   │
                                    └──────────┘      └──────────┘
External/Conceptual   Database
    Mapping           System
                                    ┌───────────────────┐
                                    │   Application     │
                                    │ Programs/Querie   │
                                    └───────────────────┘

                                    ┌───────────────────┐
                                    │ Software to Process│
                                    │ Queries/Programs   │
                                    └───────────────────┘
```

Conceptual level   DBMS

        Conceptual/Internal   Software

        mapping

┌─────────────────────┐
│ Software to Access │
│ Stored Data   │
└─────────────────────┘

Internal level

Example=>

1)External level=> The user-interf Definition   ug
schema accept and display in (Meta-data)   e fo
user expects. For Student enro   in university
user interface accept and display information such as

Stored database Definition (Meta-data)

Stored database

    a) students' admission info with Students name,
address, phone number,

    b) Completed pre-requisite certificates,

    c) my courses info,

    d) Departments

    e) Instructors

    f) TB risk assessment info.

2)Logical or Conceptual level=>The DBMS uses the
conceptual schema to create the logical record interface,
which defines and creates the working environment for
the conceptual level to present data to end users.
Conceptual level is a collection of logical records of the
data.

Software

- Print Server
- Web Server
- DBMS Server
- File Server
- Email server

3)Internal level=>It works with operating system and DBMS for storing and retrieving data to and from the storage devices. internal schema which defines how data is represented, how record are sequenced what indexes exist etc.

Students

a) health insurance file,

b) Completed prerequisite file,

c) Study plan info file,

d) financial info file and so on.

6) Draw and explain the Two-Tier client-server architecture for a Library management system.
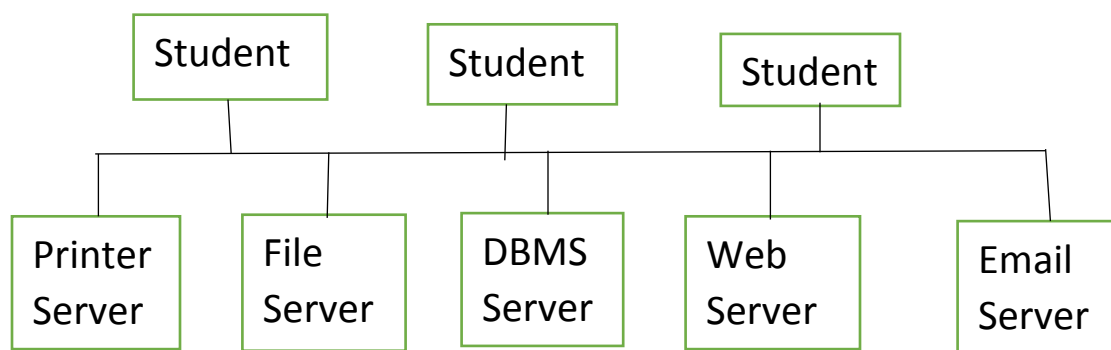
Student can

a) Request for print
b) Request to retrieve File
c) Request for Data display
d) Have access to Web page
e) Communicate through email

Elmasri 7e book (pages 55-56)

7) Problem 2.12
Think of different users for the database shown in Figure 1.2.
What types of applications would each user need? To which user
category would each belong, and what type of interface would
each need?

Different Users	Use Type of Application	Need type of Interface
Students	Google Drive, Google calendar, Canvas Student, Google Classroom	Menu Interface Form Interface
Professors	Google Drive, Canvas, Zoom, Google classroom,	GUI Interface

	Google Calendar, Google Classroom	
Parents	Canvas Parents, Google Drive, Google Classroom	Menu Interface Form Interface
Office Personnel	Microsoft office	GUI Interface

Application	User category
Google Drive	Student, Professor, Parent
Canvas	Student, Professor, Parent
Google calendar	Student, Professor, Parent
Google Classroom	Student, Professor, Parents
Microsoft Office/Office 365	Office Personnel

8) Problem 2.14
   If you were designing a Web-based system to make airline reservations and sell airline tickets, which DBMS architecture would you choose from Section 2.5? Why? Why would the other architectures not be a good choice?
   ⇨ I would pick three-tier client/Server Architecture as
   a) User would be able to use website from anywhere by connecting to software

b) To use basic client/server Architecture, user have very limited access to services. the client handles both the Presentation layer (application interface) and Application layer (logical operations), while the server system handles the database layer.
c) Where in Three tier, The Application layer is where we find logic controls and functionality that processes data received from the presentation layer and database layer.
d) Three tier provides following benefits,
    1. Scalability= Can load balance
    2. Performance= can cache requests, network utilization is minimized, and the load is reduced on the Application and Data tiers.
    3. Availability= If the Application tier server is down and caching is sufficient, the Presentation tier can process Web requests using the cache.

9) Problem 2.15
   Consider Figure 2.1. In addition to constraints relating the values of columns in one table to columns in another table, there are also constraints that impose restrictions on values in a column or a combination of columns within a table. One such constraint dictates that a column or a group of columns must be unique across all rows in the table. For example, in the STUDENT table, the Student_number column must be unique (to prevent two

different students from having the same Student_number).
Identify the column or the group of columns in the other tables
that must be unique across all rows in the table

⇨ the column or the group of columns in the other tables that
   must be unique across all rows in the table are as follow
   1) Student_number
   2) Course_number
   3) Prerequisite_number
   4) Section_identifier