Topics Covered in Todays Class

Unit 1:
- Characteristics of the Database Approach
- Advantages of Using the Database Approach
- When not to use a DBMS

Main Characteristics of the Database Approach

1. **Self-describing nature** of a database system.
2. **Insulation** between programs and data, and data manipulation.
3. Support of **multiple views** of the data.
4. **Sharing** of data and **multi-user** transaction processing

Main Characteristics of the Database Approach

1. Self-describing nature of a database system

What will be your description of the data stored in the following tables ?

1BM14CS001	Aditya	3	WP
1BM14CS002	Bharath	3	DS

1BM14CS001	1000
1BM14CS002	1000

1BM14CS001	S
1BM14CS002	B

Main Characteristics of the Database Approach

1. Self-describing nature of a database system.

Student_Details

USN	Name	Sem	Sub
1BM14CS001	Aditya	3	WP
1BM14CS002	Bharath	3	DS

Student_ExamFee_Details

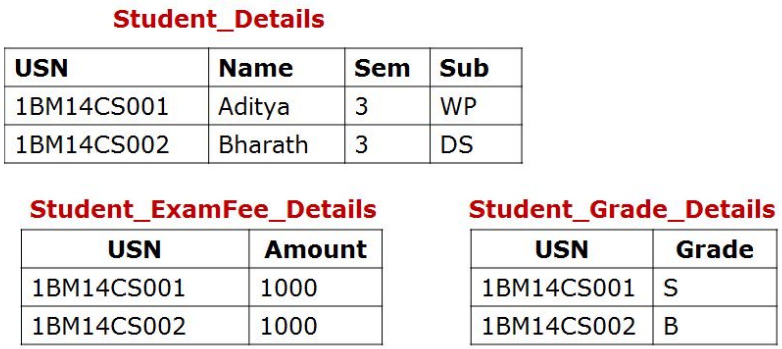
USN	Amount
1BM14CS001	1000
1BM14CS002	1000

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B

Main Characteristics of the Database Approach

1. Self-describing nature of a database system.



Student_Details

USN	Name	Sem	Sub
1BM14CS001	Aditya	3	WP
1BM14CS002	Bharath	3	DS

Student_ExamFee_Details

USN	Amount
1BM14CS001	1000
1BM14CS002	1000

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B

Column_name	Data_Type	Belongs_to
USN	Char(10)	Student_Details
Name	Char(30)	Student_Details
Sem	Integer	Student_Details
Sub	Char(2)	Student_Details
Amount	Float	Student_ExamFee_Details
Grade	Char(1)	Student_Grade_Details

Catalog
Information stored in catalog is called **meta-data** which Describes the structure Of primary database

Main Characteristics of the Database Approach

2. Insulation between programs and data, and data manipulation.

File Approach

student.txt

```
1BM14CS001 Aditya LA,Java,DBMS,OS,DC
1BM14CS002 Baharth DBMS,OS,DC
```

```
fp=fopen("student.txt","r");
while(fscanf(fp,"%s %s %s",USN,name,subjects)!=EOF)
{
printf("USN: %s Name: %s Subjects: %s",USN,name,subjects);
}
```

What will be the Output of the above program statements ?

Main Characteristics of the Database Approach

2. Insulation between programs and data, and data manipulation.

File Approach

student.txt

```
Aditya 1BM14CS001  LA,Java,DBMS,OS,DC
Baharth 1BM14CS002  DBMS,OS,DC
```

```
fp=fopen("student.txt","r");
while(fscanf(fp,"%s %s %s",USN,name,subjects)!=EOF)
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printf("USN: %s Name: %s Subjects: %s",USN,name,subjects);
}
```

What will be the Output of the above program statements ?

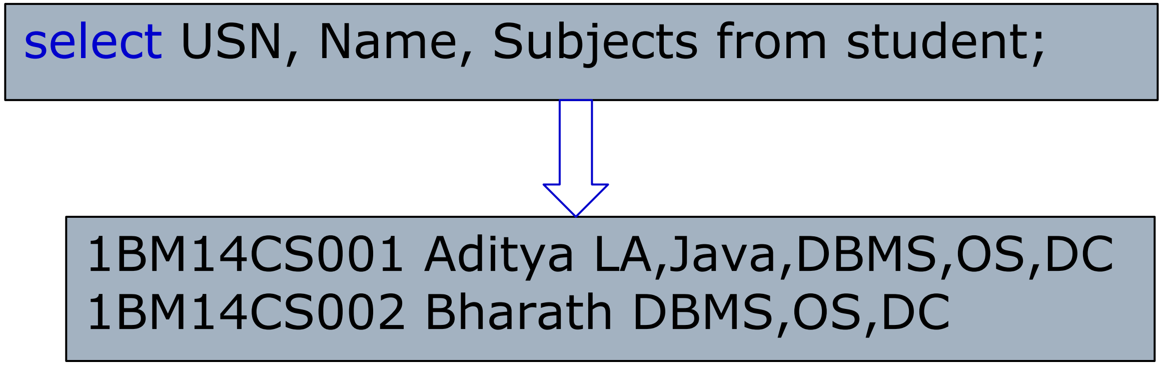
Main Characteristics of the Database Approach

2. Insulation between programs and data, and data manipulation.

DBMS Approach

student

USN	Name	Subjects
1BM14CS001	Aditya	LA, Java, DBMS,OS,DC
1BM14CS002	Bharath	DBMS, OS, DC



```
select USN, Name, Subjects from student;
```

```
1BM14CS001 Aditya LA,Java,DBMS,OS,DC
1BM14CS002 Bharath DBMS,OS,DC
```

SQL **query** to retrieve and display table information

Main Characteristics of the Database Approach

2. Insulation between programs and data, and data manipulation.

DBMS Approach

student

Name	USN	Subjects
Aditya	1BM14CS001	LA, Java, DBMS,OS,DC
Bharath	1BM14CS002	DBMS, OS, DC

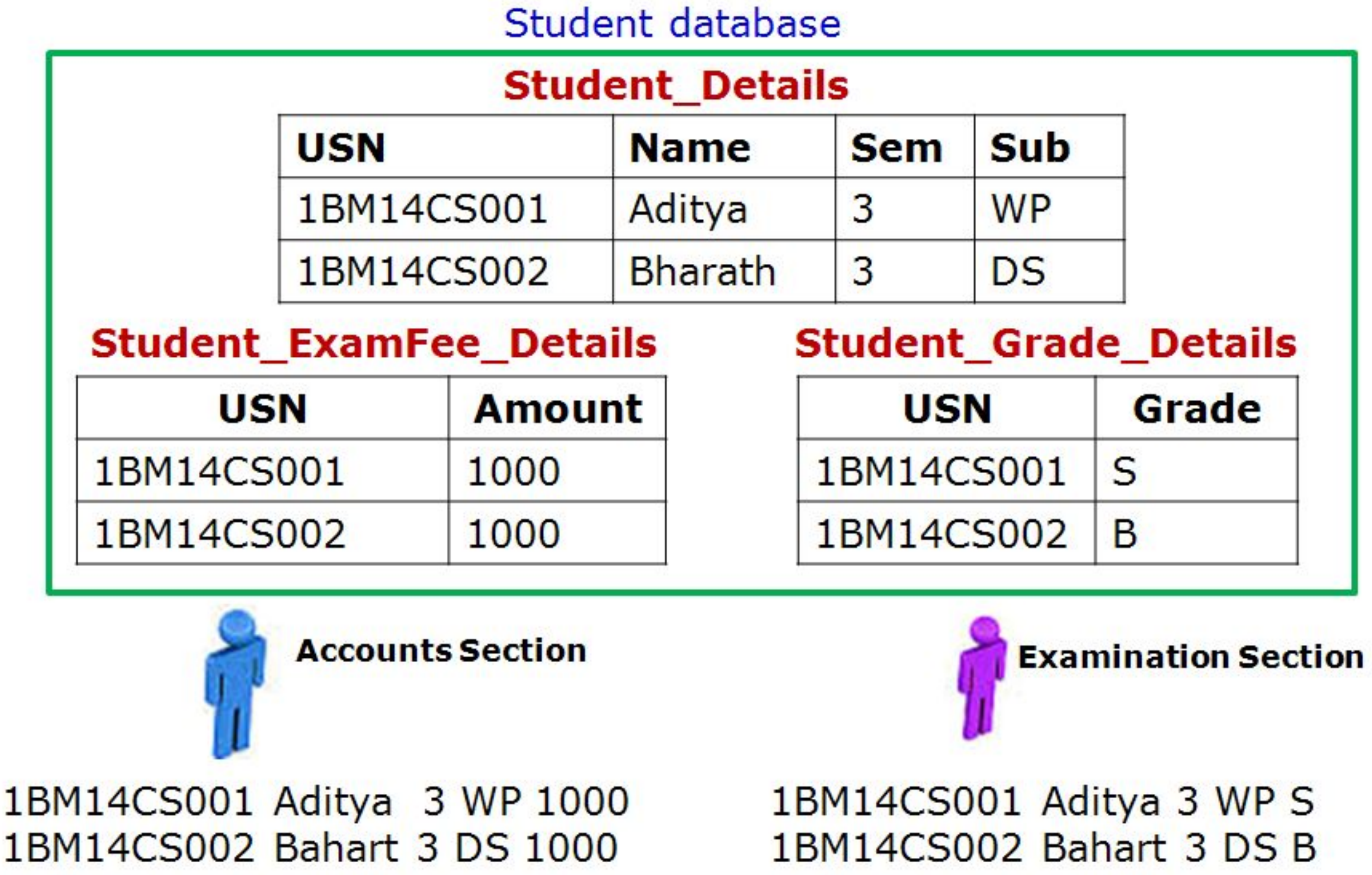
```
select USN, Name, Subjects from student;
```

SQL **query** to retrieve and display table informati

```
1BM14CS001 Aditya LA,Java,DBMS,OS,DC
1BM14CS002 Bharath DBMS,OS,DC
```

Main Characteristics of the Database Approach

3. Support of multiple views of the data



Student database

Student_Details

USN	Name	Sem	Sub
1BM14CS001	Aditya	3	WP
1BM14CS002	Bharath	3	DS

Student_ExamFee_Details

USN	Amount
1BM14CS001	1000
1BM14CS002	1000

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B

1BM14CS001 Aditya 3 WP 1000
1BM14CS002 Bahart 3 DS 1000

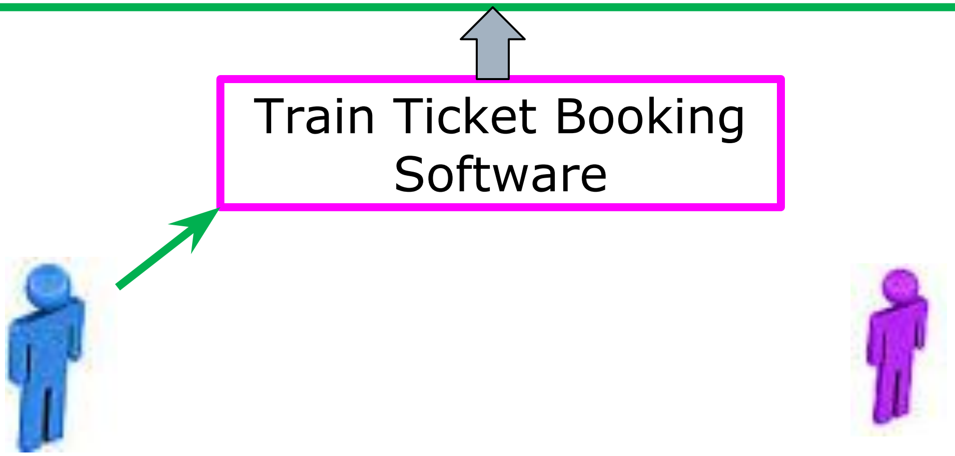
1BM14CS001 Aditya 3 WP S
1BM14CS002 Bahart 3 DS B

Main Characteristics of the Database Approach

4. Sharing of data and **multi-user** transaction processing

Train Reservation Database

Source	Destination	Train Name	Start Time	Start Date	Number of Seats Availability
Bangalore	Mysore	Chamundi Express	18:15	14-1-2016	2



Train Ticket Booking Software

Main Characteristics of the Database Approach

- **Self-describing nature of a database system:**
  - A DBMS **catalog** stores the description of a particular database (e.g. data structures, types, and constraints)
  - The description is called **meta-data**.
  - This allows the DBMS software to work with different database applications.
- **Insulation between programs and data, and data manipulation:**
  - Called **program-data independence**.
  - Allows changing data structures and storage organization without having to change the DBMS access programs.
  - A **data model** is used to hide storage details and present the users with a conceptual view of the database.
  - Programs refer to the data model constructs rather than data storage details

Main Characteristics of the Database Approach

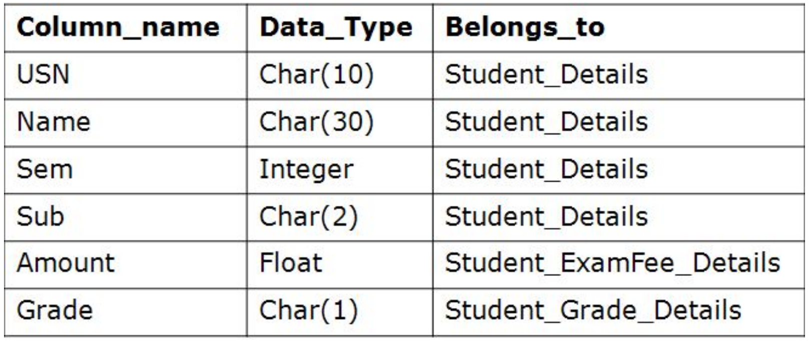
- **Support of multiple views of the data:**
  - Each user may see a different view of the database, which describes **only** the data of interest to that user.
- **Sharing of data and multi-user transaction processing:**
  - Allowing a set of **concurrent users** to retrieve from and to update the database.
  - *Concurrency control* within the DBMS guarantees that each **transaction** is correctly executed or aborted
  - *Recovery* subsystem ensures each completed transaction has its effect permanently recorded in the database
  - **OLTP** (Online Transaction Processing) is a major part of database applications. This allows hundreds of concurrent transactions to execute per second.

Advantages of Using the Database Approach

1. **Controlling redundancy** in data storage and in development and maintenance efforts.
2. Restricting **unauthorized** access to data.
3. Providing **persistent storage** for program Objects (data structures provided by DBMS & the programming languages were incompatible)
4. Providing Storage Structures (e.g. indexes) for **efficient Query Processing**
5. Providing **backup** and **recovery** services.
6. Providing **multiple** interfaces to **different classes of users**.
7. Representing **complex relationships** among data.
8. Enforcing **integrity constraints** on the database.
9. Drawing **inferences and actions** from the stored data using deductive and active rules

Understanding **integrity constraints** on the database

Database **Catalog** for following database tables



Column_name	Data_Type	Belongs_to
USN	Char(10)	Student_Details
Name	Char(30)	Student_Details
Sem	Integer	Student_Details
Sub	Char(2)	Student_Details
Amount	Float	Student_ExamFee_Details
Grade	Char(1)	Student_Grade_Details

Which of the following tables data storage is correct as per the above catalog definition ?

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	8

Understanding **integrity constraints** on the database

Student_Details

USN	Name	Sem	Sub
1BM14CS001	Aditya	3	WP
1BM14CS002	Bharath	3	DS

What is wrong in the following table data as per the **Student_Details** table ?

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B
1BM14CS003	C

Understanding drawing of “**inferences and actions**” from the stored data

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B
1BM14CS003	C
1BM14CS004	S
1BM14CS005	F
1BM14CS006	S

Using the above table data, Can you **infer**
How many Students have scored **S grade** and What are their USN’s?

Understanding drawing of "**inferences and actions**" from the stored data

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B
1BM14CS003	C
1BM14CS004	S
1BM14CS005	F
1BM14CS006	S

Catalog

Column_name	Data_Type	Constraint
USN	Char(10)	
Grade	Char(1)	Should not be empty

Using the above Catalog information, Can you tell Whether the following insert action on Student_Grade_Details table is **Right or Wrong** ?

insert into **Student_Grade_Details** values (1BM14CS007);

When not to use a DBMS ?

When not to use a DBMS

- Main inhibitors (**costs**) of using a DBMS:
  - High initial investment and possible need for additional hardware.
  - Overhead for providing generality, security, concurrency control, recovery, and integrity functions.
- When a DBMS may be unnecessary:
  - If the database and applications are **simple**, well defined, and **not expected to change**.
  - If access to data by **multiple users is not required.**

Activity - Questionnaire

1. What are the four main Characteristics of DBMS ?
2. What is the meaning of “Catalog” w.r.t DBMS ?

Topics Covered in Todays Class

Unit 1: Database System Concepts and Architecture

- Data Models, Schemas and instances
- Three Schema Architecture and Data Independence
- Database language and interfaces
- The Database System Environment

Case Study 1

For example Say Ramu, who is staying in Basvangudi area has a empty land plot of 30x40 feet area. He wants to construct a house in this site. He is going to discuss this issue with you. But you are computer science student. How you will guide Ramu to resolve his issue.

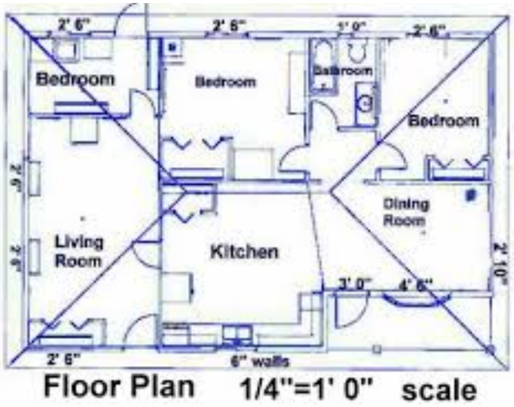
Case Study 1

High level view of house

Building Architecture

Middle level view

Civil Engineer



Quantity of cement, brick, mud, iron, wood….etc to be used.

Low level view

Building Constructor

Case Study 2

Principal
BMS College of Engineering

Dear Student,
I need an software application to keep track of student Information and Department information. You should build a software which will help me to carry out the operations, such as display, insertion, deletion and updating of Student and department information. For each Student USN, Name, Semester and Department name to be stored. For each Department its name and HOD name to be stored. Provide your design plan for developing this application software.

Objective of todays class

Understanding the basic terminologies and definitions involved in building Architecture of Database Systems.

In this regard, First we will understand
Data Models, Schemas and Instances

Data Models

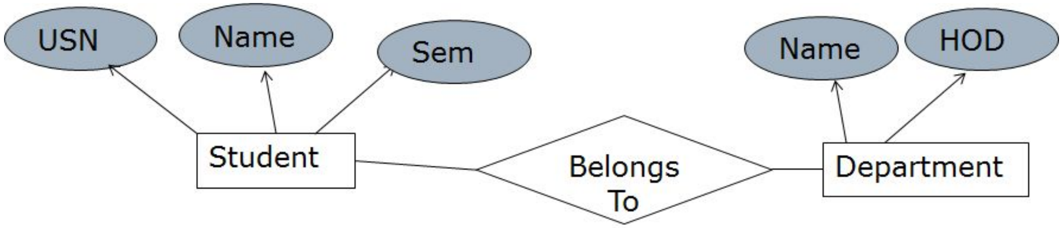
- **Data Abstraction** generally refers to the suppression of details of data organization and storage and the highlighting of the essential features for improved understanding of data.
- **Data Model:**
  - A set of concepts to describe the ***structure*** of a database, the ***operations*** for manipulating these structures, and certain ***constraints*** that the database should obey.
  - Data Models provides the necessary means to achieve data abstraction.

Categories of Data Models

- **Conceptual (high-level, semantic) data models:**
  - Provide concepts that are close to the way many users perceive data.
    - (Also called ***entity-based*** or ***object-based*** data models.)
- **Implementation (representational) data models:**
  - Provide concepts that fall in between high and low level, used by many commercial DBMS implementations (e.g. relational data models used in many commercial systems).
- **Physical (low-level, internal) data models:**
  - Provide concepts that describe details of how data is stored in the computer. These are usually specified in an ad-hoc manner through DBMS design and administration manuals

Categories of Data Models

Conceptual (high-level)

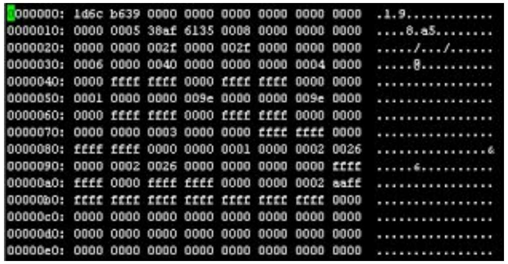


Implementation (Representational)

USN	Name	Sem	Dep
1BM14CS001	Aditya	3	CSE
1BM14IS002	Bharath	3	ISE

Dep	HOD
CSE	Dr. H S Guruprasad
ISE	Dr. Gowrishankar

Physical (low-level)



```
0000000: 1d6c b639 0000 0000 0000 0000 0000 0000  .l.9............
0000010: 0000 0005 38af 6135 0008 0000 0000 0000  ....8.a5........
0000020: 0000 0000 002f 0000 002f 0000 0000 0000  ...../.../......
0000030: 0006 0000 0040 0000 0000 0000 0004 0000  .....@..........
0000040: 0000 ffff ffff 0000 ffff ffff 0000 0000  ................
0000050: 0001 0000 0000 009e 0000 0000 009e 0000  ................
0000060: 0000 ffff ffff 0000 ffff ffff 0000 0000  ................
0000070: 0000 0000 0003 0000 0000 ffff ffff 0000  ................
0000080: ffff ffff 0000 0000 0001 0000 0002 0026  ...............&
0000090: 0000 0002 0026 0000 0000 0000 0000 ffff  .....&..........
00000a0: ffff 0000 ffff ffff 0000 0000 0002 aaff  ................
00000b0: ffff ffff ffff ffff ffff ffff ffff 0000  ................
00000c0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
00000d0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
00000e0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
```

Schemas, Instance and Database State

- Database Schema:
  - The ***description*** of a database.
  - Includes descriptions of the database structure, data types, and the constraints on the database.
  - Schema Diagram:
  - An ***illustrative*** display of (most aspects of) a database schema

□ Database State:

- ■ The actual data stored in a database at a ***particular moment in time***. This includes the collection of all the data in the database.
- ■ Also called **database instance** (or occurrence or snapshot).
  - □ The term *instance* is also applied to individual database components, e.g. *record instance, table instance, entity instance*

Schemas, Instance and Database State

□ Schema Diagram

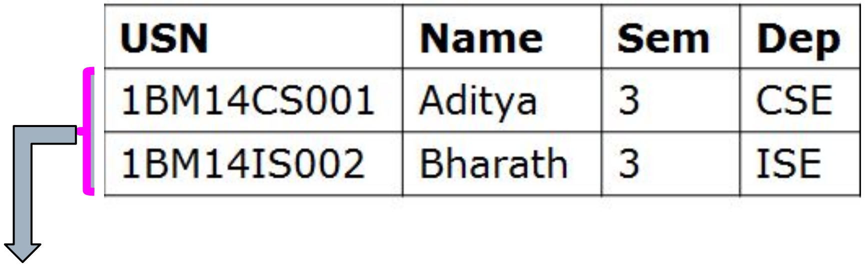
Student

USN	Name	Sem	Dep

Department

Dep	HOD

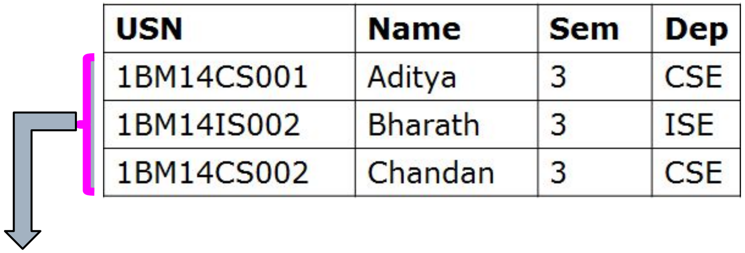
Database State at time "X"



USN	Name	Sem	Dep
1BM14CS001	Aditya	3	CSE
1BM14IS002	Bharath	3	ISE

Database Instance

Database State at time "Y"



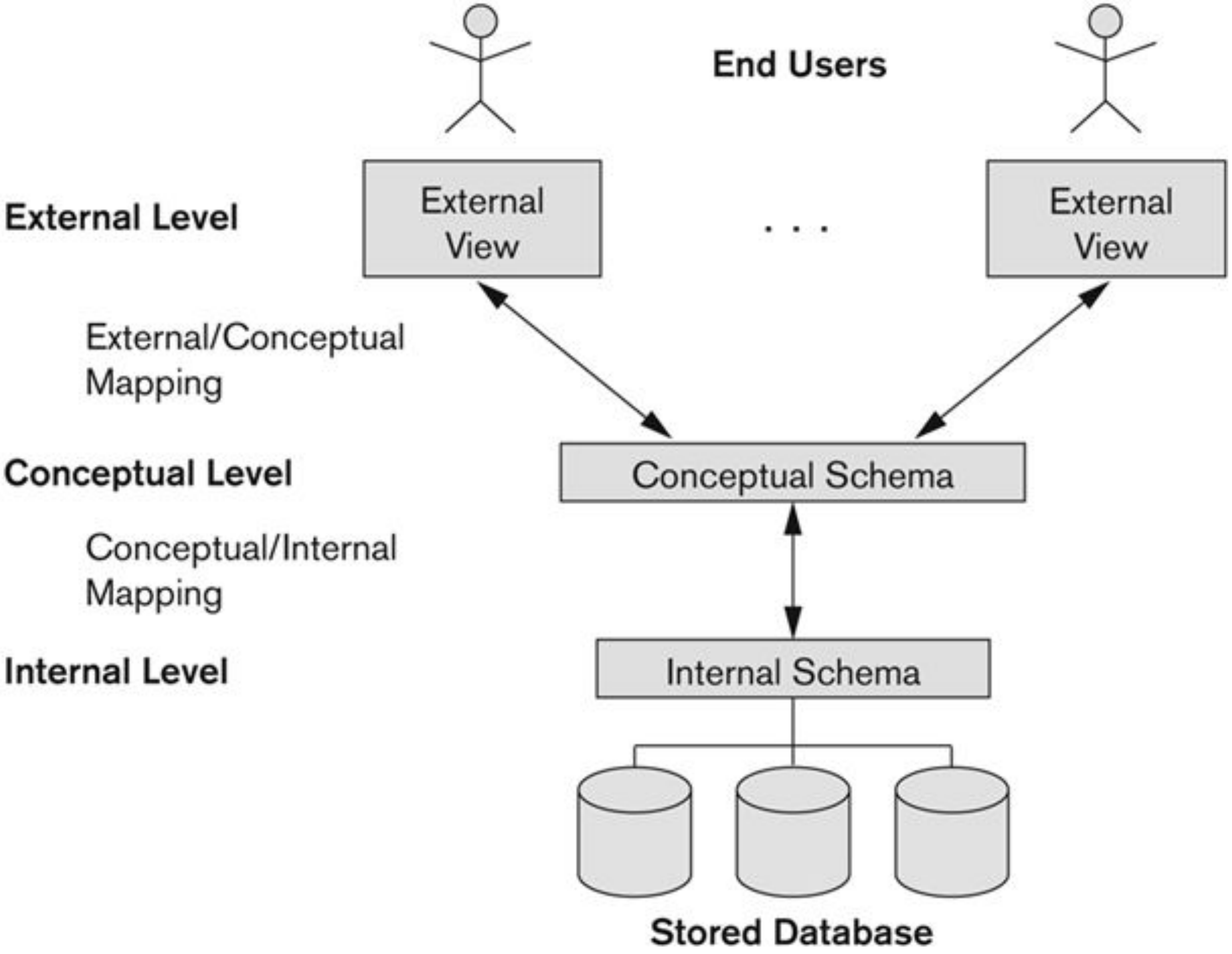
USN	Name	Sem	Dep
1BM14CS001	Aditya	3	CSE
1BM14IS002	Bharath	3	ISE
1BM14CS002	Chandan	3	CSE

Database Instance

Three-Schema Architecture

- Defines DBMS schemas at ***three*** levels:
  - **Internal schema** at the internal level to describe physical storage structures and access paths (e.g indexes).
    - Typically uses a **physical** data model.
  - **Conceptual schema** at the conceptual level to describe the structure and constraints for the whole database for a community of users.
    - Uses a **conceptual** or an **implementation** data model.
  - **External schemas** at the external level to describe the various user views.
    - Usually uses the same data model as the conceptual schema.

The three-schema architecture



Data Independence

- **Logical Data Independence:**
  - The capacity to change the conceptual schema without having to change the external schemas and their associated application programs.
- **Physical Data Independence:**
  - The capacity to change the internal schema without having to change the conceptual schema.

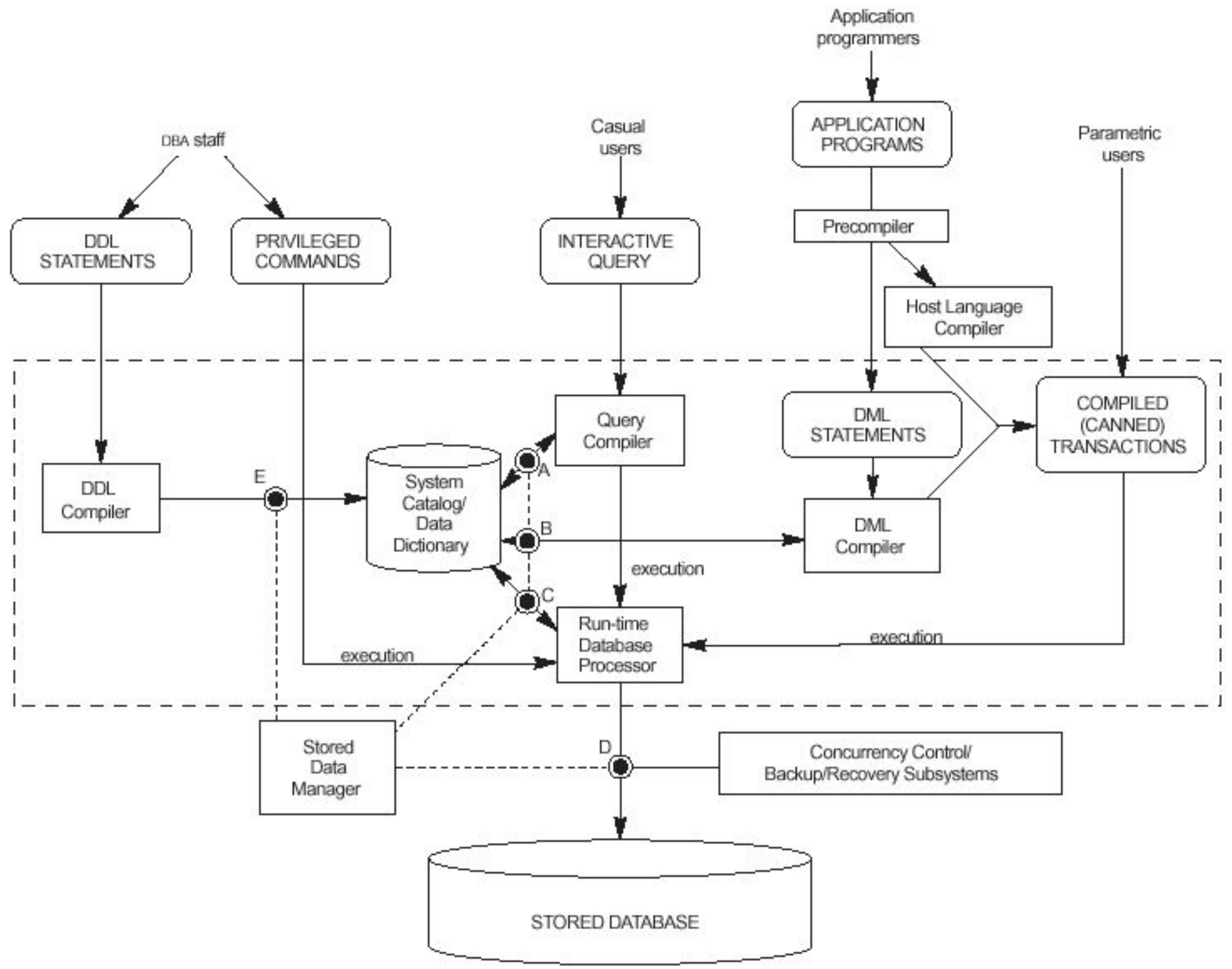
Review on Your Own

- Database language and interfaces
- The Database System Environment

Data Definition language and Interfaces

- DBMS Languages
  - Data Definition Language (DDL)
  - Storage Definition Language (SDL)
  - View Definition language (VDL)
  - Data manipulation Language (DML)
- Data Interfaces
  - Menu-based
  - Form-Based
  - Graphical User Interface
  - Natural language Interface
  - Speech Input and Output
  - Interfaces for Parametric users
  - Interfaces for DBA

The Database System Environment



Activity - Questionnaire

1. Mention three different levels in Three-Schema Architecture

Thanks for Listening

Student database

Student_Details

USN	Name	Sem	Sub
1BM14CS001	Aditya	3	WP
1BM14CS002	Bharath	3	DS

Student_ExamFee_Details

USN	Amount
1BM14CS001	1000
1BM14CS002	1000

Student_Grade_Details

USN	Grade
1BM14CS001	S
1BM14CS002	B

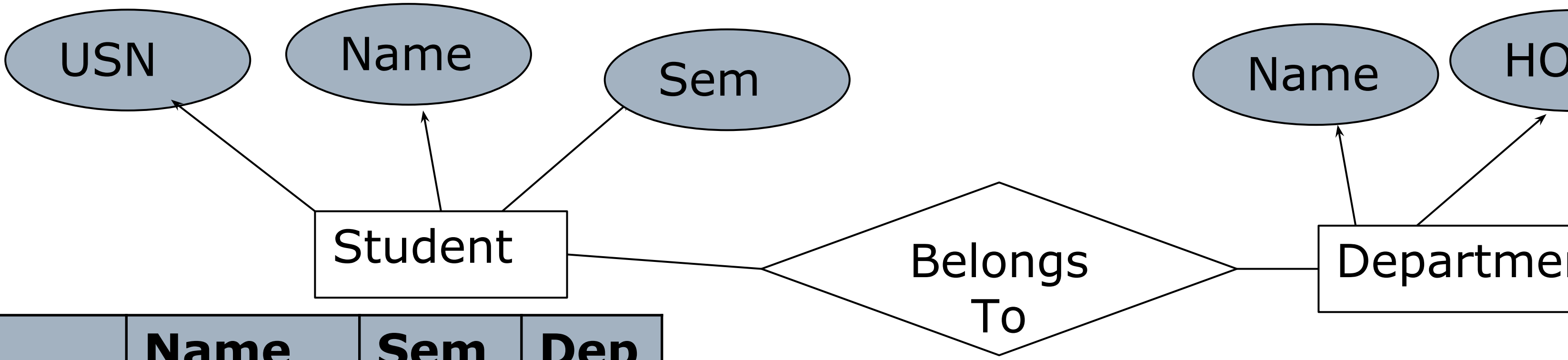
Accounts Section

1BM14CS001 Aditya 3 WP 1000
1BM14CS002 Bahart 3 DS 1000

Examination Section

1BM14CS001 Aditya 3 WP S
1BM14CS002 Bahart 3 DS B

Categories of Data Models



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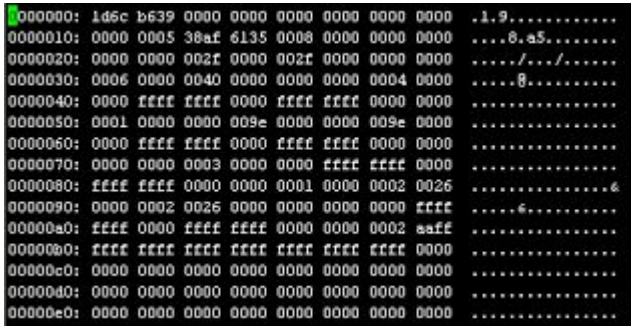

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0000000: 1d6c b639 0000 0000 0000 0000 0000 0000  .l.9............
0000010: 0000 0005 38af 6135 0008 0000 0000 0000  ....8.a5........
0000020: 0000 0000 002f 0000 002f 0000 0000 0000  ...../.../......
0000030: 0006 0000 0040 0000 0000 0000 0004 0000  .....@..........
0000040: 0000 ffff ffff 0000 ffff ffff 0000 0000  ................
0000050: 0001 0000 0000 009e 0000 0000 009e 0000  ................
0000060: 0000 ffff ffff 0000 ffff ffff 0000 0000  ................
0000070: 0000 0000 0003 0000 0000 ffff ffff 0000  ................
0000080: ffff ffff 0000 0000 0001 0000 0002 0026  ...............&
0000090: 0000 0002 0026 0000 0000 0000 0000 ffff  .....&..........
00000a0: ffff 0000 ffff ffff 0000 0000 0002 aaff  ................
00000b0: ffff ffff ffff ffff ffff ffff ffff 0000  ................
00000c0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
00000d0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
00000e0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
```

USN	Name	Sem	Dep
1BM14CS001	Aditya	3	CSE
1BM14IS002	Bharath	3	ISE
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