Objectives

◆ In this session, you will learn to:

- ◈ Describe the types of data models
- ◈ Define a relational database management system
- ◈ Describe the operators that work on relations

Record-Based Logical Model
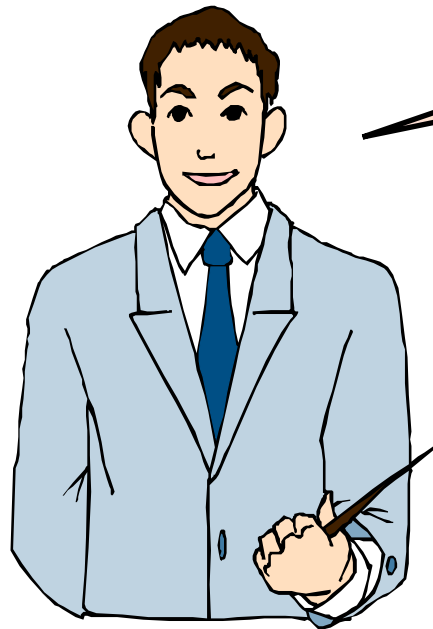
Let us now understand the record-based logical model.

Record-Based Logical Model (Contd.)

- The three types of record-based logical models are:
  - Hierarchical model:
    - Represents data in the form of a tree, and relationships between the data by links.
  - Network model:
    - Is similar to a hierarchical model.
    - Represents records in a database graphically.
  - Relational model:
    - Represents data in the form of tables in a database.
    - Is the most popular model.

Record-Based Logical Model (Contd.)

- The following diagram describes the details of a teacher table in the database in the row-column format.

T_CODE	NAME	AGE	SEMESTER
I1001	Nancy Mathews	27	I
I1002	Catherine	38	II
I1003	Mac Thames	50	IV
I1004	Joe Nelson	35	III

- An RDBMS can be defined as a DBMS where all the data is organized strictly as tables of data values.

Record-Based Logical Model (Contd.)

◆ Some typical applications of an RDBMS are:

- Airline and railway reservations
- Banking applications
- Manufacturing industry
- Order processing
- Hospital management systems
- Library management systems
- Hotel industry

Record-Based Logical Model (Contd.)

- Several RDBMS products are available today. Some popular products are:
  - Sybase
  - Oracle
  - Microsoft SQL Server
  - Ingres
  - DB2

Record-Based Logical Model (Contd.)

- Relational data structure:
  - Each table in a database has a unique table name.
  - The row (or record) in the table is called a tuple.
  - The column (or field) is called an attribute.
  - Every column in a table must have a unique name.
  - The number of tuples is called the cardinality of the table.
  - The number of attributes is called the degree of the table.
  - A column or combination of columns that uniquely identifies each row in the table is called the primary key of the table.
  - A table where every row is different from all other rows is called a relation.
  - A domain is a collection of values from which one or more attributes (columns) draw their actual values.

Record-Based Logical Model (Contd.)

◆ The following diagram describes the data structure of an RDBMS.

Tuple

T_CODE	NAME	AGE	SEMESTER
I1001	Nancy Mathews	27	I
I1002	Catherine	38	II
I1003	Mac Thams	50	IV
I1004	Joe Nelson	35	III

Record-Based Logical Model (Contd.)

◆ The following diagram describes the data structure of an RDBMS.

Attributes

T_CODE	NAME	AGE	SEMESTER
I1001	Nancy Mathews	27	I
I1002	Catherine	38	II
I1003	Mac Thams	50	IV
I1004	Joe Nelson	35	III

Record-Based Logical Model (Contd.)

◆ The following diagram describes the data structure of an RDBMS.

Primary Key

T_CODE	NAME	AGE	SEMESTER
I1001	Nancy Mathews	27	I
I1002	Catherine	38	II
I1003	Mac Thams	50	IV
I1004	Joe Nelson	35	III

Relation

Record-Based Logical Model (Contd.)

◆ The following diagram describes the data structure of an RDBMS.

DOMAIN T_CODE	DOMAIN NAME	DOMAIN AGE	DOMAIN SEMESTER

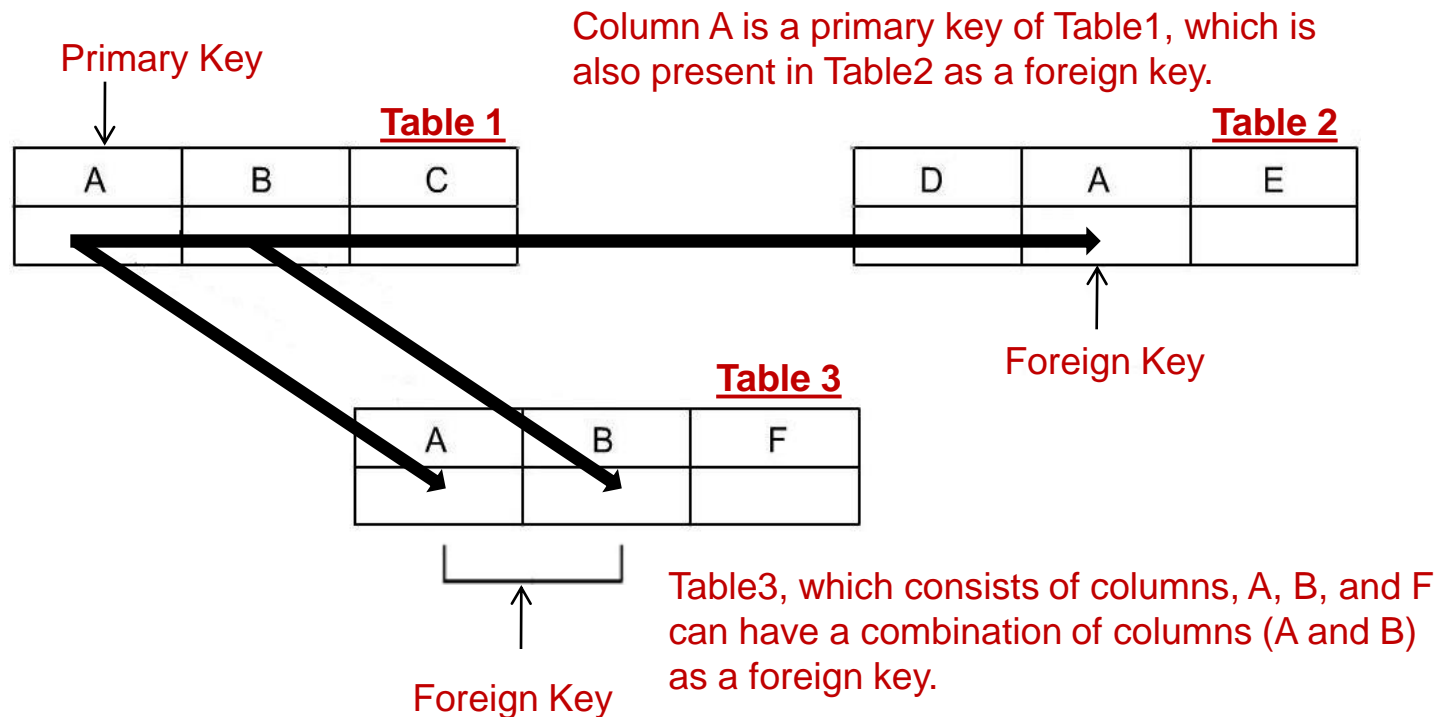| T_CODE	NAME	AGE	SEMESTER
I1001	Nancy Mathews	27	I
I1002	Catherine	38	II
I1003	Mac Thams	50	IV
I1004	Joe Nelson	35	III
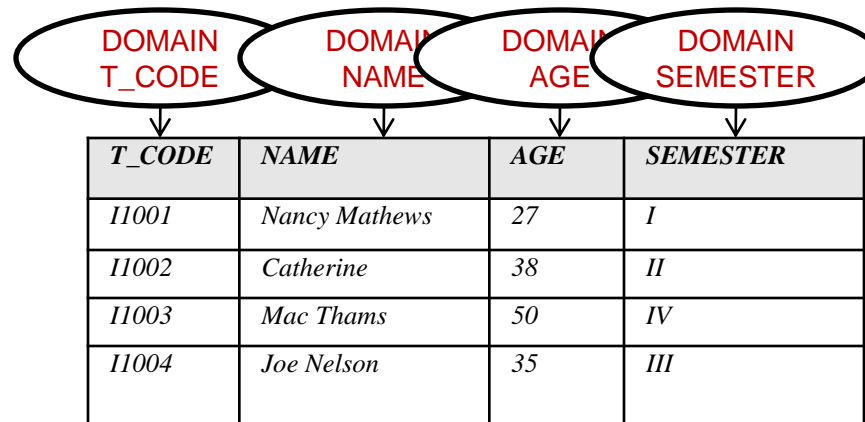
Record-Based Logical Model (Contd.)

- Representing missing information:
  - In RDBMS, missing or unknown information is represented as a NULL value in a table.
  - NULL is not the same as space or zero.
- Representing relationships in an RDBMS:
  - A column in one table whose value matches the primary key in some other table is called a foreign key.
  - A primary key and a foreign key create a parent-child relationship between the tables that connect them.

Record-Based Logical Model (Contd.)

◆ The following diagram represents the parent-child relationship in a relational model.

Primary Key

Column A is a primary key of Table1, which is also present in Table2 as a foreign key.

Table 1

A	B	C

Table 2

D	A	E

Foreign Key

Table 3

A	B	F

Table3, which consists of columns, A, B, and F can have a combination of columns (A and B) as a foreign key.
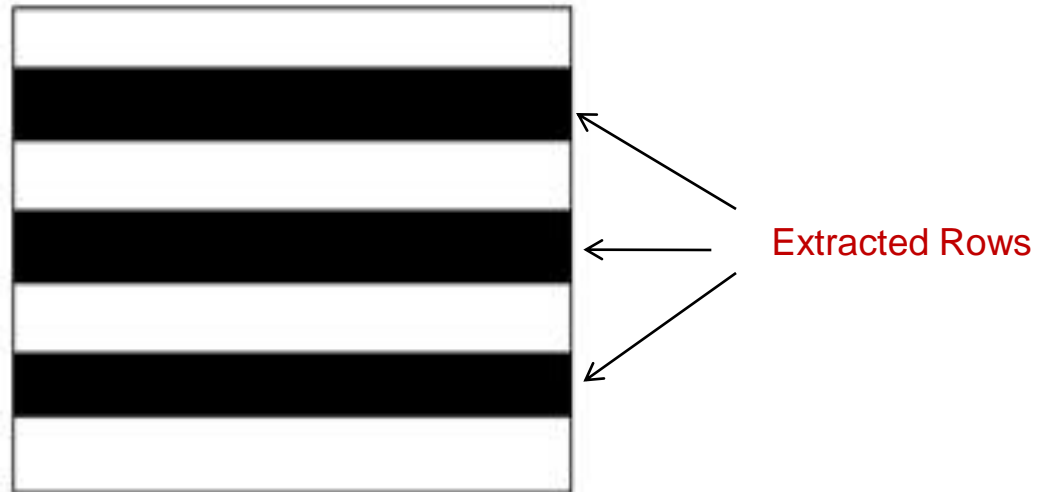
Foreign Key

Steps for Creating an ER Diagram

◆ The following steps should be followed while creating an ER diagram:

1. Identify the entities
2. Find the relationships
3. Identify the key attribute
4. Identify other important attributes
5. Draw a complete ER diagram
6. Review of ER diagram

Relational Operators

- Each operator takes one or two relations as its input and produces a new relation as its output.

- It is based on the principle of relational algebra.

- The following operators have been defined as relational operators:
    - RESTRICT
    - PROJECT
    - PRODUCT
    - UNION
    - INTERSECT
    - DIFFERENCE
    - JOIN
    - DIVIDE

RESTRICT

♦ The restrict operator extracts specified tuples or rows from a given relation based on a condition, as shown in the following diagram.

Extracted Rows

RESTRICT (Contd.)

◆ The following table describes the columns of the STUDENT table.

ROLLNO	STUDNAME	AGE	GENDER
0911	Jerry	20	M
0965	Susan	23	F
0856	Nancy	21	F
0910	Anthony	26	M
0988	Ramy	24	M
0976	Sara	28	F

The condition is to extract only those tuples from the STUDENT table where the age of the students is more than 25.

PROJECT

◆ The project operator extracts specified attributes or columns from a given relation, as shown in the following diagram.

Extracted Rows

PROJECT (Contd.)

◆ The following table describes the columns of the STUDENT table.

ROLLNO	STUDNAME	AGE	GENDER
0911	Jerry	20	M
0965	Susan	23	F
0856	Nancy	21	F
0910	Anthony	26	M
0988	Ramy	24	M
0976	Sara	28	F

The condition is to extract only the name and age of all the students.

PRODUCT

- ◆ The product operator joins two relations such that every tuple of the first relation is matched with every tuple of the second relation.

- ◆ To be product compatible, the two tables must have common attributes.

- ◆ The following diagram shows an example of the product operator.
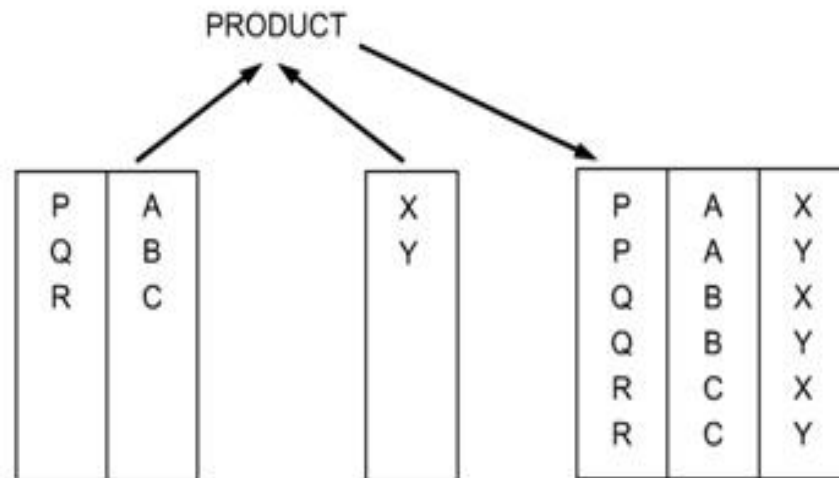
PRODUCT (Contd.)

◆ In the following diagram, the product operator creates the Cartesian product between the TEACHER and the BATCH tables.

TEACHER Table

T_CODE	NAME
I1001	Nancy Mathews
I1002	Catherine
I1003	Mac Thames

BATCH Table

BATCH_CODE	T-CODE
B001	I1001
B002	I1002
B003	I1003

PRODUCT

T_CODE	NAME	BATCH_CODE	T-CODE
I1001	Nancy Mathews	B001	I1001
I1001	Nancy Mathews	B002	I1002
I1001	Nancy Mathews	B003	I1003
I1002	Catherine	B001	I1001
I1002	Catherine	B002	I1002
I1002	Catherine	B003	I1003
I1003	Mac	B001	I1001
I1003	Mac	B002	I1002
I1003	Mac	B003	I1003

Summary

- In this session, you learned that:
    - In the relational model, data is represented in tables (relations) of rows (tuples) and columns (attributes).
    - The number of tuples is called the cardinality of the table, and the number of attributes is called the degree of the table.
    - An attribute (or set of attributes) that is unique in every tuple is called the primary key.
    - Unknown or missing information is represented as NULL in a table.
    - The foreign key is a column in one table that matches the primary key of another table.

Summary (Contd.)

- The following steps should be followed while creating an ER diagram:
    - Identify the entities
    - Find the relationships
    - Identify the key attribute
    - Identify other important attributes
    - Draw a complete ER diagram
    - Review of ER diagram
- The relational model is based on the principle of relational algebra.
- The eight operators that operate on relations are restrict, project, product, union, intersect, difference, join, and divide.