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# Database

- The collection of organized interrelated data to any purpose
- Used to store, organize and extract data.
- Database can be computerized or non-computerized (manual).
- A database may have single or multiple tables.
- The data in database are organized in rows and columns.

e.g. Telephone directory, marks ledger, attendance register, dictionary etc.



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# Data and Information

- Data can be defined as raw fact.
- Many not have meaning
  - Name: Ram, Roll no: 5
- Processed data is known as information.
- Gives certain meaning
  - Ram is a student. His roll no. is 5.

Data → Information
Processing

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# Database Processing / Management tasks

- Data Capture
- Data classification
- Data storage
- Data arranging
- Data retrieval
- Data maintenance
- Data verification
- Data coding
- Data editing
- Data transcription
- Data transmission



# Database Management System (DBMS)

- A technique that stores data, process them and provides the information in an organized form using database management software.
- allows user to modify, update, organize and retrieve information from the database

**E.G.**

- MS- Access
- Oracle
- FoxPro
- MS SQL Server
- MySQL
- dBase

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# Advantages of DBMS

- Reduce data redundancy (duplication)
- Increase data consistency (constant nature)
- Greater data integrity (completeness: complete data can be retrieved)
- Improved data security
- High storage
- Concurrent data access

# Disadvantages of DBMS

- Initial investment cost in hardware, software and training is high
- Cost for maintenance of software
- Complexity of backup and recovery



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# Relational DBMS (RDBMS)

- Most widely used software or program that stores database in multiple tables in the basis of a key field.
- Allows a user to view or create or retrieve records from multiple linked tables

**E.g.**

- MS- Access
- Oracle
- MS SQL Server
- MySQL

# Microsoft Access (MS-Access)

- A relational database management system developed by Microsoft Corporation
- Used to store and manipulate large amount of data in the form of tables.
- Allows the user to create database and store data in multiple tables
- Extension of ms access file: .mdb (2003), .accdb (2007)
- Template extension: .mdn (2003), .accdt (2007)

**Objects of MS Access**

- Table
- Query
- Form
- Report
- Pages
- Macro
- Modules



# Table

- The primary object of MS-Access.
- Building block of database that stores large volume of data in the form of rows of columns.

# Creating table

Different ways to create a table in ms access database are:

- Creating Table in Design View
- Creating Table by Using Wizard
- Creating Table by entering Data

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# Primary Key and Foreign Key

- The special fields of table that uniquely identifies each record from database.
- It does not accept duplicate value and can not be left blank.
- Foreign Key is a field in a table that matches the primary key field (column) of another table in relation.

**Importance:**

- To identify each record uniquely
- To control duplication data entry
- To set relationship between tables



# Elements of Table

**Field**

- A column of a table which stores a particular type of data.
- Also known as an attribute

**Record**

- Row of a table that gives complete information of a particular object
- The collection of multiple related fields
- It is also known as tuple.

| SN | Fname | Date of birth | Address |
|---|---|---|---|
| SIT01 | Kamal | 1/11/2048 | Kathmandu |
| SIT02 | Rojina | 5/9/2052 | Lalitpur |
| SIT03 | Mohan | 9/13/2045 | Kalimati |
| SIT04 | Sujata | 9/15/2045 | Kirtipur |

# Candidate, alternate and composite key

- **Candidate key:**
  - Any column or a combination of columns that can qualify as unique key in database.
  - One Table can have multiple Candidate Keys which can be taken as a primary key
- **Alternate key:**
  - A key (columns) which uniquely identify every row in the table, but which is not the primary key.
- **Composite (Compound) Key:**
  - a combination of two or more columns in a table that can be used to uniquely identify each row in the table.



# Data Type

It is the feature of a field that determines what kinds of data can be entered in the field.

**Text**

Default data type which stores alphanumeric value.
Default size: 50 characters
Maximum size: 255 characters

**Memo**

Stores alphanumeric values upto 65535

**Number**

Stores only number

Default numeric field size: Long Integer

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# Data Type

**Date/Time**

Stores date and time

Size: 8 bytes

**Currency**

Stores currency value

Storage size: 8 bytes

**Auto Number**

Generates unique sequential number automatically

Size: 4 bytes

**OLE Object**

Stores picture, video, sound

Size: 1 GB



# Data Type

**Yes/No**

Stores logical value that can be only one of two possible values: yes/no, true/false, on/off etc.

Field size: 1 bit

**Hyperlink**

Stores link of other documents

Size: 2048 characters

**Attachment**

Attaches any document or file in the table

**Lookup Wizard**

Displays data from another table in list box or combo box.

Storage size: 4 bytes

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# Common field properties

- **Field Size**: Maximum Number of characters
- **Format**: Appearance of value to be displayed
- **Input Mask**: It specifies a pattern and controls value of records for all data to be entered
- **Caption**: alternate name for the field upto 2048 characters
- **Default Value**: specifies the value entered automatically
- **Validation Rule**: Controls and limits the value to be entered
- **Validation** Text: Text messaged to be displayed when data entered is not matched to validation rule
- **Required**: specifies data must be entered or not
- **Indexed**: speeds up sorting and searching data



# Query

An object of database that is used to view, retrieve, change and analyzed records from a table or multiple linked tables.

When a user changes data in the query, the data in the table also get changed.

**Different ways to create query are:**

- Creating query in design view
- Creating query by using wizard

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# Types of Query

- **Select Query**: Retrieves records from table with or without criteria
- **Crosstab Query**: Presents data in a sheet, used to summarize and analyze data
- **Parameter Query**: Retrieves data as parameter given and works in conjunction with other types of queries
- **SQL Query**: Communicates with other types of database, uses SQL commands
- **Action Query**: Performs action (makes changes) on the data retrieved
  - **Update Query**: Updates specified value on the table
  - **Append Query**: Adds or appends data from one table to another
  - **Delete Query**: Deletes records from a table or multiple tables.
  - **Make Table Query:** Makes new database table from the result of the query



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# Forms

- A database object that is used to create an interface for entering data in a table or multiple tables
- A form displays a complete record at a time.
- Form can be created from table or query

**Different ways to create a form are:**

- Creating form using Design View
- Creating form by using wizard

**Different Form Layout**

- **Columnar:** Default layout
- **Tabular**
- **Datasheet:** Same as excel worksheet
- **Justified**

[Columnar and justified display single record at a time. Tabular and Datasheet display multiple record]

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# Forms

**Different parts/sections of form**

- **Header :** Displayed when the form is viewed in the form view.
- **Detail:** Detail area that contains the entire contents of form design.
- **Footer**: Displayed when the form is viewed in the form view.

# Reports

- Database object that presents output in a printed format.
- Used to display result
- Report can be created from table or query



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# Report

**Different ways to create a report are:**

- Creating report using Design View
- Creating report by using wizard

**Different Report Layout**

- Columnar
- Tabular: Default layout
- Justified

**Report Layout with grouped field**

- Stepped
- Block
- Outline

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# Report

**Different parts/section of report**

- **Report Header:** Appears at the top of the first page and displays the report title.
- **Page Header:** Appears at the top of every page and displays the headings (field labels) for each column.
- **Page Footer:** Appears at the bottom of every page and displays the page number and total number of pages.
- **Detail Section:** Appears between the page header and page footer and displays the records from the table or query.
- **Report Footer:** This section is optional. Appears on the last page of the report and displays summary information such as grand totals.



# Pages

- Pages allow you to view and update the data in your database from within a browser

# Macros

- Used to perform most of the task that you perform manually from keyboard, menus and toolbars.

# Modules

- Foundation of any application and lets to create libraries of functions that can be used throughout your application

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# Basic Database Term

- **Entity**: Entity is the distinguishable objects of real world.
  e.g. Student, Customer, Employee
- Attribute: Set of properties possessed by an entity.
  e.g. Name, Class, Section of a student
- **Tuple**: Each record row in a table
- **Sorting**: Arrangement of all the records in ascending or descending order either alphabetically or numerically



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# Basic Database Term

- **Filtering of Data**: Process of retrieving required record of a table based on given criteria
- **Formatting the table:** Changing the appearance of to make it attractive. E.g. changing row height or column width, changing border color and style, changing font and its size

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# Basic Database Term

- **Database index**: A data structure that improves the speed of data retrieval operations on a database
- **Design View:** A window that shows the design of database objects: table, query, form, reports etc.
- In this view, we can create new database objects and modify them.
- **Datasheet View:** A window that displays data from a table, query, form in a row and column format. In this view, we can edit fields, add and delete data and search for data.



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# Basic Database Term

- **Control**: Graphical objects which performs certain action on form or report
  - Text box, Label, Check box, Buttons, List box, Combo box
- **Toggle Button**: control which acts as on/off button
- **Front End and Back End**: Back-end application contains tables while front end application contains other objects like, queries, forms and reports

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# Basic Database Term

- **Wizard:** Step by step process to perform any action
- **Data Normalization:** A process to make the table efficient and compact as possible to eliminate the possibility of inconsistencies, duplicate and error.

**Database Administrator (DBA)**

- An information specialist who has responsibility for managing the database
- Duties of DBS: four major areas: Database planning, implementation, operation and security



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# Basic Database Term

- **Data Model:** a representation of reality, 'real world' objects and events
- **Data integrity:** refers to maintaining and assuring the accuracy and consistency of data
- **Confidentiality:** Confidentiality is a set of rules or a promise that limits access or places restrictions on certain types of information
- **Data redundancy:** Repetition of a field that in two or more tables
- **Data consistency:** Data consistency is the accuracy, validity, usability and integrity of associated data
- **Replication :** Process of copying and maintaining database objects in multiple databases that make up a distributed database system

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# Relationship

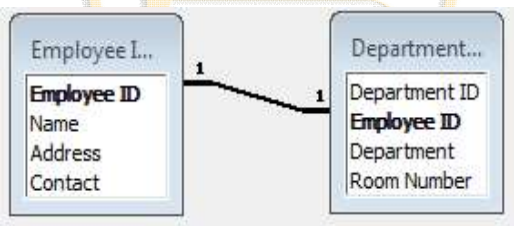
- An association among different related tables so that we can retrieve information from different tables easily.
- Types of Relationship:
  - One to One
  - One to Many
  - Many to Many





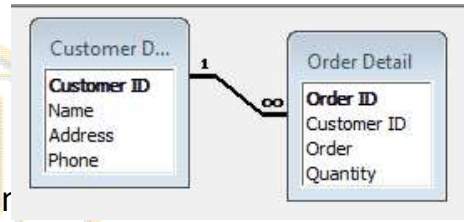
# Relationship

- **One to One Relationship:**
  - Each record in the first table can have only one matching record in the second table and vice versa
  - E.g. Employee: Department, Country: President



# Relationship

- **One to Many Relationship:**
  - Most common type of relationship
  - Each record in the first table can have more than one matching record in the second table
  - E.g. Customer: Order, Country: Citizer




- **Parent And Child table**
  - Parent Table: Table in one side of one to many relationship
  - Child Table: Table in many side of of one to many relationship



# Relationship

- **Many to Many Relationship:**
  - More Complicated
  - Each record in the first table can have more than one matching record in the second table and vice versa
  - Needs third table called **junction table** to establish relationship
  - E.g. Movie: Actor

# Database Models

- 1st Gen.
  - **Hierarchical Data Model:** Data are organized in tree structure (parent-child structure) in different hierarchy (level)
  - **Network Database Model:** In a network data model, record is stored with a link to other records.
- 2nd Gen.
  - **Relational Database Model:** Data are organized in more than one table related to one another.
- 3rd Gen.
  - **Object Oriented Database Model:** It assumes data as an object.
  - **Object Relational Database Model:** Objects oriented with relational database model.



# Database Schema

- Complete picture/structure/blue print of database
  - **Physical Schema**
    - Design at the physical level
    - Describes how data are actually stored in database
  - **Logical Schema**
    - Design at the logical level.
    - Describes what data are stored in database and what relationship exists among them

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# Data Integrity/ Integrity Constraint

- Set of rules to be followed in database
  - **Entity integrity**
    - The Primary key cannot have a NULL value.
  - **Domain integrity**
    - Refers to the range of valid entries for a given column
    - Ensures that there are only valid entries in the column.
  - **Referential integrity**
    - Ensures that for every value of a Foreign key, there is a matching value of the Primary key.



# 3 Level Architecture of Database

- **External level:** has the users' views of the database.
- **Conceptual level:** describes the logical structure of the entire database, including descriptions of the data and relationships among the data.
- **Internal level:** gives the details of the physical storage of the database on the computer.

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# Steps in database design

- **Step 1:** Define the Purpose of the Database (Requirement Analysis) Gather the requirements and define the objective of your database.
- **Step 2:** Gather Data, Organize in tables and Specify the Primary Keys.
- **Step 3:** Create Relationships among Tables.
- **Step 4:** Refine & Normalize the Design.

**Hierarchy of data**

- Bit >> Byte (Character)>> Field >> Record >> Table (file) >> Database >> Data Bank



# Types of Table

**1. Master Table:**

a. It has unique record in a table

b. It contains relatively permanent records and rarely changed

c. It is created only once

**2. Transaction Table:**

a. May have unique record but generally has duplicate records

b. It contains relatively temporary records and changeable

**3. Linker/Junction Table:**

a. Used to relate two or more tables

b. It has two common columns (Key fields)

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# ER Diagram (Entity-relationship diagram)

- A data modeling technique that graphically illustrates an information system's entities and the relationships between those entities.
- A conceptual and representational model of data used to represent the entity framework infrastructure.
- **The elements of an ERD are:** Entities, Relationships, Attributes


**DFD (Data Flow Diagram)**

- A Data Flow Diagram (DFD) is a traditional way to visualize the information flows within a system.



# Different Opening options in MS Access:

- **Open:** to open the database for shared access in a multi-user environment so that you and other users can read and write to the database.
- **Open Read-Only:** open the database for read-only access so that you can view but not edit it. Other users can still read and write to the database.
- **Open Exclusive:** When you have a database open with exclusive access, anyone else who tries to open the database receives a "file already in use" message.
- **Open Exclusive Read-Only:** Other users can still open the database, but they are limited to read-only mode.

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# Database Languages

**DDL**

- **Data Definition Language** (DDL) statements are used to define the database structure or schema. Some examples:
  - **CREATE** - to create objects in the database
  - **ALTER** - alters the structure of the database
  - **DROP** - delete objects from the database
  - **TRUNCATE** - remove all records from a table, including all spaces allocated for the records are removed
  - **COMMENT** - add comments to the data dictionary
  - **RENAME** - rename an object



# Database Languages

**DML**

- **Data Manipulation Language** (DML) statements are used for managing data within schema objects.
  - **SELECT** - retrieve data from the a database
  - **INSERT** - insert data into a table
  - **UPDATE** - updates existing data within a table
  - **DELETE** - deletes all records from a table, the space for the records remain

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# Database Languages

**DCL**

- **Data Control Language** (DCL) statements.
  - **GRANT** - gives user's access privileges to database
  - **REVOKE** - withdraw access privileges given with the GRANT command

**TCL**

- **Transaction Control** (TCL) statements are used to manage the changes made by DML statements.
  - **COMMIT** - save work done
  - **SAVEPOINT** - identify a point in a transaction to which you can later roll back
  - **ROLLBACK** - restore database to original since the last COMMIT
  - **SET TRANSACTION** - Change transaction options like isolation level and what rollback segment to use



# Shortcuts and Limitations in MS Access

**Shortcuts**

- Ctrl + F2: Invoke Builder
- F11 or Alt + F1: Bring database window to the front
- F12 or Alt + F2: Save As
- Ctrl + "+": Insert new record
- F6: Navigate between panes

**MS Access Limitations**

- Database size: 2 GB
- No. of objects in a database: 32768
- Number of characters in an object name: 64
- Number of concurrent users: 255
- Number of characters in a field name: 64
- Number of fields in a table: 255
- Number of fields in an index or primary key: 10
- Number of characters in a label (form/report): 2,048
- Number of actions in a macro: 999

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# SQL Join

- A JOIN clause is used to combine rows from two or more tables, based on a related column between them.

**Inner join**

- Returns records that have matching values in both tables
- Also known as Equi join.

**Self Join**

- Sometime we need to join a table to itself. This type of join is called Self join. In this Join, we need to open two copies of a same table in the memory.

**Left (Outer) Join:**

- Returns all records from the left table, and the matched records from the right table

**Right (Outer) Join:**

- Returns all records from the right table, and the matched records from the left table



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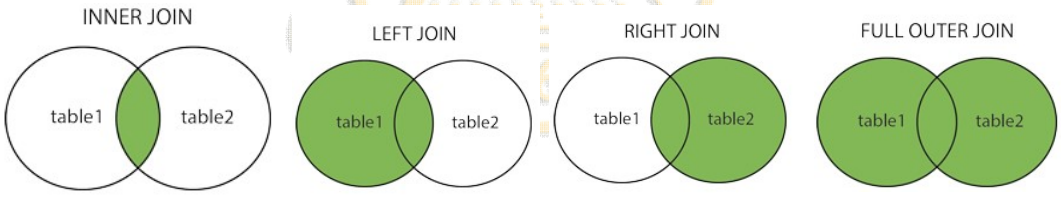
# SQL Join

**Full (Outer) Join:**

- Returns all records when there is a match in either left or right table

**Cross Join**

- Combines all the rows from the left table with every row from the right table.
- Returns Cartesian product of rows from tables in the join

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# SQL Operators

- **ALL:** The ALL operator is used to compare a value to all values in another value set.
- **AND:** The AND operator allows the existence of multiple conditions in an SQL statement's WHERE clause.
- **ANY:** The ANY operator is used to compare a value to any applicable value in the list as per the condition.
- **BETWEEN:** The BETWEEN operator is used to search for values that are within a set of values, given the minimum value and the maximum value.
- **EXISTS:** The EXISTS operator is used to search for the presence of a row in a specified table that meets a certain criterion.



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# SQL Operators

- **IN:** The IN operator is used to compare a value to a list of literal values that have been specified.
- **LIKE:** The LIKE operator is used to compare a value to similar values using wildcard operators.
- **NOT:** The NOT operator reverses the meaning of the logical operator with which it is used. Eg: NOT EXISTS, NOT BETWEEN, NOT IN, etc. This is a negate operator.
- **OR:** The OR operator is used to combine multiple conditions in an SQL statement's WHERE clause.
- I**S NULL:** The NULL operator is used to compare a value with a NULL value.
- **UNIQUE:** The UNIQUE operator searches every row of a specified table for uniqueness (no duplicates).

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