

KAZAKH NATIONAL AGRARIAN UNIVERSITY
Department: Automation and information technologies



DATABASE SYSTEMS

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CONTENT:

1. Bases of database systems: concept, characteristic, architecture.
2. Data Models
3. Database Management System
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5. Types of Relationships
6. External, conceptual, and internal views
7. Database Management Applications

INTRODUCTION TO DATABASES

- A database is a structured collection of records or data. A computer database is a kind of software to organize the storage of data. Databases help you organize this related information in a logical fashion for easy access and retrieval. To develop a database, there are several models used such as Hierarchical model, Network model, Relational model, Object-Oriented model etc. Though discussing about these models in details is beyond the level of this course unit, for the sake of completion, some models are briefed below.

DATA MODELS

- **Hierarchical model.** In a hierarchical model, data is organized into an inverted tree-like structure. This structure arranges the various data elements in a hierarchy and helps to establish logical relationships among data elements of multiple files. Each unit in the model is a **record** which is also known as a **node**. Each record has a single parent.
- **Network model.** The network model tends to store records with links to other records. Each record in the database can have multiple parents, i.e., the relationships among data elements can have a many to many relationships. So this model is an expansion to the hierarchical structure, allowing many-to-many relationships in a tree-like structure that allows multiple parents.
- The network model provides greater advantage than the hierarchical model in that it promotes greater flexibility and data accessibility.

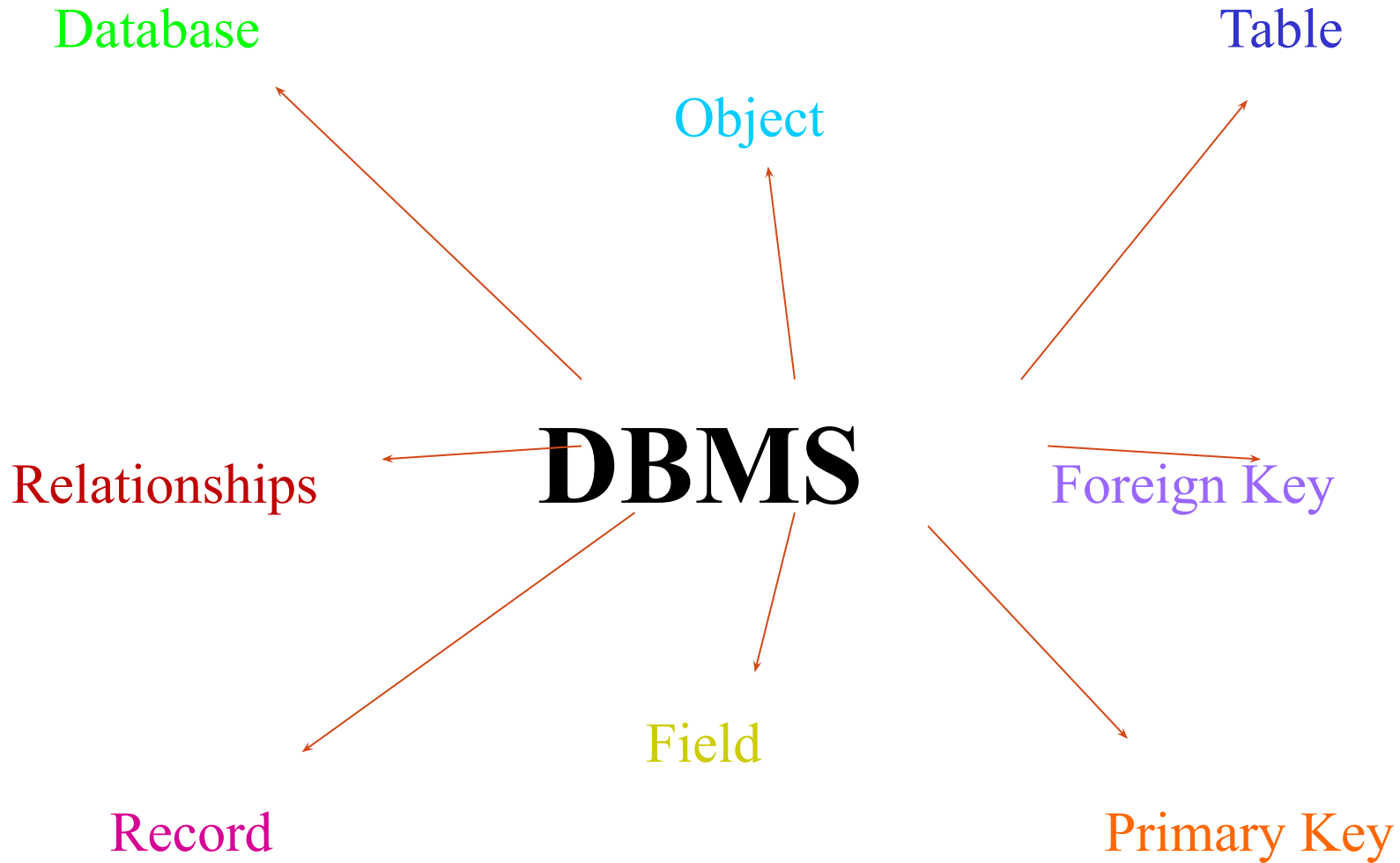
- **Relational model.** The relational model for the database management is a database model based on relations. The basic data structure of the relational model is a **table** where information about a particular **entity** (say, a student) is represented in columns and rows. The columns enumerate the various **attributes** (i.e. characteristics) of an **entity** (e.g. student name, address, registration _number). The rows (also called records) represent **instances** of an entity (e.g. specific student).

- **Object–Oriented model..** It provides full-featured database programming capability, while containing native language compatibility. It adds the database functionality to object programming languages. This approach is the analogical of the application and database development into a constant data model and language environment. Applications require less code, use more natural data modeling, and code bases are easier to maintain. Object developers can write complete database applications with a decent amount of additional effort. But object-oriented databases are more expensive to develop.

DATABASE MANAGEMENT SYSTEM

- A Database Management System (DBMS) is computer housekeeping tasks such as updating data, deleting obsolete records, and backing up the database.
- Obtaining subsets of data software designed for the purpose of managing databases based on a variety of data models. A DBMS is a complex set of software programs that controls the organization, storage, management, and retrieval of data in a database. DBMS are categorized according to their data structures or types, sometime DBMS is also known as a *Database Manager*. Data management tasks fall into one of four general categories as given below:
 - Entering data into the database.
 - There are several advantages in DBMS such as reduced data redundancy and inconsistency, enhanced data integrity, improved security etc.

Basic terminology in Databases



Basic terminology in Databases

- **Database.** A database is an organized collection of the related information.

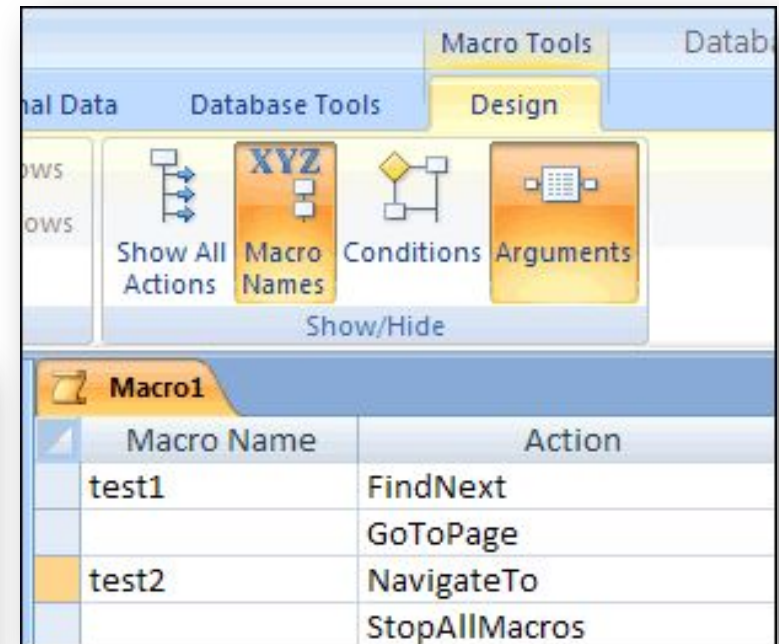
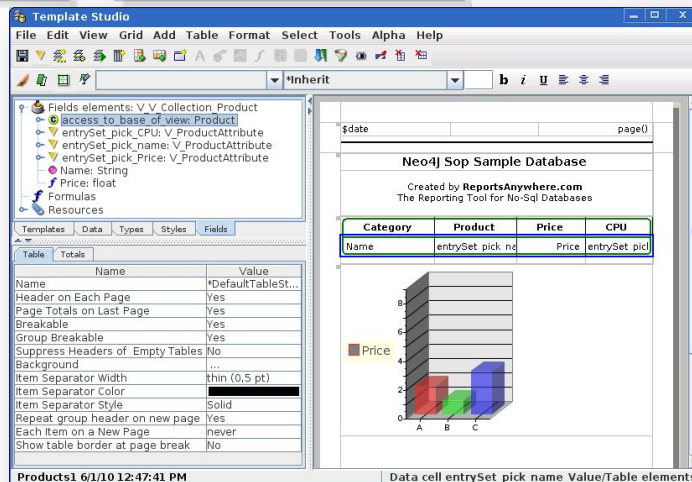


- **Object.** An object is a component in the database such as a table, query, form, report, or macro, etc.

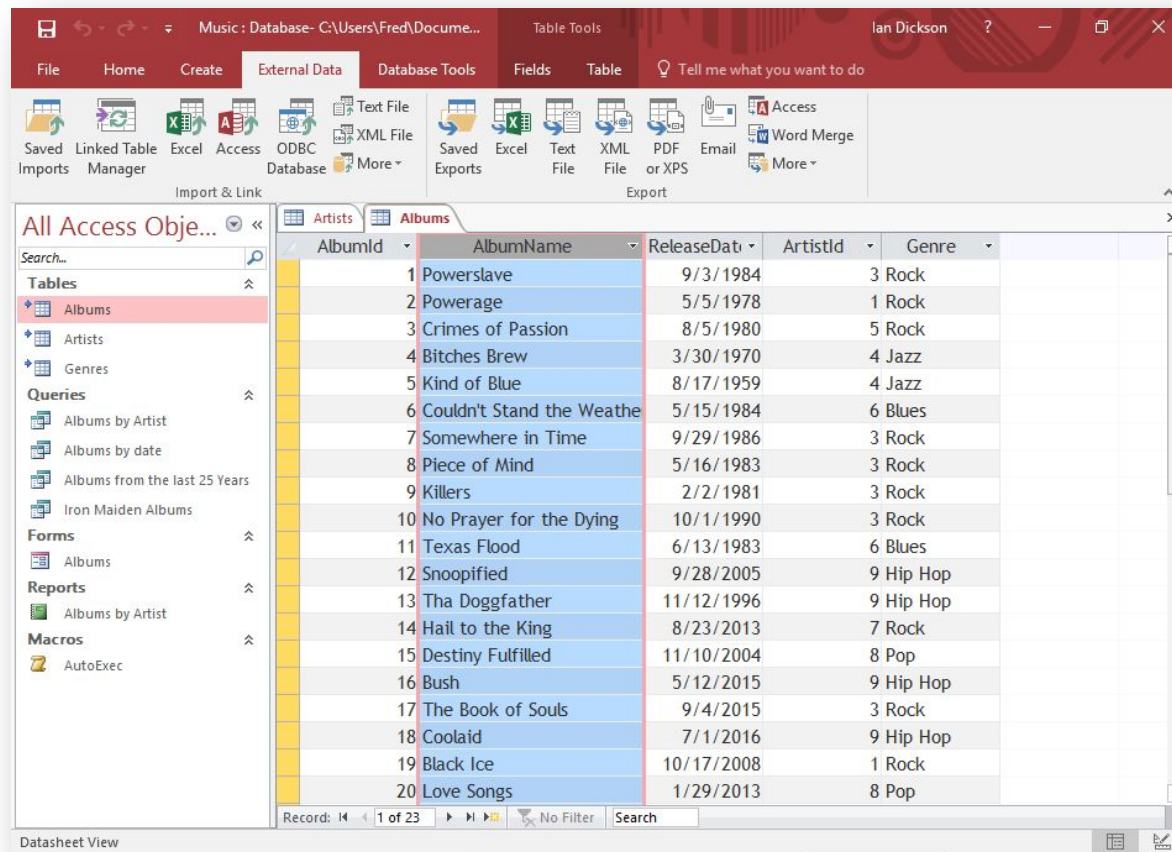
Object Type <i>person_typ</i>	
Attributes	Methods
idno	get_idno
first_name	display_details
last_name	
email	
phone	

Object	
idno:	65
first_name:	Verna
last_name:	Mills
email:	vmills@example.com
phone:	1-650-555-0125

Object	
idno:	101
first_name:	John
last_name:	Smith
email:	jsmith@example.com
phone:	1-650-555-0135



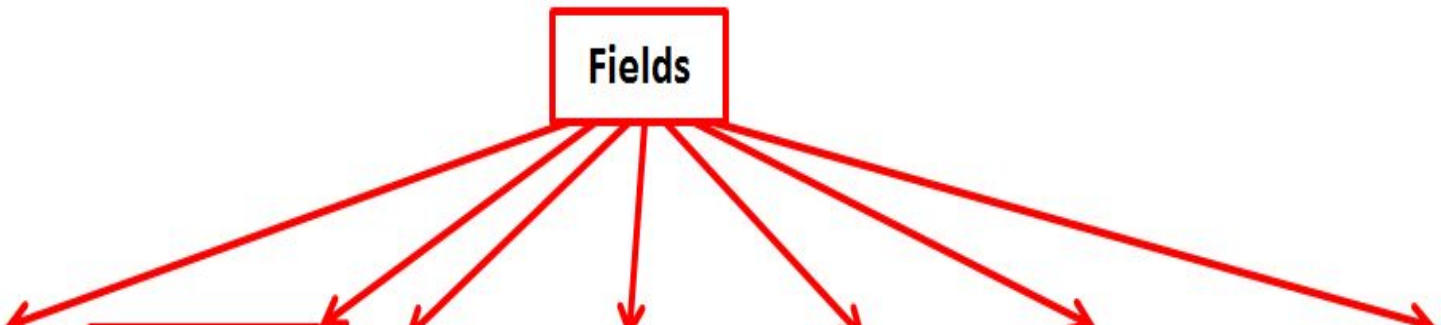
- **Table.** A table is a group of related data organized in fields (columns) and records (rows) on a datasheet. By using a common field in two tables, the data can be combined. Many tables can be stored in a single database



The screenshot shows the Microsoft Access application window. The title bar indicates the database is located at 'C:\Users\Fred\Documents\Music : Database-'. The ribbon includes 'File', 'Home', 'Create', 'External Data', 'Database Tools', 'Fields', 'Table', and a search bar. The 'External Data' tab is active, showing options for importing and exporting data. The 'All Access Objects' pane on the left lists 'Tables' (Albums, Artists, Genres), 'Queries' (Albums by Artist, Albums by date, Albums from the last 25 Years, Iron Maiden Albums), 'Forms' (Albums), 'Reports' (Albums by Artist), and 'Macros' (AutoExec). The 'Albums' table is selected and displayed in Datasheet View. The table has 5 columns: AlbumId, AlbumName, ReleaseDate, ArtistId, and Genre. It contains 20 records, numbered 1 through 20. The status bar at the bottom shows 'Record: 1 of 23' and 'No Filter'.

AlbumId	AlbumName	ReleaseDate	ArtistId	Genre
1	Powerslave	9/3/1984	3	Rock
2	Powerage	5/5/1978	1	Rock
3	Crimes of Passion	8/5/1980	5	Rock
4	Bitches Brew	3/30/1970	4	Jazz
5	Kind of Blue	8/17/1959	4	Jazz
6	Couldn't Stand the Weather	5/15/1984	6	Blues
7	Somewhere in Time	9/29/1986	3	Rock
8	Piece of Mind	5/16/1983	3	Rock
9	Killers	2/2/1981	3	Rock
10	No Prayer for the Dying	10/1/1990	3	Rock
11	Texas Flood	6/13/1983	6	Blues
12	Snoopified	9/28/2005	9	Hip Hop
13	Tha Doggfather	11/12/1996	9	Hip Hop
14	Hail to the King	8/23/2013	7	Rock
15	Destiny Fulfilled	11/10/2004	8	Pop
16	Bush	5/12/2015	9	Hip Hop
17	The Book of Souls	9/4/2015	3	Rock
18	Coolaid	7/1/2016	9	Hip Hop
19	Black Ice	10/17/2008	1	Rock
20	Love Songs	1/29/2013	8	Pop

- **Field.** A field is a column on a datasheet and defines a data type for a set of values in a table. For a mailing list table might include fields for first name, last name, address, city, and telephone number.



A diagram with a central box labeled "Fields" has seven red arrows pointing to the column headers of the table below: "First Name", "Surname", "Address 1", "Address 2", "Post Code", "Date of birth", and "Christmas Card".

First Name ▾	Surname ▾	Address 1 ▾	Address 2 ▾	Post Code ▾	Date of birth ▾	Christmas Card ▾
Donald	Duck	12 Quack Street	Ducktown	DT1 3DD	21/04/1934	☐
Bugs	Bunny	3 Rabbit Road	Hareville	HV3 9BB	12/01/1938	☒
Road	Runner	4 Meep Lane	Meeptown	MT2 1RR	19/10/1948	☒
Micky	Mouse	51 Squeak Street	Mousington	MT2 3MM	12/11/1928	☐
Minnie	Mouse	51 Squeak Street	Mousington	MT2 3MM	12/11/1928	☐
Marvin	Martian	1 Moon Street	Marsville	MV3 5MM	12/12/1952	☒
Daffy	Duck	32 Crazy Close	Quacksville	QV4 6DD	02/02/1937	☒

- **Record.** A record is a row on a datasheet and do fields define a set of values. In a mailing list table, each record would contain the data for one person as specified by the intersecting fields.

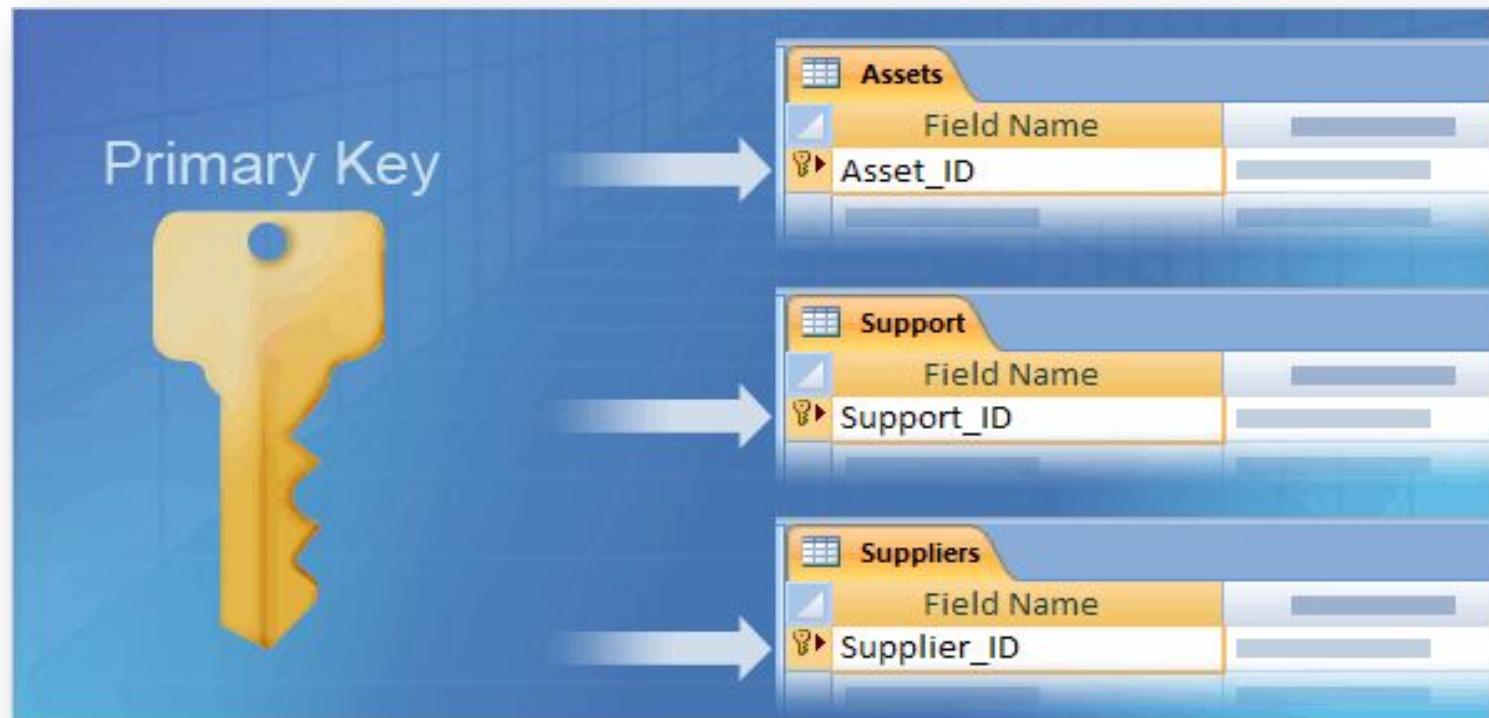
First Name	Last Name	Address	City	Age
Mickey	Mouse	123 Fantasy Way	Anaheim	73
Bat	Man	321 Cavern Ave	Gotham	54
Wonder	Woman	987 Truth Way	Paradise	39
Donald	Duck	555 Quack Street	Mallard	65
Bugs	Bunny	567 Carrot Street	Rascal	58
Wiley	Coyote	999 Acme Way	Canyon	61
Cat	Woman	234 Purrfect Street	Hairball	32
Tweety	Bird	543	Itotitaw	28



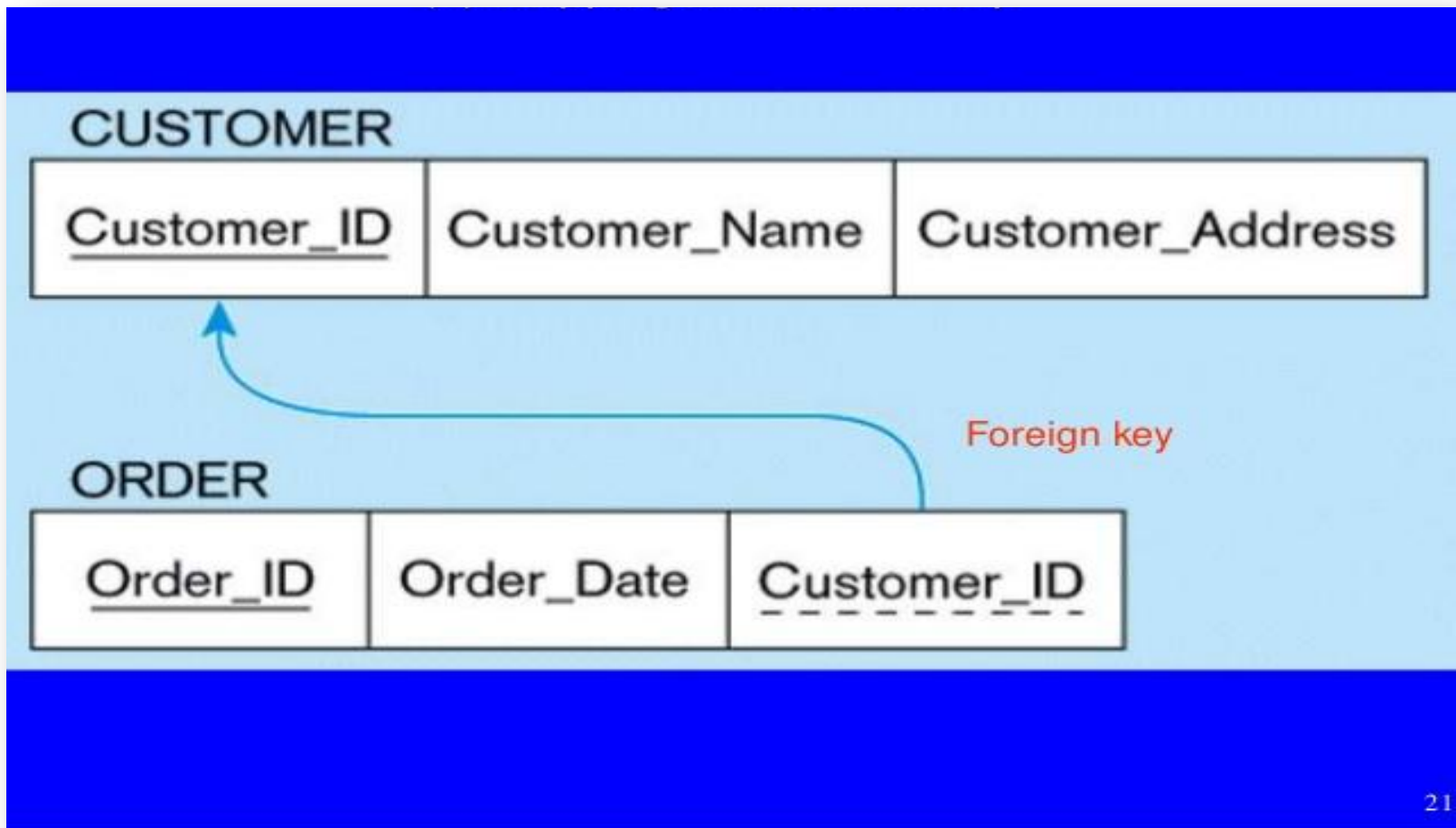
The diagram illustrates the concept of records in a table. A red rectangular box highlights the row for 'Wonder Woman' (987 Truth Way, Paradise, 39). To the right of the table, the word 'Records' is written in red. Five blue arrows originate from this word and point to the five rows of data in the table, indicating that each row represents a record.

Records

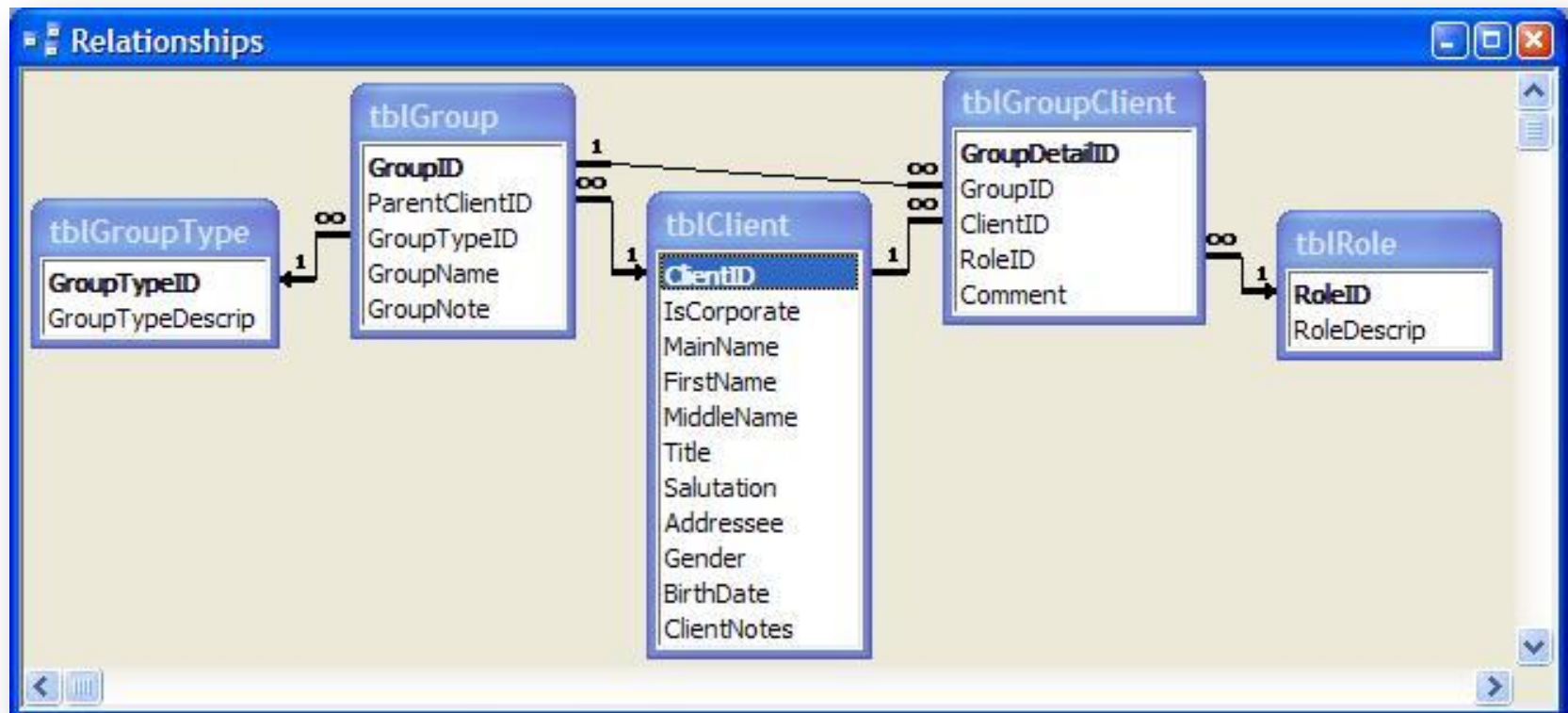
- **Primary key.** A primary key is used to uniquely identify each row in a table. It can either be a part of the actual record itself, or it can be an artificial field (one that has nothing to do with the actual record). A primary key can consist of one or more fields on a table. When multiple fields are used as a primary key, they are called as a composite key.



- **Foreign key.** A foreign key is a field (or fields) that points to the primary key of another table. The purpose of the foreign key is to ensure referential integrity of the data.



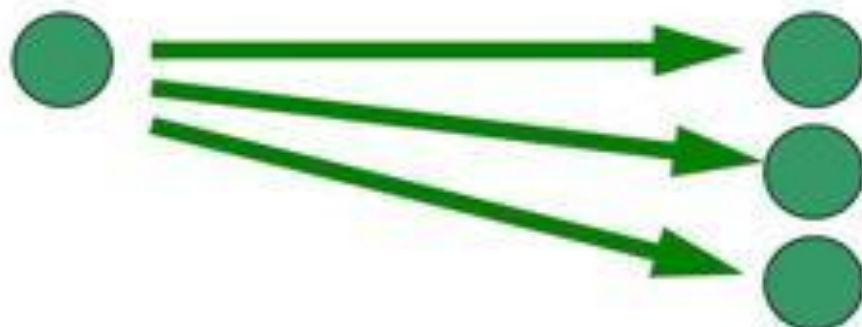
- **Relationships.** Two tables/entities in a database may relate to each other using one or more common attribute. There are three types of relationships among tables namely, One-to-one, one-to-many, many-to-many.



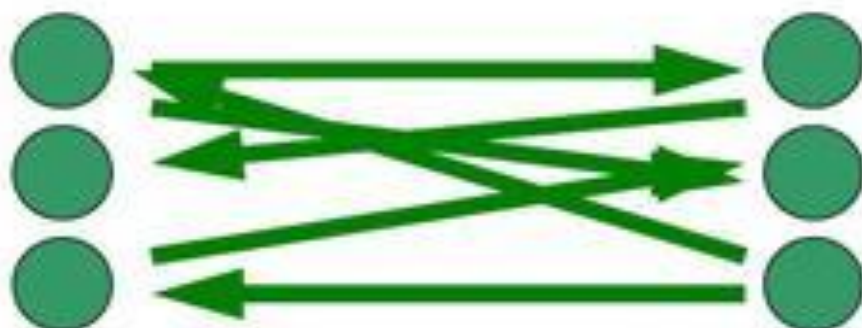
One to one relationships connect one entity to one other entity:



One to many relationships connect one entity to one or more other entities:



Many to many relationships connect many entities to many other entities:



EXTERNAL, CONCEPTUAL, AND INTERNAL VIEWS

A database management system provides three views of the database data:

- *The external level* defines how each group of end-users sees the organization of data in the database. A single database can have any number of views at the external level.
- *The conceptual level* unifies the various external views into a compatible global view. It provides the synthesis of all the external views. It is out of the scope of the various database end-users, and is rather of interest to database application developers and database administrators.
- *The internal level* (or physical level) is the internal organization of data inside a DBMS. It is concerned with cost, performance, scalability and other operational matters. It deals with storage layout of the data, using storage structures such as indexes to enhance performance.

LANGUAGES

Database languages are special-purpose languages, which do one or more of the following:

- Data definition language – defines data types such as creating, altering, or dropping and the relationships among them
- Data manipulation language – performs tasks such as inserting, updating, or deleting data occurrences
- Query language – allows searching for information and computing derived information.

DATABASE MANAGEMENT APPLICATIONS

- There are several different database management applications which are not only meant for entering and retrieving information but also they facilitate simultaneous updates and queries from multiple users.
- Some of the database management applications are listed below:



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CONCLUSION

Databases today are essential to every business. Whenever you visit a major Web site — Google, Yahoo!, Amazon.com, or thousands of smaller sites that provide information — there is a database behind the scenes serving up the information you request. Corporations maintain all their important records in databases. In this presentation we learned a lot of information concerning databases. And we supplemented our vocabulary with different terms.

REFERENCE

- **DATABASE SYSTEMS. The Complete Book. Second Edition.** Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom. Department of Computer Science, Stanford University. Upper Saddle River, New Jersey 07458.

LINKS

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- <https://raima.com/database-terminology/>
- [https://en.wikipedia.org/wiki/One-to-one \(data model\)](https://en.wikipedia.org/wiki/One-to-one_(data_model))
- [https://en.wikipedia.org/wiki/One-to-many \(data model\)](https://en.wikipedia.org/wiki/One-to-many_(data_model))
- [https://en.wikipedia.org/wiki/Many-to-many \(data model\)](https://en.wikipedia.org/wiki/Many-to-many_(data_model))