

LESSON 1

Data

- Raw facts that are used as basis for manipulation and computation which are considered to be the input.
- Unorganized facts that need to be processed
- No meaning

Information

- Processed data that are considered to be the results or the output
- When data is processed, organized, structured or presented as to make it useful.

Levels of Data Organization

- Bit
 - It is the smallest form of data
 - Consist binary digits (0 and 1)
- Byte (8 bits)
 - Smallest unit of data
 - It is equal to one character (A-Z, 0-9, and any symbo)
 - Character is the most basic element of data that can be observed and manipulated
- Field
 - Group of characters that taken as one. A logical unit of data (Ex. Name, Address, Phone)
- Record
 - It is a group of related fields pertaining to one entity
 - Ex:

Susan's Record

Name	Bday	SS	Street	City	St	Zip	Phone
Almond, Susan	10/22/1985	245-88-9845	31 Bessemer St	Greensboro	NC	25233	336-585-5646

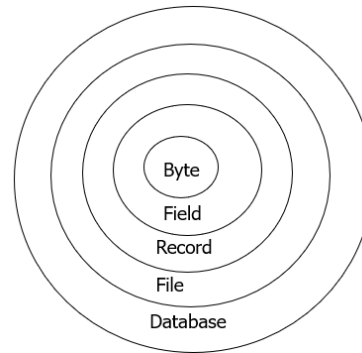
- File
 - A group of related records pertaining to subject. Sometimes called a table
 - Ex. Student, Professor, Course, Schedule
- Database
 - A colletion of related files pertaining to one subject

Examples of Business Databases

- Telephone book
- Student data
- Music
- Fingerprint Database
- Dictionaries
- Customer Data

- Real Estate listings
- Hospital/patient data
- Inventory

Levels of Data Organization



LESSON 2

Database before the use of computers

- Data was stored in:
 - Books
 - Ledgers
 - Card files
 - Folders
 - File cabinets
 - Or simply in people's heads

Traditional File Processing System

- In traditional approach, we use to store information in flat files which are maintained by the file system under the operating system's control
- File system – a method for storing and organizing computer files and the data they contain to make it easy to find and access them
- Use a storage device such as a hard disk or CD-ROM and involve maintaining the physical location of the files

Flat Files

- Contain all the information worth keeping in a database; the resulting information can eventually become the fields of a table

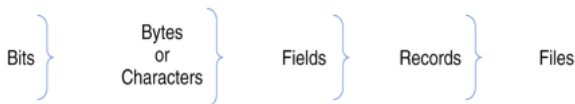
Student ID	Student Name	Contact Number	College	Course	Subject Code	Subject Description	Units
0145-56	Gabriel Ross Quiray	7782334 9660002	Science	Botany	B-058	Ecology 2	3
0145-56	Gabriel Ross Quiray	7782334 9660002	Science	Botany	B-091	Chemistry 1	3
0143-59	Ferdinand Miguel Natividad	6420048 09165209140	Science	Physics	L-023	Physics 2 Lab	2
0143-59	Ferdinand Miguel Natividad	6420048 09165209140	Science	Physics	B-024	Physics 2 Lec	3
0143-67	Joss Vincent Quiray	4332209	Arts & Letters	Economics	E-014	English	3

Disadvantage of File Processing System

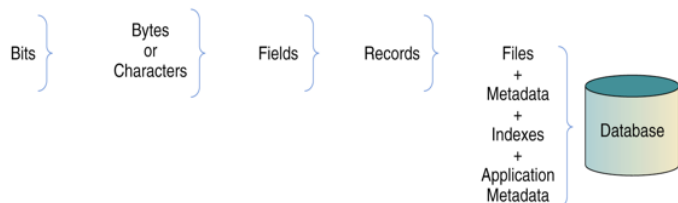
- Data redundancy
 - means same information is duplicated in several files
- Data inconsistency
 - means different copies of the same data are not matching
 - different version of same basic data are existing
- Difficulty in accessing data
 - Need to write a new program to carry out each new task
- Data isolation
 - Data are scattered in various files and the files may be in different format, writing new application program to retrieve data is difficult
- Security problems
 - Enforcing security constraints in file processing system is very difficult as the application programs are added to the system in an ad-hoc manner

The Hierarchy of Data

- File Processing



- DBMS



Database

- An organized collection of logically related data
- Used to store, manipulate, and retrieve data in nearly every type of organization
- It is a container that holds the data.
- Ex. Business, health care, education, government, and libraries

Why do we need database?

- To keep a record of activities and interventions
- Keep sales records
- Develop reports
- Perform research

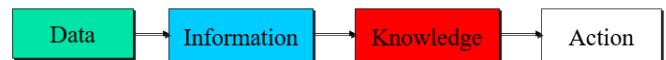
Database Applications

- Banking – all transactions
- Airlines – reservations, schedules
- Universities – registration, grades

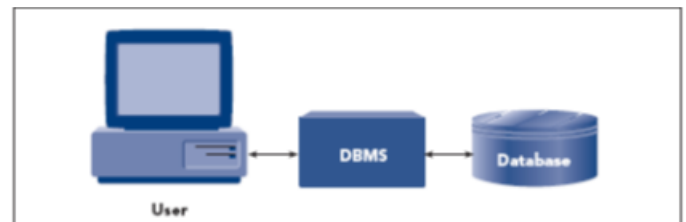
- Sales – customers, products, purchases
- Manufacturing – production, inventory, orders, supply chain
- Human resources – employee records, salaries, tax deductions

Database Management System (DBMS)

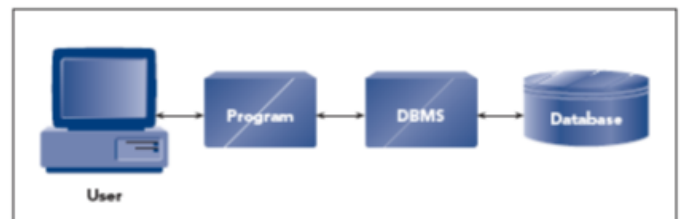
- Consists of a group of programs that manipulate the database and provide an interface between the database, the user of the database and other applications programs
- DBMS provides an environment that is both convenient and efficient to use
- Ultimate purpose of a DBMS
 - Is to transform:



- Using a DBMS directly



- Using a DBMS Through another program



Advantages of a DBMS

- Improved availability
 - One of the principle advantages of a DBMS is that the same information can be made available to different users
- Minimized redundancy
 - The data in a DBMS is more concise because as a general rule, the information in it appears just once. This reduces data redundancy, or in other words, the need to repeat the same data and over and over again
- Accuracy
 - Accurate, consistent, and up-to-date is a sign of data integrity. DBMS foster data integrity because updates and changes to the data only have to be made in one place
- Program and file consistency

- Using database management system, file formats and system programs are standardized. This makes the data files easier to maintain because the same rules and guidelines apply across all types of data
- User-friendly
 - Data is easier to access and manipulate with a DBMS than without it.
 - DBMS also reduce the reliance of individual users on computer specialists to meet their data needs
- Improved security
 - DBMSs allow multiple users to access the same data resources.
 - Through the use of passwords, database management systems can be used to restrict data access to only those who should see it

Disadvantages of DBMS

- Cost
 - Implementing a DBMS system can be expensive and time consuming, especially in large organizations
 - High cost of software
 - Hardware costs high due to software complexity
 - Requirement for skilled staff
 - Higher programming costs – greater skill required
- Security
 - It may be possible for some unauthorized users to access the database
 - Steps should also be taken to regularly make backup copies of the database files and store them because of the possibility of fires and earthquakes that might destroy the system
 - More difficult recovery (if disaster strikes)
 - Increased vulnerability

Popular DBMS

- MS Access
- DB2
- Oracle
- MySQL
- Microsoft SQL Server

People who work with databases

- Database implementers/designers
- Database administrators (DBA)
- Application programmers
- End users

Type of database End Users

- Casual users
 - These are people who use the database occasionally.

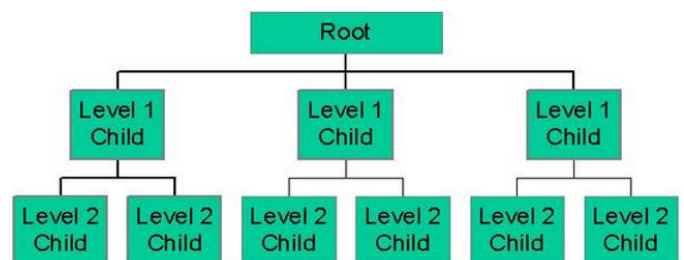
- Naïve users
 - These are users who constantly querying and updating the database
 - Eg. Reservation clerks of airline, railway, hotel, etc.
 - Clerks at receiving station of courier service, insurance agencies, etc.
- Sophisticated users
 - People who use for their complex requirements
 - Eg. Engineers, scientists, business analysts
- Standalone users
 - Who maintain database for personal use

Database Administrators (DBA)

- The central authority in charge of database
- Roles of DBA
 - Managing resources
 - Creation of user accounts
 - Providing security and authorization
 - Managing poor system response time
 - System recovery
 - Tuning the database

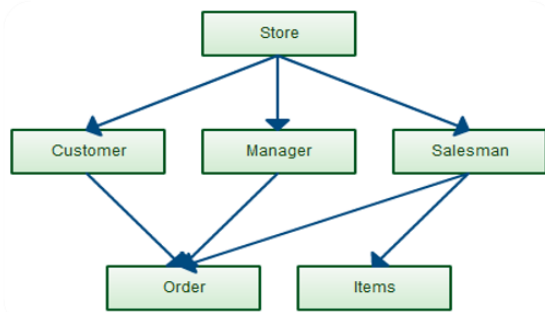
Types of DBMS

- Hierarchical database
 - DBMS is said to be hierarchical if the relationships among data in the database are established in such a way that one data item is present as the subordinate of another one
 - Based on parent-child relationship
 - Data structure “tree” is followed by the DBMS to structure the database
 - No backward movement is possible/allowed in the hierarchical database
 - Ex. Taxonomy, directory tree folder



- Network database
 - DBMS is said to be a network DBMS if the relationship among data in the database are of type many-to-many
 - The relationships among many-to-many appears in the form of a network
 - The structure of a network database is extremely complicated because of these many-to-many relationships in which one record can be used as a key of the entire database

- Difference over hierarchical is that each child or member can have more than one parent (or owner)



- relational database
 - DBMS is said to be a relational DBMS or RDBMS if the database relationships are treated in the form of a table
 - Relational database connects data in different files by using common data elements or primary key
 - Number of RDBMS are available, some popular examples are oracle, Microsoft, SQL server, and Microsoft access

Rep								
RepNum	LastName	FirstName	Street	City	State	Zip	Commission	Rate
20	Kaiser	Valerie	624 Randall	Grove	FL	33321	\$20,542.50	0.05
35	Hull	Richard	532 Jackson	Sheldon	FL	33553	\$39,216.00	0.07
65	Perez	Juan	1626 Taylor	Fillmore	FL	33336	\$23,487.00	0.05

Customer								
CustomerNum	CustomerName	Street	City	State	Zip	Balance	CreditLimit	RepNum
148	Al's Appliance and Sport	2837 Greenway	Fillmore	FL	33336	\$6,550.00	\$7,500.00	20
282	Brookings Direct	3827 Devon	Grove	FL	33321	\$431.50	\$10,000.00	35
356	Ferguson's	382 Wildwood	Northfield	FL	33146	\$5,785.00	\$7,500.00	65
408	The Everything Shop	1828 Raven	Crystal	FL	33503	\$5,285.25	\$5,000.00	35
462	Bargains Galore	3829 Central	Grove	FL	33321	\$3,412.00	\$10,000.00	65
524	Kline's	838 Ridgeland	Fillmore	FL	33336	\$12,762.00	\$15,000.00	20
608	Johnson's Department Store	372 Oxford	Sheldon	FL	33553	\$2,106.00	\$10,000.00	65
687	Lee's Sport and Appliance	282 Evergreen	Altomville	FL	32543	\$2,851.00	\$5,000.00	35
725	Dreerfield's Four Seasons	282 Columbia	Sheldon	FL	33553	\$248.00	\$7,500.00	35
842	All Season	28 Lakeview	Grove	FL	33321	\$8,221.00	\$7,500.00	20

Relational Database Terminology

SQL/Access Term	RDBMS Term	Description
Row	Tuple or record	A data set representing a single item
Column	Attribute or field	A labeled element of a tuple, e.g. "address" or "date of birth" or "name"
Table	Relation or Entity	A set of tuples sharing the same attributes; a set of columns and rows

Advantages of a RDBMS

- All data is stored in the database
- Data redundancy is reduced
- Easier to maintain data integrity
- Eliminates the dependence between programs and data
- The database can operate as a stand alone application

Properties of a relation/table

1. A relation consists of a set of fields with unique names (field names cannot repeat in the same table). It doesn't matter in which order the fields are listed
2. The values of fields fall into a known domain or legal values
3. Each record (Row) in the database is unique. That is records do not repeat
 - To avoid records from repeating, we have what is called "primary key".
 - Primary key cannot take null value.

Types of Relational Keys

- Primary Key
 - Primary key is a column in a table that is uniquely identifies the rows in that table
- Foreign Key
 - A column in a table that provides a link between data in two tables using one of the primary keys
- Candidate Key
 - A column that meets all of the requirements of a primary key. It has the potential to be a primary key
- Alternate Key
 - Any candidate key that is not selected to be a primary key can be an alternate key.

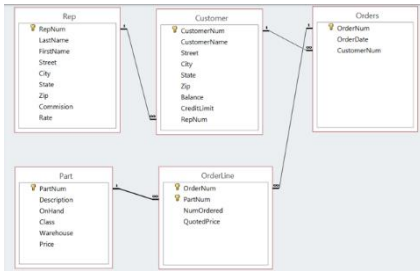
LESSON 3

RDBMS

- Relational Database Management System
- Relational Database store the data into collection of tables, which might be related by common fields
- RDBMS was developed by Edgar Frank (E.F.) Codd in 1970
- A relation is nothing but a "table" that consists of "records/tuples" (Rows) and "fields/attributes" (columns)
- A relational Database Management System is a piece of software that manages groups of tables which are related to one another
- MS access is an example of RDBMS

Table relationship

- Table relationships in RDBMS are created using a primary key from one table and linking it to a related field in another table called a foreign key



Integrity Rules

- Rule for a data in the database
- Used to ensure accuracy and consistency of data in a relational database
- Types of integrity rules
 - Entity Integrity – implies that a primary key cannot accept null value
 - Referential Integrity – a foreign key cannot be entered into one table unless it matches a primary key in another
 - Referential Integrity can also prevent the deletion of a record if the record has a primary key that matches foreign keys in another table

GROUP 1 – Conceptual/Logical Database Design for Relational Model

History of Relational Model

- Relational Model (1970s)
 - Edgar F. Codd introduced the relational model, which revolutionized data organization by using tables with rows and columns
- Early data handling (1950s-1960s)
 - In the early days of computing, data was managed informally, often with little structure
- Introduction of Data Models (1960s-1970s)
 - People began using simple models and flowcharts to represent data relationships
- Entity-Relationship Diagrams (1970s-1980s)
 - ERDs were introduced as visual tools to help plan and depict data structures
- Structured Query Language (1970s-Present)
 - SQL became the standard language for interacting with relational databases, facilitating communication
- Formal Methodologies (1980s-Present)
 - Systematic methodologies emerged, providing step by step approaches for designing databases

Benefits of Conceptual Design

- Easier modification
 - Changes that you make to the value of a given field will not adversely affect the values of other fields within the table
- Easy to Maintain
 - The database structure should be easy to maintain. The design is perfect if changes in one field is not affecting changes in another field.

Benefits of Logical Database Design

- Easy to use
 - Users can easily access/retrieve their required information within seconds without indulging in the complexity of the database. SQL is used to execute complex queries
- Accuracy
 - A key feature of relational databases is that they're strictly defined and well organized. So data doesn't get duplicated.
 - relational databases have accuracy because of their structure with no data duplication

Technology Sample for Conceptual database design

- Entity-Relationship Diagrams (ERDs)
 - Tools like lucidchart, draw.io, or even hand-drawn diagrams can be used to create ERDs
- Data Modeling Software
 - Tools like Microsoft visio, oracle sql developer data modeler, or mysql workbench can help design conceptual models
- Pen and paper
 - Sometimes, a simple sketch or drawing can be a quick way to conceptualize a database

Application areas of conceptual database design

- Requirements gathering
 - It helps in understanding and documenting the data requirements of an organization
- Communication
 - It facilitates communication between database designers, stakeholders, and developers

Technology sample logical database design

- MySQL
 - An open-source RDBMS widely used for web applications and smaller-scale database systems
- PostgreSQL
 - Another open-source RDBMS known for its advanced features, extensibility and support for complex data types
- Oracle Database
 - A commercial RDBMS known for its robustness, scalability, and comprehensive feature set, often used in enterprise applications

Application of Logical database design in Real-World Scenarios

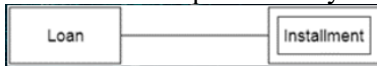
- Business
 - Relational databases are commonly used for storing and managing business-related data such as customer information, sales records, and inventory
- Healthcare
 - They are used to manage patient records, medical histories, and healthcare facilities operations.
- Education
 - Educational institutions use relational databases for student records, course management, and resource allocation

ER Diagram in DBMS

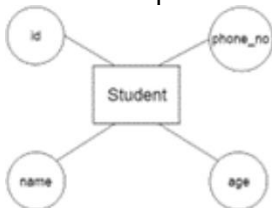
- The entity-relationship (ER) model simplifies data organization. It uses an entity-relationship diagram to visualize the database structure
- Components
 1. Entity – an entity can represent objects, classes, persons, or places and is depicted as rectangles in the ER diagram



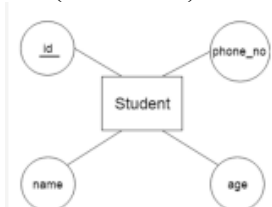
→ Weak Entity – depends on another entity. It doesn't contain any key attributes of its own. It is represented by a double rectangle



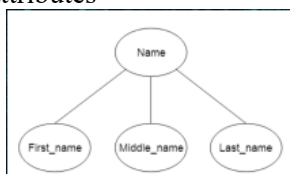
2. Attribute – describes entity properties. Eclipse is used to represent it



→ Key attributes – main characteristics (underlined)



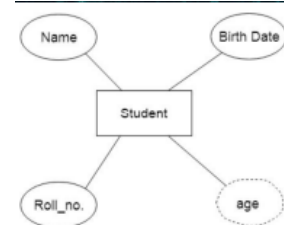
→ Composite attribute – made up of multiple attributes



→ Multivalued attribute – can have multiple values



→ Derived attribute – derived from other attributes (dashed ellipse). An attribute that can be derived from other attributes is known as a derived attribute



3. Relationship – a relationship is used to describe the relation between entities. Diamond or rhombus is used to represent the relationship



→ One-to-one – one instance associates with another



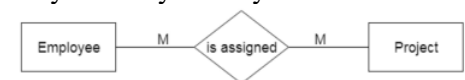
→ One-to-many – one on the left relates to many on the right



→ Many-to-one – many on the left relates to one on the right



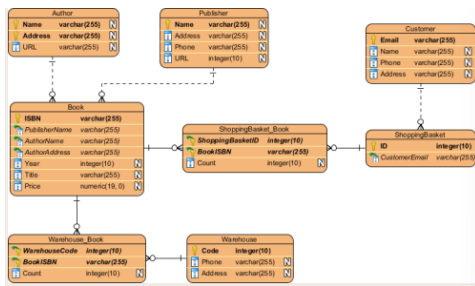
→ Many-to-many – many on both sides relate



GROUP 2 – Methodology-physical database design for relational databases

Physical database design

- The process of transforming a data model into the physical data structure of a particular database management system



History

- Physical database design for relational databases has evolved alongside the development of relational database management systems (RDBMS) since the 1970s

Concepts/Overview

- Table design
- Indexing
- Normalization
- Partitioning
- Datatypes
- Constraints
- Denormalization
- Performance optimization

Benefits of physical database design for relational databases

- Improved performance
- Data integrity
- Scalability
- Manageability

Advantages of physical database design for relational databases

- Improved performance
 - A well-designed physical database can significantly improve query performance and reduce response times
- Improved data integrity
 - By defining constraints, relationships, and data types at the physical level
- Data consistency
 - Data will be sent directly to the database
- Enhanced security
 - Physical database design can include security measures such as access controls, encryption, and data separation

Disadvantages of physical database design for relational databases

- Complexity
 - The design process can be complex and time consuming

- Over-optimization
 - Excessive indexing or denormalization can lead to performance problems
- Maintain burden
 - A highly optimized physical database design may require more effort and resources to maintain
- Expertise required
 - Skilled database designers are needed to make informed decisions
- Incompatibility
 - A highly optimized physical design may not work well with certain software applications or tools

Application in diagram and programs of physical database design for relational databases

- SQL Commands and relationships
 - SQL Commands
 - DDL (Data definition Language) – used to define database schema
 - DML (Data Manipulation Language) - used to manipulate data present in the database
 - DCL (Data Control Language) – deals with access rights and data control on the data present in the database
 - TCL (Transaction Control Language) – deals with the transactions happening in the database
 - DQL (Data Query Language) – is used to retrieved data from the database using SQL queries

RELATIONSHIPS IN SQL

- One-to-many relationship
- One-to-one relationship
- Many-to-many relationship
- Many-to-one relationship
- Self-referencing relationship
- hierarchical relationship

Methodology-monitoring and tuning the operational system

- are critical aspects of ensuring that the system operates efficiently, meets its performance goals, and remains stable under varying conditions
- monitoring and tuning are critical practices for keeping operational systems running smoothly and securely.

History

- In the early days of computing, monitoring and tuning were manual and reactive processes. However, with the advent of complex distributed systems and the rise of cloud computing, automated

monitoring and proactive tuning have become essential.

Concepts/Overview

- Monitoring
- Metrics and alerts
- Analysis
- Capacity planning
- Automation
- Security monitoring

Benefits of monitoring and tuning the operational system

- Improved performance
- Reliability
- Security

Advantages of monitoring and tuning the operational system

- Compliance assurance
 - For industries with strict regulatory requirements, monitoring can help ensure that systems are compliant
- Enhanced reliability
 - Continuous monitoring and periodic tuning reduce system downtimes and ensure higher availability
- Documentation and historical analysis
 - Monitoring systems typically store historical data, allowing for trend analysis.
- Optimal resource utilization
 - Through tuning, resources like CPU, memory, storage, and bandwidth are used efficiently

Disadvantages of physical database design for relational databases

- Overhead costs
 - Implementing and maintaining monitoring solutions can be expensive
- Potential for misconfiguration
 - Incorrectly tuning a system can lead to reduced performance, system instability, or outages
- Maintenance overhead
 - Monitoring tools themselves require regular maintenance, including software updates, patches, and addressing any issues they might have
- Learning curve
 - New tools often have a steep learning curve, requiring training for the operational team.

Technology sample and application of physical database design for relational databases

- SQL Performance Tools
 - SolarWinds Database Performance Analyzer

- SQL Power Tools
- SQL Sentry
- Redgate SQL Monitor
- MySQL Workbench

GROUP 3 – Microsoft Access Environment

Microsoft Access

- a well-known database management system produced by Microsoft and is part of the Microsoft 365 office suite.
- Microsoft Access combines Microsoft's relational Jet Database Engine with software development tools and a graphic user interface (GUI).

Features of MS Access

- User-Friendly Interface
- Customized templates
- Powerful Query Designer
- Integrated Reporting Tools
- Customizable Forms
- Macros for automation
- Customizable Code
- Collaboration Features
- Integration with other applications

To Use MS Access, follow these four steps

1. Database creation
2. Data input
3. Query
4. report

Benefits of MS Access

- Access offers an affordable solution for small to medium sized businesses and smaller teams in larger organizations
- It's easier to learn and use than a client-server database.
- It's easy to import and export to other Microsoft Office programs such as Excel.
- An Access database can link to external databases and query and report results.
- Users can maintain an Access database on a server or desktop computer (you don't have to use a cloud-based solution).

Advantages of MS Access

- Easy to use and learn
- Rapid development and prototyping
- Integration with Microsoft office
- Data security and permissions
- Customizable user interface

Disadvantages of MS Access

- Limited scalability and performance
- Lack of version control and collaboration features
- Relational database constraints
- Compatibility and portability issues
- Concurrent user limitations

GROUP 4 – MS Access database and Programs

Normalization

- The process of minimizing redundancy from a relation or set of relations.
- The process of splitting data to improve overall performance, integrity, and longevity

Relationship

- A relationship works by matching data in key columns usually columns with the same name in both the tables
- One-to-one relationships
 - row in table a can have no more than one matching row in table b
 - is created if both of related columns are primary keys or have unique constraints
 - might use to dividing tables, isolation, storing temporary data, storing information that applies to a subset of the main table
 - not common relationship
- one-to-many relationship
 - a row in table a can have many matching rows in table b. but row in table b can only have one matching row in table a
 - created if only one of the related columns is a primary key or has a unique constraint
 - common relationship
- many-to-many relationship
 - a row in table a can have many matching rows in table b
 - you create such a relationship by defining a third table called a junction table
 - the primary key of the junction table consists of the foreign keys from both table a and table b
 - denoted by I to infinity and infinity to I

Advantages of using Microsoft access

- user friendly interface
- sample databases and templates
- integration with Microsoft office suite

Disadvantages of using Microsoft access

- scalability limitations
- file-based storage
- not a full-features RDBMS
- Limited cross-platform compatibility

- Steady decrease of popularity

Limitations of MS Access

- Only support 255 concurrent users
- Maximum of 2gb data in a single database file
- Maximum of 255 fields and reports per database
- Maximum of 747 forms per database

GROUP 5 – Security and administration

Data Breaches

- The importance of security in database research has greatly increased over the years as most of the critical functionality of business and military enterprises has become digitized.
- The database is an integral part of any information system, and it often holds sensitive data.

History

- Pre-1980s
 - During this period, database management systems weren't widespread
 - Attackers were mostly sophisticated users who pursued attacks as a challenge
 - Database systems were mostly static and offline. Data wasn't stored across shared resources or repositories
 - Earliest viruses – errors in the algorithm that can replicate itself. Viruses were often to either communicate a message, a test or to show proof of someone's programming abilities
 - Creeper - Test to try self-replicating programs. Hops on multiple computers and deletes itself on previous hosts
 - Rabbit - Replicates itself to reduce performance and eventually crash the computer
 - Brain - Made to counter illegal software copies. Infects floppy disks.
 - ANIMAL - First trojan. A 20-question game with another program called PERVADE, which secretly spreads ANIMAL to all of the user's directories.
- 1980s
 - Commercial applications using database systems started spreading
 - The attackers were motivated more out of the competition.
 - Focus on security policies and mechanisms lead to improvement in areas like access control.
 - MAC VS DAC
 - Mandatory access control – requires administrators themselves to manually

manage user access rights (Read, write, modify, delete)

→ Discretionary Access Control – only requires administrators to grant access rights to a user and that same user can provide the same rights to others at their discretion

- 1990s
 - The development of the Windows browser revolutionized the web. It highlighted its potential for not only information sharing but commerce, intensifying the demand for digital security.
 - Earlier in the period, attackers were often for publicity, as a path to being a security consultant.
 - More users and applications were utilizing database servers.
 - Role-based Access
 - During this period, a new access control model was developed, Role-Based Access Control (RBAC)
 - RBAC is a type of discretionary access control where authorization administration is simplified around the notion of a role
- 2000s
 - Personal information about individuals became readily available through public records and via social Web 2.0 phenomena.
 - This period saw the emergence of information security attacks as a large multi-billion business.
 - Attackers have also attempted to minimize any impact on the compromised system to limit the possibility of detection.
 - Encryption became more common for data not only in transit but at rest.
 - User authentication methods have also been upgraded due to the threat posed by exploitation of the web applications up fronting critical data systems.

Concepts/Overview

- Confidentiality
 - Database security should make data inaccessible to unauthorized users
- Integrity
 - Database security should ensure that a system and its data has not suffered unauthorized modification
- Availability
 - Database security guarantees that systems, applications and data are available to users when they need them

Benefits of database security

- Databases can be safeguarded from security breaches and malicious attacks such as firewall intrusion, malware spread, and ransomware.
- Stop malware, contagious files, and infections within the database.
- Protection for server systems from substantial harm that might result in failure of data processing/retrieval.

Advantages of database security

- Database protection
- Trust and reputation
- Prevention of data loss
- Compliance

Disadvantages of database security

- Cost
- Security gaps
- User experience
- complexity

Advantages of database administration

- Data security
- Data integrity
- Back up and recovery
- Security enforcement
- Data migration
- Cost management

Disadvantages of database administration

- Human error
- Complexity of scale
- Cost and licensing
- Dependency on administrators

Technology sample and application

- Firewalls
- Authentication and authorization
- Encryption
- Data masking
- Hardware-based security
- Data resilience
- Data erasure

Application in diagram and programs

- Windows security firewall
- MySQL security

GROUP 6 – Professional, legal, and ethical issues in data management

Legislation in the Philippines related to data management

- Data Privacy Act of 2012 (Rep Act 10173) - Its primary goal is to ensure the privacy and security of individuals' personal information and to establish accountability for organizations that handle such data.
- Cybercrime Prevention Act of 2012 (Rep Act 10175) - focuses on the pre-emption, prevention, and prosecution of cybercrimes such as offenses against the privacy, confidentiality, integrity, and availability of computer data and systems, computer-related offenses, and content-related offenses.

Intellectual Property

- Intellectual Property Code of the Philippines (Rep Act 8293)
 - to protect and secure the exclusive rights of scientists, inventors, artists and other gifted citizens to their intellectual property and creations, particularly when beneficial to the people, for such periods as provided in this Act.
- Copyright
 - Provides an exclusive (legal) right for a set period of time to reproduce and distribute a literary, musical, audiovisual, or other “work” of authorship
- Patent
 - Provides an exclusive (legal) right for a set period of time to make, use, sell, or import an invention.
 - Patents are granted by a government when an individual or organization can demonstrate:
 - The invention is new
 - The invention is in some way useful
 - The invention involves an inventive step
- Trademark – Provides an exclusive (legal) right to use a word, symbol, image, sound, or some other distinctive (in connection with certain goods or services) element that identifies the source of origin

5 P's of Ethical data handling

- Provenance
 - Where does the data come from?
 - Was it legally acquired?
 - Was appropriate consent obtained?
- Purpose
 - Is the data being repurposed?
 - Would the original source of the data agree to its reuse for a purpose different from the one originally announced or implied?

- Protection
 - How is the data being protected?
 - How long will it be available for the project?
 - Who is responsible for destroying it?
- Privacy
 - Who will have access to data that can be used to identify a person?
 - How will individual observations in the data set be anonymized?
 - Who will have access to anonymized data?
- Preparation
 - How was the data cleaned?
 - Are data sets being combined in a way that preserves anonymity?
 - How is the accuracy of the data being verified and, if necessary, improved?
 - How are missing data and variables being managed?

Advantage

- Data accuracy and quality
 - Addressing professional, legal, and ethical issues promotes data accuracy and quality. Reliable data is fundamental for informed decision making and business success.
- Compliance
 - Adherence to legal and ethical standards mitigates legal risks, potential fines, and safeguards an organization's reputation. It fosters trust among customers and stakeholders.
- Data security
 - Proper data management practices enhance data security, protecting sensitive information from breaches and unauthorized access.

Disadvantage

- Ethical dilemmas
 - Addressing professional, legal, and ethical issues promotes data accuracy and quality. Reliable data is fundamental for informed decision-making and business success.
- Data access restrictions
 - Strict adherence to guidelines may limit data access, potentially impeding innovation and research efforts.
- Complexity
 - The ever-evolving legal and ethical landscape surrounding data management presents complexity. Staying current with regulations and ethical considerations is a continuous challenge.