**DB Lab Report - Week 05**

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**Introduction**

This report serves as a comprehensive summary of the tasks pertaining to MongoDB that were accomplished during the Week 05 lab session. The tasks are neatly categorized into basic, medium, and advanced levels. These tasks encompass a wide range of MongoDB operations, including but not limited to document relationships, the flexibility of schemas, data queries, and MongoDB-specific operations that are equivalent to SQL commands. This allows for a detailed understanding of MongoDB's capabilities and functionality within the context of the lab.

**Week 01**

**Key Learning Points**

Understand the definitions of "data" and "metadata".

Master the knowledge related to databases and Database Management Systems (DBMS).

Clarify the concepts of data protection and data privacy.

**Lab Activity Objective**

Create a document to record the research results of the database, organized with headings for each subject area for easy final submission.

**Lab Task Description**

**Basic Tasks**

Research and record: the definitions of data and information and the differences between them; the definition and purpose of metadata.

**Medium Tasks**

Research data protection - related content, including the definition of data privacy, key elements (practices, rules, guidelines, tools) that organizations use to maintain data privacy compliance, and the importance and differences of data privacy for individuals and businesses.

**Week 02**

**Key Learning Points**

Key concepts of the relational data model and database modeling.

Entity Relationship modeling in Chen's/Crow’s feet or UML notation.

**Lab Activity Objective**

Create content in the document that demonstrates the database modeling process.

**Lab Task Description**

**Basic Tasks**

Construct a hierarchy of abstraction for the given sets of terms (such as terms related to humans and software systems).

Define terms in the Entity Relationship model: entity, entity type, entity instance, optionality, mandatory, cardinality.

Define the data model and explain three important reasons for data modeling.

Develop an ER diagram representing the relationships between entities in a company (such as branch, department, employee, and project), including describing the scenario in plain English and adding cardinality and participation constraints.

For a hospital scenario (doctors, patients, consultations, tests, etc.), identify the entities, attributes, and draw an ER diagram.

**Medium Tasks**

Develop an ER diagram based on a surgery appointment scenario (patients, doctors, appointments, diagnoses, medications, etc.) and assign attributes appropriately.

Draw an ER diagram according to a banking system scenario (bank, account, customer, transaction, loan, etc.).

**Advanced Tasks**

Develop an ER model in Chen’s notation based on the requirements of a customer order system (customer, order, order item, product, etc.).

Develop an ER diagram in Chen’s notation for the extended customer order system (involving product categories, suppliers, etc.).

**Week 03**

**Key Learning Points**

Definitions of normalization - related terms (normalization, UNF, 1NF, 2NF, 3NF).

Reinforce the application of ERD in data modeling.

**Lab Activity Objective**

Create content in the document that demonstrates the database normalization process.

**Lab Task Description**

**Basic Tasks**

Define terms such as candidate key, composite key, foreign key, and functional dependency.

Identify and explain the three integrity rules/constraints in the relational model.

For the given relational tables (such as film, director, supplier, song tables), find any violations of the relational integrity rules.

**Medium Tasks**

Analyze the possible anomalies in the table of projects and employees (ProjectEmployee) during insertion, deletion, and modification operations, and derive 1NF, 2NF, and 3NF.

For the Excel table of bakery orders, identify anomalies, derive 1NF, 2NF, and 3NF, including defining keys (primary and foreign) for each table, the relationships between tables, and generating an ER diagram.

For the given hospital - related tables (patient, admission information, doctor, ward, etc.), determine the schema, relationships between tables, and foreign key links, and generate an ER diagram.

**Advanced Tasks**

For the two given tables (order and customer information table, student and course information table), identify functional dependencies and derive 1NF, 2NF, and 3NF tables.

For the report table of a car rental company, complete the entire process of database development, including generating logical and physical models, an ER diagram, identifying functional dependencies, populating with test data, and completing normalization.

**Week 04**

**Key Learning Points**

DDL SQL commands.

DML SQL commands.

**Lab Activity Objective**

Create content in the document that demonstrates SQL programming skills.

**Lab Task Description**

**Basic Tasks**

Create a simple HR system for a university. Use SQL DDL to create a new database in the selected DBMS (such as PostgreSQL with pgAdmin 4).

Create the Staff and Faculty tables according to the database schema of the system, add constraints to ensure that the facultyName is not null, create primary and foreign keys, and populate the tables with the given data. Consider the order of data population and the reasons.

Write SQL commands to query all data in the Staff table, list all columns in the Staff table in reverse alphabetical order by name and change the output headings, list employees born in the 1980s, find the facultyName where the number of staff is less than 75, update the faculty of Alison Green, and delete the record of Kieran West.

**Medium Tasks**

Create a database for a simulated friendly bank. Use SQL DDL to create a new database.

For the tables related to the friendly bank database, write SQL statements to complete various query operations, such as calculating the percentage increase of a value, listing employee names, listing product types, finding specific employees, filtering employees according to conditions, handling customer information updates (name, account balance, etc.), deleting transaction records, filtering accounts based on balance, handling queries related to customer birth years, handling queries related to employee positions and start dates, handling operations related to account IDs and balances, handling city information queries, handling customer name changes, handling changes to employee departure records, filtering customers by product code and sorting.

**Week 05**

**Key Learning Points**

SQL commands.

SQL clauses and functions.

**Lab Activity Objective**

Create content in the document that demonstrates SQL programming skills.

**Lab Task Description**

**Basic Tasks**

Based on the friendly bank database created last week, write SQL queries: count the total number of transactions in the bank, query the number of 'CHK' type accounts in the bank, list job titles and the number of employees in each position, list customers and the number of accounts they have, query the total available balance of a specific customer (James Hadley), list all customers and their total available balance, list account product types and the average available balance for each type.

**Medium Tasks**

Find the total available balance in customers’ accounts where the opening branch was the Woburn Branch, list account product types and the highest available balance for each, query the minimum available balance, list the total available balance per customer (rounded down), output employee details in specific formats (name and position).

**Advanced Tasks**

Replace a word in a given text and return the result, standardize the format of FED\_ID in the CUSTOMER table, query the year portion of the account transaction date and the number of transactions in each year, update the job titles in the EMPLOYEE table to uppercase, count the number of employees whose job titles contain 'Teller' and the number of other employees, list customers whose accumulated available balance is less than £5000, report the total number of staff assigned to each branch, and using only the ACCOUNTS table, count the number of accounts with specific product codes (CHK and SAV) and display the corresponding text.

**Summary**

Through these five weeks of database course labs, students gradually and in - depth learn database - related knowledge, from fundamental concepts to database design, normalization, and then to SQL programming practice, covering multiple key aspects of database development. The aim is to cultivate students' comprehensive database application capabilities and lay a solid foundation for further in - depth learning or actual database project development. Each experimental session focuses on the combination of theory and practice, driving students to master the core skills in the database field through practical tasks.