Database Systems - Exam Revision Summary

Chapter 1: Introduction to Database Systems

- DBMS = software to store and manage large amounts of data efficiently and securely.
- Applications: banking, social media, retail, universities, airlines, etc.
- Levels of abstraction: Physical (storage), Logical (structure), View (user access).
- Database Languages: DDL (CREATE, ALTER, DROP), DML (INSERT, DELETE, UPDATE, SELECT).
- Data Models: Relational, E-R, Object-Oriented, Semi-structured (XML/JSON).
- Architecture: Centralized, Client-Server, Parallel, Distributed.
- Users: Naive users, Application Programmers, Sophisticated Users, DBAs.
- DBA Tasks: Schema definition, access control, backups, integrity constraints, etc.

Chapter 2: Relational Model and Algebra

- Data Model: Tables = relations, Rows = tuples, Columns = attributes.
- Keys: Primary key (unique ID), Candidate key, Foreign key (references other tables).
- Relational Algebra Operators:
  * SELECT (sigma): filters rows, e.g. SELECT dept_name = 'Physics' (instructor)
  * PROJECT (pi): selects columns, e.g. PROJECT name, salary (instructor)
  * UNION, INTERSECT, DIFFERENCE: set operations on compatible tables.
  * CARTESIAN PRODUCT, JOIN: combine rows from two tables.
  * RENAME, ASSIGNMENT: used for clarity and intermediate steps.
- Operators can be combined for complex queries.

Chapter 3: Introduction to SQL

- SQL Language:
  * DDL: CREATE, DROP, ALTER tables and constraints.
  * DML: SELECT, INSERT, DELETE, UPDATE data.

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- Basic Queries: SELECT-FROM-WHERE, DISTINCT, ORDER BY, LIKE, BETWEEN, IN.

- Joins: INNER JOIN, NATURAL JOIN, USING. Cartesian product + filtering.

- Aggregate Functions: COUNT, SUM, AVG, MAX, MIN with GROUP BY and HAVING.

- Subqueries: IN, EXISTS, ANY, ALL, scalar subqueries in SELECT, WHERE, FROM.

- Set Operations: UNION, INTERSECT, EXCEPT.

- Modifications:
  * INSERT (with or without subqueries)
  * DELETE (with WHERE or IN subquery)
  * UPDATE (with WHERE or CASE for conditions)