

DATA BASES

DEFINITION AND TYPOLOGY OF DATABASES (DB)

The concepts of data, data structuring, database (DB), and database management system (DBMS). DBMS functions. Classification of DBMS and databases.

METHODOLOGICAL FOUNDATIONS OF THE DATABASE

Logical organization of databases. The concept of a data model. Types of data models. The relationship between the concepts of "data" and "metadata". Hierarchical databases: Principles of construction, data models, and areas of application. Advantages and disadvantages of hierarchical databases. Network databases: Principles of construction, data models, and areas of application. Advantages and disadvantages of network databases. Object-oriented databases: Principles of construction, data models of the fields of application. Advantages and disadvantages of object-oriented databases. Relational databases: Principles of construction, data model, and areas of application. Advantages and disadvantages. Centralized and distributed databases. Client-server and file-server architectures.

FUNDAMENTALS OF RELATIONAL DATABASE THEORY

Theoretical foundations of relational databases. Relational algebra and relational calculus. The basic operations of relational algebra in data processing. The basic concepts of relational models: relation, tuple, attribute, domain, primary and foreign keys. Linking tables. The foreign key. Referential integrity (link integrity).

NORMALIZATION THEORY

The concept of functional dependence of attributes. Full and partial functional dependencies. Transitive dependence. The concept of 1, 2, 3 normal forms. The Boyce-Codd normal form. 4 and 5 are normal forms. The normalization algorithm.

DATABASE INTEGRITY

Concepts of database integrity. Classification of integrity constraints. Ways to set integrity constraints in modern DBMS: procedural and declarative ways to set integrity constraints. Integrity constraints in a relational database. Referential integrity and ways to ensure it.

INFOLOGICAL (CONCEPTUAL) MODELING OF THE SUBJECT AREA

Stages of database design. Purpose and features of the stages of conceptual, logical, and physical database design. Two- and three-level approaches to database design. Methodology of info logical (conceptual) database design. Analysis and decomposition of the subject area. Modeling of local representations. The entity-relationship model. Elements of the ER diagram. Entities, attributes, and relationships. Connection properties. The unique identifier of the entity (primary key) and the requirements for it. Attribute domains. The concept of database design notation. Barker Notation, IDEF1X, Information Engineering (IE). Building a set of conceptual models of local representations of the subject area. Synthesis of the conceptual scheme of the subject area. Checking the conceptual scheme for completeness and correctness.

DATALOGICAL DESIGN

The technology of datalogical database design is the mapping of the conceptual database model to the selected data model. The differences between the datalogical database model and the conceptual domain model. An algorithm for the transition from an info logical model to a relational database structure.

PHYSICAL DATABASE DESIGN

The main objects of a relational database. Tables, views, and users. Stored procedures, functions, triggers. Data types and domains. Indexes: creation and assignment, features of working with indexed fields. Description of integrity constraints in SQL.

RELATIONAL DATABASE MANAGEMENT

Data definition languages and data manipulation languages. SQL as a declarative relational database management language. General characteristics of SQL. SQL standards. The structure of the SQL language (DDL, DML, DCL). Building databases using SQL commands. DDL operators. The syntax of the basic DDL commands. Data types and domains. Description of the relationship schemes. Description of integrity constraints on SQL. Creating and using views. DML operators. Data entry, deletion, and correction using SQL tools. The syntax of the basic DML commands. INSERT, UPDATE, and DELETE commands. Using SQL to fetch data from tables. The SELECT command. Implementation of relational algebra operations in SQL. Determining the composition of the fields displayed in the request. Calculated fields. Setting the selection conditions. Predicates. Using Boolean operators to create complex predicates. Simple and multi-tabular queries. Combinations of tables in a query. Nested queries. Data grouping capabilities. Using aggregate functions. Query optimization. Procedural extensions of the SQL language. Using procedures and functions. The concept of a cursor. Creating and using cursors. The concept of a trigger. Trigger execution conditions (trigger events). The body of a trigger. Using triggers to verify the correctness of the entered data and to fulfill complex data integrity constraints. Using triggers to update data in adjacent tables.

ORGANIZATION OF ACCESS TO A DATABASE

Local databases. Database servers. The client/server architecture. Distributed databases. The general model of a distributed database system. Two and three-level client-server architecture. Processing distributed data and queries.

TRANSACTION MODELS

Features of working with databases in multi-user mode. Online transaction processing technology (OLTP technology). Properties of ACID transactions. Isolation levels in ANSI SQL. The purpose and use of the transaction log. Rollback and restore. Parallel execution of transactions. Grabs and locks.

DATABASE SECURITY. DATABASE ACCESS CONTROL

Ways to ensure data security in modern DBMS. Transaction logs. Backup. User management. Creating and deleting users. The GRANT and REVOKE commands. Types of privileges. Assigning and revoking privileges. Privilege groups, user groups. Using views to filter privileges. Data backup. Recovery procedures.

3.13 DBMS ADMINISTRATION

Administrators and end users: rights and functions.

ENGLISH REFERENCES

1. C. J. Date. Introduction to Database Systems / Pearson; 8th edition (July 22, 2003), 1040 p. <https://www.amazon.com/Introduction-Database-Systems-8th/dp/0321197844#customerReviews>
2. SQL Cookbook. Query Solutions and Techniques for All SQL Users, SECOND EDITION, Anthony Molinaro and Robert de Graaf // O'Reilly Media, Incorporated, 2020 <https://www.amazon.com/SQL-Cookbook-Query-Solutions-Techniques/dp/1492077445>

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3. Шустова Л.И. Базы данных: учебник / Л.И. Шустова, О.В. Тараканов. М.: ИНФРАМ, 2016. – 304 с. + Доп. материалы [Электронный ресурс; Режим доступа <http://www.znaniium.com>]. – (Высшее образование: Бакалавриат). – www.dx.doi.org/10.12737/11549.