Syllabus
Course Program

Database Design and Development

Specialty
121 – Software Engineering

Institute
Institute of Computer Science and Information Technology

Educational program
Software Engineering

Department
Software Engineering and Management Intelligent Technologies (321)

Level of education
Bachelor's level

Course type
Special (professional), Mandatory

Semester
4

Language of instruction
English, Ukrainian

Lecturers and course developers

Andrii Kopp

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Doctor of Philosophy (Ph.D.), Associate Professor, Associate Professor of Software Engineering and Management Intelligent Technologies Department

Google Scholar: https://scholar.google.com/citations?user=B8fggLEAAAAJ
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Scopus: https://www2.scopus.com/authid/detail.uri?authorId=57202887287
Web of Science: https://www.webofscience.com/wos/author/record/T-4283-2018).
More about the lecturer on the department's website

Sergii Golovashych

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Candidate of Technical Sciences. Experience in scientific and pedagogical work: 9 years. Number of scientific and educational publications is more than 50, among them: monographs – 1, works in Scopus & Web of Science – 3. (https://scholar.google.com.ua/citations?user=p-ri7cIAAAAJ; https://orcid.org/0009-0004-2468-1952; https://www.researchgate.net/profile/Sergii-Golovashych; https://www.webofscience.com/wos/author/record/HOC-1751-2023).
Assistant Professor in disciplines: “Introduction to Neural Networks”, “Introduction to Soft Computing”, “Artificial Intelligence”, “Formal Methods of Software Verification”.
Scientific directions: Cybersecurity, Cryptography, Cryptoanalysis, Artificial Intelligence, Software Design & Development.
More about the lecturer on the department's website

General information

Summary

The objective of the discipline is to acquire the knowledge and skills necessary for the design and development of relational databases using client-server database management systems (DBMS) on the example of MySQL, implementation of business logic tools in a database based on stored procedures, functions and triggers, ensuring data integrity, maintaining data consistency and security based on transaction mechanisms and user rights, as well as building client-server applications for working with databases using PHP (mysqli, PDO), Java (JDBC), and Python (PyMySQL, MySQL Connector) as examples.

Course objectives and goals

Developing students' theoretical and practical knowledge necessary for the design and development of databases (DB) in solving problems related to the development, maintenance, and quality assurance of software.

Format of classes

Lectures, laboratory classes, self-study, consultations. Final control in the form of an exam.

Competencies

К01. Ability to think abstractly, analyze and synthesize.
К02. Ability to apply knowledge in practical situations.
К05. Ability to learn and master modern knowledge.
К06. Ability to search, process and analyze information from various sources.
К13. Ability to identify, classify and formulate software requirements.
К14. Ability to participate in software design, including modeling (formal description) of its structure, behavior and processes of functioning.
К15. Ability to develop architectures, modules and components of software systems.
К19. Knowledge of data information models, ability to create software for storing, extracting and processing data.
К22. Ability to accumulate, process and systematize professional knowledge of software development and maintenance and recognize the importance of lifelong learning.
К25. Ability to reasonably choose and master the tools for software development and maintenance.
К26. Ability to think algorithmically and logically.

Learning outcomes

PLO01. Analyze, purposefully search and select information and reference resources and knowledge necessary for solving professional problems, taking into account modern achievements of science and technology.
PLO07. To know and apply in practice the fundamental concepts, paradigms and basic principles of functioning of language, tools and computing tools of software engineering.
PLO10. Conduct a pre-project survey of the subject area, system analysis of the design object.
PLO12. Apply effective approaches to software design in practice.
PLO13. Know and apply methods of developing algorithms, designing software and data structures and knowledge.
PLO14. Apply in practice software tools for domain analysis, design, testing, visualization, measurement and documentation of software.
PLO18. To know and be able to apply information technologies for data processing, storage and transmission.
PLO21. To know, analyze, select, and competently apply means of ensuring information security (including cybersecurity) and data integrity in accordance with the applied tasks and software systems being created.
PLO23. Be able to document and present the results of software development.

Student workload

The total volume of the course is 120 hours (4 ECTS credits): lectures – 32 hours, laboratory classes – 32 hours, self-study – 56 hours.

Course prerequisites

Data Models and Structures
Object-Oriented Programming

Features of the course, teaching and learning methods, and technologies

Teaching and learning methods:
interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback, problem-based learning.
Forms of assessment:
written individual assignments for laboratory work (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS).

Program of the course

Topics of the lectures

Topic 1: Client-server architecture of DBMS
File server. Traditional two-tier client-server. 3-level client-server. N-tier client-server. Middleware. Transaction processing monitors. Web services and service-oriented architectures (SOA). Distributed DBMSs. Cloud computing and cloud databases. DBMS components. Components of the database manager (DM).
Topic 2. Designing a database
Data flow diagrams (DFD): types and elements, modeling rules. Business rules: types, best practices. Converting business rules into data model components. Standard database concepts. Entity-relationship model: attributes, entity-relationship model, relationships, associative entities. Development of an ER diagram.
Topic 3. Creating a database using SQL language
Creating and deleting a database in MySQL. Creating, modifying and deleting tables in MySQL. Column parameters NOT NULL, AUTO INCREMENT and DEFAULT. Creating primary and foreign keys in MySQL. CHECK conditions for checking the values of table columns. UNIQUE and INDEX indexes in MySQL. DDL tools in other DBMS.
Topic 4. Implementation of business logic in the database
Creating, deleting, modifying and working with views in MySQL. Creating, deleting, modifying and working with stored procedures in MySQL. Parameters of stored procedures. Variables in MySQL. Creating, deleting, modifying and working with triggers in MySQL. OLD and NEW modifiers. Creating, deleting, modifying and working with functions in MySQL. Built-in functions. Business logic tools in other DBMSs.
Topic 5: Integrity, transactions, users
Ensuring data integrity based on foreign keys and integrity control mechanisms in MySQL. Features of working with transactions in MySQL. Viewing, creating and deleting users in MySQL. Granting and revoking user privileges in MySQL. Changing user login and password in MySQL, blocking and unblocking accounts. ACID requirements. Dirty read, non-repeatable read, phantom read. Levels of transaction isolation in MySQL.
Topic 6. Building applications for working with databases
PHP mysqli library for working with MySQL databases. PHP Data Objects (PDO) framework for working with relational databases. Java JDBC library for working with relational databases. Python libraries PyMySQL and MySQL Connector for working with MySQL.

Topics of the workshops

Workshops are not provided within the discipline.

Topics of the laboratory classes

Topic 1: Generation of business rules of the subject area, translation of business rules into the database schema
Topic 2. Creating a database in MySQL using DDL statements, filling tables with records
Topic 3. Creating views in the database
Topic 4. Creating stored functions, procedures and triggers in the database
Topic 5. Working with the transaction mechanism in the database
Topic 6. Setting up user privileges and mechanisms to ensure database integrity

Self-study

The curriculum includes the completion of coursework (CW). At the beginning of the semester, students choose the topics of the course work from the list or propose their own topics and agree them with the teacher. The CW is completed during the semester and is defended during the test week or examination session.
Students are recommended with additional materials (videos, articles) for self-study and processing.

Course materials and recommended reading

Key literature

1. V. M. Grippa, S. Kuzmichev, Learning MySQL, O'Reilly Media, 2021, 632 p.
2. J. Duckett, PHP & MySQL: Server-side Web Development, Wiley, 2022, 672 p.
3. S. bin Uzayr, Mastering MySQL for Web: A Beginner's Guide, CRC Press, 2022, 308 p.
4. V. R. Bhedi, JDBC A Bridge, Nachiket Prakashan, 2021, 138 p.
5. M. Lathkar, Python Data Persistence: With SQL and NoSQL Databases, BPB Publications, 2019, 316 p.

Additional literature

1. G. S. W. Lam et al., Business Rules: Management and Execution, Future Strategies Inc., 2020, 187 p.
2. S. Smirnova, A. Tezuysal, MySQL Cookbook, O'Reilly Media, 2022, 974 p.
3. L. Friedrichsen et al. Concepts of Database Management, Cengage Learning, 2020, 432 p.
4. R. Hogan, A Practical Guide to Database Design, CRC Press, 2018, 430 p.
5. S. Botros, J. Tinley, High Performance MySQL, O'Reilly Media, 2021, 388 p.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

100% of the final grade consists of the results of the assessment in the form of an exam (40%) and current assessment (60%):
- 6 laboratory works (3% each);
- 2 tests (6% each);
- coursework (30%).

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by 11.04.2023

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