Java-based web applications

Lecturers and course developers

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Web of Science: https://www.webofscience.com/wos/author/record/E-8279-2019).
More about the lecturer on the department's website

General information

Summary

Teaching the discipline ensures the development of the system of knowledge and practical skills necessary for a modern Java developer to work in projects to create web applications of various degrees of complexity.

Course objectives and goals

Teaching the discipline aims to provide a system of knowledge necessary to create, debug and deploy web applications in Java, including Servlets, Java Server Pages, Java Standard Tag Library, Hibernate, Spring, authentication, session management, working with cookies, and also about the organization of sending e-mail through the Google mail service; practicing the skills of creating and deploying web projects for working with client-server databases.

Format of classes

Lectures, laboratory classes, consultations, self-study. Final control in the form of a credit.

Competencies

GC 2. Ability to apply knowledge in practical situations.
PC15. Ability to develop architectures, modules and components of software systems.
PC19. Knowledge of information data models, the ability to create software for data storage, retrieval and processing.
PC20. Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering problems.
PC26. Ability to algorithmic and logical thinking.

GC1. Ability to abstract thinking, analysis and synthesis.
GC2. Ability to apply knowledge in practical situations.
GC6. Ability to learn and master modern knowledge.
GC7. Ability to search, process and analyze information from various sources.
GC8. Ability to generate new ideas (creativity).
PC3. Ability to think logically, build logical conclusions, use formal languages and models of algorithmic calculations, design, develop and analyze algorithms, evaluate their efficiency and complexity, solvability and insolvability of algorithmic problems for adequate modelling of subject areas and creation of software and information systems.
PC8. Ability to design and develop software using different programming paradigms: generalized, object-oriented, functional, logical, with appropriate models, methods and algorithms of calculations, data structures and management mechanisms.
PC10. Ability to apply methodologies, technologies, and tools to manage the life cycle processes of information and software systems, information technology products and services according to customer requirements.
PC12. Ability to ensure the organization of computational processes in information systems of various purposes, taking into account the architecture, configuration, performance indicators of operating systems and system software.

Learning outcomes

PLO13. Know and apply methods of algorithm development, software design and data and knowledge structures.
PLO17. Be able to apply methods of component software development.
PLO18. Know and be able to apply information technology processing, storage and transmission of data.
PLO23. Be able to document and present the results of software development.

PLO9. Develop software models of subject areas, choose a programming paradigm from the standpoint of convenience and quality of its application to implement methods and algorithms that solve problems in the computer science field.
PLO10. Use tools for developing client-server applications, design conceptual, logical, and physical models of databases, develop and optimize database queries, create distributed databases, repositories and showcases of databases, and knowledge bases, including those based on cloud services, using web programming languages.

Student workload

The total volume of the course is 150 hours (5 ECTS credits): lectures - 86 hours, laboratory classes - 32 hours, self-study - 88 hours.

Course prerequisites

Fundamentals of programming
Theory of algorithms

Java-based web applications

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Object-oriented programming
Database design and development
Fundamentals of web development
Java basic programming course
Java advanced programming course

122 - Computer Science and Intelligent Systems
Algorithmization and programming
Algorithms and data structures
Databases
Object-oriented programming
Java basic programming course
Java advanced programming course
Fundamentals of web development

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

Teaching and learning methods
The main method of teaching during lectures is the explanatory-illustrative method. To intensify cognitive activity, students' speeches and organization of discussions on certain issues of lectures are provided.
The laboratory course implements a project-based approach to learning. This involves the creation from class to class by a student of a Java web application on an individual topic, which implements the manipulation of data stored in a client-server database using web pages. With the completion of another laboratory work, the level of complexity of the project increases.

Forms of assessment
Assimilation of the theory is tested in the form of a rapid survey during lectures (CAS), a survey or automated testing at the beginning of laboratory work (CAS).
Control of mastering the material for self-study involves the preparation and defense of abstract on individual topics (CAS).
The level of practical skills is tested in laboratory work, which is mainly performed on an individual basis (CAS).
Final / semester control is carried out in the form of a test, which involves the development of a web application for an individual task in a limited time (FAS)

Program of the course

Topics of the lectures

Topic 1
Basics of Java web application development. Purpose and current state of development of Java EE technologies. A typical scheme for creating and deploying web applications in Java that implement data manipulation in databases, a stack of technologies for their creation. Servlets and Java Servlet Pages (JPA). Purpose and life cycle of servlets and JPA. Principles of using servlets. Interfaces for storing request and response parameters. Servlet context. Passing parameters to servlets. Setting up servlet addressing. Redirection and servlet redirection. Purpose, structure, syntax and life cycle of JSP. Organization of interaction of servlets and JSP. Features of building and debugging projects with JSP. Expression Language (EL). Features of obtaining data in EL structures. Purpose and characteristics of JSTL tag groups.

Topic 2
Development of web applications for working with databases using the Hibernate library. Principles of application of JPA and HQL. A typical project structure for working with relational databases. Schemes of interaction of Java web application components when implementing data manipulation. Peculiarities of testing web applications interacting with databases.

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Spring Framework as an environment for effective development of web applications based on Java EE. The structure of Spring applications, basic elements, features of their creation. Thymeleaf template maker. Implementation of data manipulation in tables linked by many-to-many relationships. Features of deploying Spring applications.

Topic 4

Implementation of authentication and authorization by means of Spring Security. Concept of ServletFilter, typical situations of their application. Java components for working with sessions and cookies.

Topic 5

Java Mail Service as a component of Java EE. Basic concepts for organizing email sending. Java implementation of sending mail and files via Google.

Topics of the workshops

Workshops are not provided within the discipline.

Topics of the laboratory classes

Topic 1. Exploring the Java technology stack for creating and deploying web applications using servlets and JSP.
Topic 2. Study of the principles of using Hibernate, JPA and HQL to access data in web applications.
Topic 3. Study of the principles of creating complex projects using Spring Boot, Spring Data, Thymleaf.
Topic 4. Study of the principles of using Spring Security to implement authentication, authorization and session support.
Topic 5. Study of Java components for organizing email distribution.

Self-study

Learn the features of installing software components according to the selected stack of web application development technologies in Java. Development of a servlet life cycle diagram. Development of a diagram of the web application development process. Development of JSP life cycle diagram. Development of the diagram of interaction of servlets and JSP. Typical examples of JSTL applications for various purposes. Advantages of using JSTL. The structure of web application projects according to the stack of development technologies. Analysis of the features of personalization and data protection in well-known typical web applications. Options for organizing e-mail.

Course materials and recommended reading

Key literature

1. Java EE 8 specifications. [Electronic resource]. Access mode: https://www.oracle.com/java/technologies/java-ee-8.html
2. Sarika Agarwal, Vivek Gupta. (2022). Java for Web Development: Create Full-Stack Java Applications with Servlets, JSP Pages, MVC Pattern and Database Connectivity. BPB Publications, 235 p.
3. Sahin Kevin. (2020). The Java Web Scraping Handbook. Scraping Bee, 115 p.
4. Cătălin Tudose. (2023) Java Persistence with Spring Data and Hibernate, Manning, 616 p.
5. Joseph B. Ottinger, Jeff Linwood and Dave Minter. (2022) Beginning Hibernate 6 Java Persistence from Beginner to Pro, 5th Edition, Apress, 480 p.

Additional literature

1. Jakarta E. E. Guidlins on Java EE (metanit.com). [Electronic resource]. Access mode: https://metanit.com/java/javaee/
2. Jsp Tutorials. Java Servlet. [Electronic resource]. Access mode: https://o7planning.org/10979/servlet-jsp .
3. https://www.baeldung.com/
4. https://www.javaguides.net/

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5. https://hibernate.org/orm/
6. https://spring.io/guides
7. https://www.thymeleaf.org/
8. https://howtodoinjava.com/

Assessment and grading

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

The grade for the discipline consists of the points obtained during the course of study during the semester and the points awarded for the assessment. During the semester, a student can receive up to 80 points for:
- assimilation of theory (topics of independent work) (up to 20 points);
- performance of 5 laboratory works (up to 60 points).
A student can receive up to 20 points for completing assignments within a limited time frame..

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	08.06.2023	Head of the department Ihor HAMAIUN
	08.06.2023	Guarantors of the educational programs Andrii KOPP Uliya LITVINOVA