Syllabus
Course Program

Algorithmization and Programming

Specialty
113 Applied mathematics

Institute
Educational and Scientific Institute of Computer Science and Information Technology.

Educational program
Intelligent Data Analysis

Department
Department of Computer Mathematics and Data Analysis.

Level of education
Bachelor's level

Course type
Special (professional), Mandatory.

Semester
1

Language of instruction
Ukrainian

Lecturers and course developers

Oleksii Haluza

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Doctor of Science (Physics&Mathematics), Full Professor, Professor of Computer Mathematics and Data Analysis Department.

Work experience – more than 20 years. The author of many scientific, educational, and methodological works. Leading lecturer in the courses: «Algorithmization and Programming», «Optimization Methods», «Machine Learning», etc.

More about the lecturer on the department's website

General information

Summary

The course is aimed at equipping students with the necessary competencies in programming, developing basic theoretical knowledge and practical skills in algorithm design and their software implementation. It covers fundamental algorithmic constructs, data types, and other tools of the C++ language. Methods for building complex programs are examined. Special attention is given to typical complex dynamic data structures and algorithms for working with them, as well as methods for their implementation in C++.

Course objectives and goals

Acquisition of essential competencies in algorithmization and programming.

Format of classes

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

Competencies

GC 1. Ability to learn and master modern knowledge.
GC 2. Ability to apply knowledge in practical situations.
GC 3. Ability to generate new ideas (creativity).

GC 4. Ability to be critical and self-critical.
GC 6. Capability of abstract thinking, analysis and synthesis.
GC 7. Ability to search, process and analyse information from various sources.
GC 8. Knowledge and understanding of the subject area and understanding of professional activities.
GC 10. Skills in the use of information and communication technologies.
SC 2. Ability to perform tasks formulated in mathematical form.
SC 3. Ability to choose and apply mathematical methods for solving applied problems, modelling, analysis, design, management, forecasting, decision-making.
SC 5. Ability to develop algorithms and data structures, software tools and program documentation.
SC 7. Ability to solve professional problems with the help of computer equipment, computer networks and the Internet, in the environment of modern operating systems, using standard office applications.
SC 14. Ability to understand the task statement formulated in the language of a particular subject area, to search and collect the necessary initial data.
SC 15. Ability to formulate a mathematical statement of a problem, based on the statement in the language of the subject area, and choose a method of solving it that ensures the required accuracy and reliability of the result.

Learning outcomes

LO 1. Demonstrate knowledge and understanding of basic concepts, principles, theories of applied mathematics and use them on practice.
LO 3. Formalize tasks formulated in the language of a particular subject fields; formulate their mathematical formulation and choose rational method of solution; solve the resulting problems with analytical and numerical methods, evaluate the accuracy and reliability of the results obtained.
LO 11. Be able to apply modern programming technologies and software development, software implementation numerical and symbolic algorithms.
LO 14. Demonstrate the ability to self-learn and continue professional development.
LO 15. Be able to organize your own activities and get results within a limited time frame.

Student workload

The total volume of the course is 180 hours (6 ECTS credits): lectures – 42 hours, laboratory classes – 48 hours, self-study – 90 hours.

Course prerequisites

School courses in mathematics and informatics.

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

In teaching this discipline, methods such as gamification and peer-to-peer learning are employed. Learning management systems (LMS) are used throughout the educational process.

Program of the course

Topics of the lectures

Topic 1. Introduction
Subject, goals, and objectives of the course. Stages of problem-solving on a computer. Concept of an algorithm. Algorithmic languages.
Topic 2. Introduction to C++
C++ language (alphabet, identifiers, keywords, operations). Program structure. Basic data types. Variables. Operations. Expressions. Operators.
Topic 3. Conditional Algorithms
Conditional operators; selection operator; conditional statement.
Topic 4. Cyclic Algorithms
while operator, do … while operator; for operator.
Topic 5. Arrays
One-dimensional arrays. Multi-dimensional arrays.

Topic 6. Characters and Strings
Representation of textual information. Concept of encoding tables. Methods for representing text strings.
Topic 7. Pointers and Dynamic Memory
Memory model. Pointers. Address arithmetic. Dynamic allocation and deallocation of memory. Working with dynamic variables. Explicit type casting. Dynamic allocation of one- and multi-dimensional arrays.
Topic 8. Functions
Concept of a function. Return values and parameters. Memory structure. Concept of a stack. Local and global variables. Mechanism of parameter passing and return values. Passing arrays as parameters.

Topics of the workshops

Workshops are not included within the framework of this discipline.

Topics of the laboratory classes

Topic 1: Introduction to Programming in C++
Topic 2: Conditional Algorithms
Topic 3: Loops with Pre- and Post-conditions
Topic 4: The `for` Loop
Topic 5: Arrays
Topic 6: Characters and Strings
Topic 7: Pointers and Address Arithmetic. Dynamic Memory Allocation
Topic 8: Functions

Self-study

The course involves completing individual assignments, the results of which are automatically checked using LMS tools and monitored and evaluated by instructors. Students are also recommended additional materials (videos, articles) for independent study.

Non-formal education

As part of non-formal education in accordance with the relevant regulation (http://surl.li/pxssv), the educational component or its individual topics may be considered in cases of independent completion of professional courses/training, obtaining civic education, online education, professional internships, etc.

Course materials and recommended reading

Basic literature

1. Рудий Т. В., Паранчук Я. С., Сеник В. В. Алгоритмізація та програмування. Частина 1. Структурне програмування : навчальний посібник. - Львів: Львівський державний університет внутрішніх справ, 2023. - 240 с. ISBN 978-617-511-373-8
https://dspace.lvduvs.edu.ua/bitstream/1234567890/5515/1/%D0%90%D0%BB%D0%B3%D0%BE%D1%80%D0%B8%D1%82%D0%BC%D1%96%D0%B7%D0%B0%D1%86%D1%96%D1%8F...--%D1%87.%201----%D0%92%D0%95%D0%A0%D0%A1%D0%A2%D0%9A%D0%90.pdf
2. Іванов Є.О., Ліндер Я.М., Жереб К.А. Основи мови програмування С++: навчальний посібник. – К.: Логос, 2020. - 90 с. ISBN 978-617-7631-24-7.
https://iss.csc.knu.ua/library/study-guides/foundations-of-c++-language.pdf
3. Ришковець Ю.В., Висоцька В.А. Алгоритмізація та програмування. Частина 1: навчальний посібник – Львів: Видавництво «Новий Світ-2000», 2020. – 336 с. ISBN 978-617-7519–16–3
https://ns2000.com.ua/wp-content/uploads/2019/07/Alhorytmizatsiia-ta-prohramuvannia-I-chastyna.pdf

Additional literature

1. Основи програмування на С++ [Електронний ресурс] : навч. посібник / О. О. Водка [та ін.] ; Нац. техн. ун-т "Харків. політехн. ін-т". – Електрон. текст. дані. – Харків, 2021. – 112 с. https://repository.kpi.kharkov.ua/handle/KhPI-Press/52280
2. Васильєв О. Програмування С++ в прикладах і задачах. – Київ: Ліра-К, 2020. - 382 с. ISBN: 978-617-7507-41-2

Internet resources

1. https://www.hackerrank.com - база задач з програмування
2. https://projecteuler.net - база алгоритмічних задач

Assessment and grading

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

100% of the final grade consists of assessment results in the form of an exam (40%) and ongoing assessment (60%).

Exam: written assignment (2 theoretical questions and a problem) and an oral presentation.

Ongoing Assessment: grades for laboratory work, 2 control tests, and a calculation task.

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

Date, signature
29.08.2024  Head of the Department
Olena AKHIIEZER

Date, signature
29.08.2024  Guarantor of the Educational Program
Olena AKHIIEZER