

**НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ ВОДНОГО ГОСПОДАРСТВА ТА
ПРИРОДОКОРИСТУВАННЯ**

Навчально-науковий інститут кібернетики, інформаційних технологій та інженерії

04-04-38S

СИЛАБУС

навчальної дисципліни

SYLLABUS

Програмування: CS50		Programming: CS50
Шифр за ОП	–	Code in Degree Programme
Освітній рівень: Бакалаврський (перший) Магістерський (другий)		Level of Education: Bachelor's (first) Master's (second)
Галузь знань Усі галузі знань НУВГП		Field of Knowledge All Fields of Knowledge
Спеціальність Усі спеціальності НУВГП		Field of Study All Fields of Study
Освітня програма: Усі освітні програми		Degree Programme: All Degree Programmes

Syllabus of the course *Programming: CS50* for Bachelor's and Master's degree applicants studying in all degree programmes of all fields of study of the NUWEE. Rivne. NUWEE. 2024. 11 p.

Developer of the syllabus:

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Syllabus approved at the meeting of the Department of Computer Engineering

Protocol No. 6 from January 12, 2024

Head of the Department:

B.B. Krulikovskiy, PhD, Associate Professor.

Approved by the Scientific and Methodological Council for Quality of the Educational and Research Institute of Cybernetics, Information Technologies and Engineering

Protocol No. 5 from February 26, 2024

Head of the Scientific and Methodological Council for Quality of the Educational and Research Institute:

P.M. Martyniuk, Doctor of Engineering, Professor.

Approved by the Scientific and Methodological Council of NUWEE
Protocol No. 5 from May 29, 2024

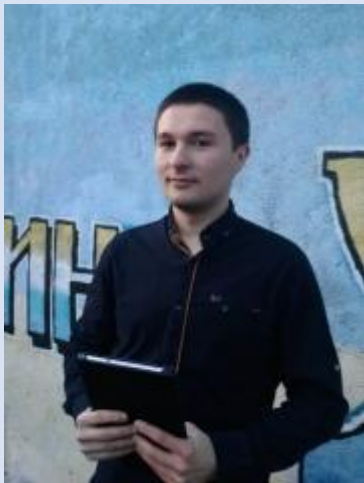
Scientific Secretary of the Scientific and Methodological Council:

T.A. Kostiukova

Previous version of the syllabus: not available.

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COURSE PROGRAMME	
Programming: CS50	
OVERVIEW	
Level of Education	<i>Bachelor's and Master's degree</i>
Degree Programme	<i>All degree programmes</i>
Specialty	<i>All specialties of NUWEE</i>

Year of study, Semester	
Number of ECTS credits	3
Lectures:	6 hours
Laboratory classes:	24 hours
Independent study:	60 hours
Course project:	No
Form of study	Full-time/extramural
Type of Summative Assessment	Credit
Language of instruction	English
UNIVERSITY TEACHER PROFILE	
Lecturer	 <p><i>Boichura Mikhailo Volodymyrovych</i> <i>PhD, Associate Professor of the Department of</i> <i>Computer Engineering</i></p>
Wiki	https://wiki.nuwm.edu.ua/index.php/Бойчур_Михайло_Володимирович
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COURSE INFORMATION	
Goals and tasks	

This course is based on the materials of the “CS50 Introduction to Computer Science” course taught at Harvard University by Professor David Malan. Lectures and labs are also available in Ukrainian thanks to the International Renaissance Foundation, BrainBasket Foundation, IT company SoftServe, etc. Access to the relevant material in Ukrainian (lecture videos and practical classes) and the issuance of certificates, in particular, is provided by the Prometheus platform. The course develops skills in algorithmic thinking and effective problem solving using C, Scratch, and Python programming languages, databases, and web development tools such as CSS, HTML, JavaScript, and PHP.

Purpose: *significant development of algorithmic thinking skills, mastery of generally accepted styles of coding, ability to independently solve problems arising in programming, including information retrieval and debugging programs, ability to systematize knowledge while learning several programming languages; preparation of students for further independent development as programmers.*

Goals (tasks): *mastering common styles of coding, acquiring skills in debugging programs, mastering the basics of editing graphic files using programming tools, acquiring skills in developing an effective spell checker, mastering web development skills, learning the basics of a number of common programming languages, forming and improving skills in searching for and organizing information.*

Link to the course on Moodle, on the platform of degree programmes and their educational components

<https://exam.nuwm.edu.ua/course/view.php?id=5440>

Competencies

- C1. Ability to think abstractly, analyze and synthesize.*
- C2. Ability to communicate in English both orally and in writing.*
- C3. Ability to search, process and analyze information from various sources.*
- C4. Ability to apply knowledge in practical situations.*
- C5. Ability to learn and master modern knowledge.*
- C6. Ability to justify the choice of methods for solving problems, critically evaluate the results obtained, justify and defend decisions.*

Degree programme learning outcomes (PLOs). Learning outcomes (LOs)*

LO1. Ability to use modern methods and programming languages to develop algorithmic software.

LO2. Ability to develop specific software: for working with graphic files, processing text information and developing web applications using databases.

LO3. Ability to decompose a problem into subproblems and combine individual solutions into a single whole.

LO4. Ability to separate design from implementation details.

LO5. Ability to debug programs.

COURSE STRUCTURE AND CONTENT

№	Topic	Description of the topic	Description of the laboratory class	Description of the independent study
MODULE 1.				
Content module 1: Basic data types and structures in CS50				
1	Fundamentals of computer arithmetic. Scratch language. 2 hr of lectures LO3, LO4	The binary system. Data abstraction. Algorithms. Pseudocode. Syntax and structure of the Scratch program.	Development of an application in the Scratch language. 2 hr of laboratory	The syntax of the Scratch language. 2 hr of independent study
2	C programming language. LO3, LO5	The structure of the program. Program syntax. Basic algorithmic constructions. Compilation. Debugging. Comparison with Scratch. CS50 Sandbox environment. Clang compiler. The cs50 library. The Luna algorithm.	Development of console programs: Hello, Mario pyramid, two Mario pyramids, Cash, Credit. 2 hr of laboratory	Commands of the CS50 environment when working with the C language. Mathematical nuances of laboratory work 2. Study of algorithms for determining the type of credit card. 6 hr of independent study
3	Arrays. LO1, LO3, LO5	Strings. Command line arguments. Encryption. Caesar's algorithm. The Vigenère algorithm. Program termination codes. Sorting.	Development of console programs: Caesar, Vigenère, Crack. 2 hr of laboratory	Analysis of modern encryption algorithms; areas of application of Caesar and Vigenère algorithms. 4 hr of independent study

4	Memory. LO1, LO2, LO3, LO5	Memory allocation. Memory leakage. Pointers. Strings. Functions for work with strings. CS50 IDE. Decrypting images. Files. BMP files. JPEG files. Bit map. The structure of a graphic file. Image scaling issues. Issues of image quality improvement.	Development of console programs: Whodunit, Resize (simpler version), Resize (more complex version), Recover. 6 hr of laboratory	Work in the CS50 IDE Offline environment. Programming 24-bit uncompressed bmp files. Programming JPEG files. 10 hr of independent study
5	Data structures. 2 hr of lectures LO1, LO2, LO3, LO5	Structures. CS50 error correction tools. The valgrind function. Features of using the functions for allocating and freeing memory for pointers. Linked lists. Custom functions for list processing. The realloc function. Dynamic arrays. Hash tables. Trees. Spell checking systems.	Development of console programs: Speller (using a hash table or prefix tree). 4 hr of laboratory	The concept of hash tables. The concept of a prefix tree. Programming a spell checker. 8 hr of independent study
MODULE 2.				
Content module 2: Python language and web development				
6	HTTP, HTML, CSS. LO2	CS50 commands. TCP/IP protocol. HTTP protocol. The HTML language. The structure of HTML. Tags. CSS style sheets. JavaScript language. Basic functions and operations. Requirements for code design and style. Code validators.	-	The concept of HTTP and TCP/IP. HTML markup language, W3C Markup Validation Service. CSS style sheet. The JavaScript language. 6 hr of independent study
7	Python. LO1, LO3, LO5	CS50 commands. Comparison of Python with C languages. Data types and structures. Data input and output. Arithmetic operations. Basic algorithmic constructions. Working with files. Command line arguments. Sorting. Text censoring program.	Development of console programs: Hello, Mario Pyramid, Two Mario Pyramids, Cash, Credit, Caesar, Vigenère, Bleep. 4 hr of laboratory	Differences between C and Python syntax. Commands of the CS50 environment for the Python language. Message censoring programs. Decrypting hashed passwords. 8 hr of independent study
8	Web programming. LO1, LO2, LO3, LO4, LO5	The Flask. HTML. CSS. JavaScript. Python. Library os. Library smtplib. Library csv. Bootstrap. MVC scheme.	Development of Web applications: Similarities. 2 hr of laboratory	Ways and means for determining the "similarity" of files. Create a web application such as Google Forms and Google Sheets. 8 hr of independent study

9	SQL. 2 hr of lectures LO1, LO2, LO3, LO4, LO5	Cookies. Session. CS50 commands. Comparison of sqlite with MS Excel. Data types of sqlite. Queries. Functions of sqlite. The relationship between tables. The phpLiteAdmin program. Interaction of HTML, Python and sqlite. SQL functions and execute. Implementation of secure transactions.	Development of a Web-based stock portfolio management application: Finance. 2 hr of laboratory	Modern requirements for website design. MVC scheme. 8 hr of independent study
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Teaching methods and technologies

<i>Forms of education</i>	<ul style="list-style-type: none"> • <i>full-time (stationary) with possibly elements of distance learning;</i> • <i>part-time.</i>
<i>Forms of the educational process</i>	<ul style="list-style-type: none"> • <i>educational classes (lectures, laboratory classes, consultations);</i> • <i>independent study of applicants;</i> • <i>work in scientific libraries and the Internet;</i> • <i>assessment measures (formative assessment, modular assessment, summative assessment).</i>
<i>Teaching methods and technologies</i>	<ul style="list-style-type: none"> • <i>contextual learning;</i> • <i>modular learning.</i>
<i>The educational process includes, in particular, the following</i>	<ul style="list-style-type: none"> • <i>coding for computer programs;</i> • <i>debugging the computer programs;</i> • <i>Code Review.</i>
<i>Learning tools</i>	<ul style="list-style-type: none"> • <i>video recording of the lecture;</i> • <i>detailed explanations of the labs in the form of text and video;</i> • <i>various tutorials.</i>

Tools, equipment and software

- *The Harvard CS50 template, which is available at <https://replit.com/>;*
- *Interface to the Prometheus platform for automatic verification of solutions.*

Procedure for assessing program learning outcomes/learning outcomes

A student can collect 100 points, taking into account the following marks:

1. modular assessment: 40 points;
2. formative assessment: 50-60 points;
3. extra points: 0-10 points.

Distribution of points:

1. for module tests:

- modular assessment No. 1 (20 points):
 - Level 1: 19 questions of 0.5 points each.
 - Level 2: 6 questions of 0.9 points each.
 - Level 3: 3 questions of 1.7 points each.
- modular assessment No. 2 (20 points):
 - Level 1: 19 questions of 0.5 points each.
 - Level 2: 6 questions of 0.9 points each.
 - Level 3: 3 questions of 1.7 points each.

2. for laboratory works (50-60 points):

The formative assessment is carried out by checking the laboratory work using the Prometheus platform. If the student is able to explain the program code and the corresponding program passes n out of m tests correctly, the student obtains $100 \cdot n/m$ % of the points allocated to perform the problem, rounded to the nearest whole number, 0 points otherwise.

Alternatively, students may complete assignments using another programming languages or perform another type of tasks altogether, provided that they are consistent with any of the CS50 courses. It is recommended to agree on the details with the university teacher in advance.

3. additional points for significant civic and student activity (0-10 points):

Up to 10 points are awarded for volunteering, competitions, contests, conferences, writing articles, active student activities, specific proposals for improving the content of the course, etc.

Combination of learning and research

During the course of their studies, students acquire the knowledge necessary to: work with bmp and jpg files, programmatically verify and process text information, and quickly develop websites using so-called startuper language called Python. Thus, the skills acquired allow students of any specialty to develop their own software products to facilitate data processing when performing research that requires working with text or images. Students will also be able to publish the results of their research on the Internet.

Bibliography (primary, secondary)

Primary

1. Prometheus. *Основи програмування CS50 2019*. URL: https://courses.prometheus.org.ua/courses/course-v1:Prometheus+CS50+2019_T1/course/ (Last accessed: 05.01.2024).
2. CS50. URL: <https://cs50.harvard.edu/x/2019/> (Last accessed: 05.01.2024).
3. CS50's Introduction to Computer Science | edX. URL: <https://www.edx.org/course/cs50s-introduction-to-computer-science> (Last accessed: 05.01.2024).

Secondary

1. Henry S., Warren Jr. *Hacker's Delight*. Boston: Addison-Wesley Professional, 2013. 2nd edition. 512 p.
2. White R. *How Computers Work*. New Jersey: Que Publishing, 2014. 10th edition. 384 p.
3. Kochan G. S. *Programming in C*. Boston: Addison-Wesley Professional, 2015. 4th edition. 552 p.
4. CS50x 2024. URL: <https://cs50.harvard.edu/x/2024/> (Last accessed: 05.01.2024).

Information resources on the Internet

1. <https://www.youtube.com/channel/UCcabW7890RKJzL968QWEyKA> (Official CS50 YouTube Channel).
2. <https://www.edx.org/cs50> (List of CS50 courses in edX).
3. <https://cs50.harvard.edu/college/2019/fall/syllabus/> (syllabus of CS50 original course)

TEACHING AND LEARNING POLICIES

"Soft" skills

- communication skills (in particular, the ability to communicate in English, including the use of professional terminology);
- ability to analyze and synthesize (including the ability to find a way out of difficult situations, ability to learn);
- ability to apply knowledge in practical situations;
- attention to detail;
- ability to adapt;
- problem-oriented approach.

Deadlines

The deadline for passing laboratory work is 3 days before the last weekday of the session. Laboratory work passes in class or during a consultation, the date and time of which is flexibly agreed between the student and the university teacher.

Students have only one attempt to pass each of the module tests. The first module takes place during any lecture until the end of October, and the second one during the last lecture. A retake of a specific module test can be organized only under exceptional circumstances.

If a student is not satisfied with the total assessment for both modules or has not passed at least one module, he or she may ask the university teacher to organize a summative assessment. In this case, marks for individual modules are cancelled.

If the applicant does not score 60 points at the end of the session, he or she can try to pass the subject on the commission.

Non-formal and informal education

The course can be re-enroll in part or in full after writing an application and providing documents that confirm the learning outcomes obtained by the student (see the provision at <https://ep3.nuwm.edu.ua/28363/>). In particular, students can independently take online courses on such learning platforms as Prometheus, Coursera, edX, edEra, FutureLearn etc for further transfer the learning outcomes. However, it is advisable to agree with the university teacher the relevance of the chosen online course to the essence of the discipline. A list of suitable courses is provided below:

- Prometheus - Основи програмування CS50 2019.*
- Harvard.edu - This is CS50.*
- edX - CS50: Computer Science Courses and Programs from Harvard.*

Convenient course search is available at the following links: <https://www.classcentral.com/>, <https://pll.harvard.edu/catalog>.

Rules of academic integrity

The following is required to prevent academic dishonesty:

- a student obtains at least some marks only if he/she understands the programme code;*
- students are prohibited from: plagiarizing, self-plagiarizing, fabricating, falsifying, cheating, deceiving, and influencing the university teacher in any way.*

Depending on the type and degree of the violation, the university teacher may impose the following sanctions:

- an oral or written comment from the university teacher;*
- warning about the possibilities of bringing to academic responsibility;*
- reducing or canceling the results of the assessment of the student's educational task;*
- performing the educational task again;*
- completing another educational task;*
- appointment of additional training on academic integrity;*
- assignment of additional assessment measures (additional individual educational tasks, tests, etc.);*
- filing a petition to the Rector in order to violate the formal procedure for considering the issue of bringing the student to responsibility.*

If a student cheats during a modular assessment or a summative assessment, he or she loses the right to submit the material and incurs an academic debt.

Documents on academic integrity (about plagiarism, course project submission procedure, student honor code, documents of the National Agency regarding integrity) are listed on the "Якість освіти" page of the NUWEE website: <https://nuwm.edu.ua/sp/akademichna-dobrochesnistj>.

Attendance requirements

There are no sanctions for missing classes. The student has the right to independently study the material necessary for passing module tests and laboratory work, which is available on the platforms such as Prometheus, EdX, the website <https://cs50.harvard.edu>, etc. In case of need for consultation, the lecturer will meet students halfway.

Attending class is allowed using your own laptop. Students should not violate course in class.

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Затверджено

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