

Ministry of Science and Higher Education of the Russian Federation
NATIONAL RESEARCH
TOMSK STATE UNIVERSITY (NR TSU)

Institute of Applied Mathematics and Computer Science

APPROVE:
Director

A. V. Zamyatin

Work program of the discipline

Data Programming in Python

in the major of training

01.04.02 Applied mathematics and informatics

Orientation (profile) of training:

Big Data and Data Science

Form of study
full-time

Qualification
Master

Year of admission
2025

AGREED
Head of EP

A.V. Zamyatin

Chairman of the EMC

S.P. Sushchenko

Tomsk – 2025

1 Planned results of the practice

The results of the internship are the following indicators of achievement of competencies:

ICP - 2.1 Formulates the goal of the project, substantiates its significance and feasibility

IUC-2.2 Develops an action program to solve project problems, taking into account available resources and limitations

IUC-2.3 Ensures project implementation in accordance with established goals, deadlines and costs

IOPK-3.1 Develops mathematical models in the field of applied mathematics and computer science

IOPK-3.2 Analyzes mathematical models for solving applied problems of professional activity

IOPK-3.3 Develops and analyzes new mathematical models for solving applied problems of professional activity in the field of applied mathematics and computer science

IOPK-4.1 Analyzes problems of applied mathematics and computer science using information technology

IOPK-4.3 Uses modern information and communication technologies to solve problems in the field of applied mathematics and computer science, taking into account information security requirements

IPK-1.2 Applies existing mathematical methods, algorithms and software to solve problems in the field of professional activity

IPK-1.3 Develops new methods, models, algorithms and software for solving problems in the field of professional activity

2. Tasks of mastering the discipline

The goal is to teach students to program using compiled and interpreted languages; to teach students to develop algorithmic and software solutions in modern interpreted and compiled languages, to create programs that interact with devices at a low level. Course objectives: - study languages, grammar by generations, paradigms; - master programs for constructing programs using various conceptual approaches; - study the principles of operation of sign systems, the basics of secure computing processes; - master the basic functionality of standard libraries that provide algorithms and means of network interaction, API to the database, mathematical calculations. 3. Место дисциплины в структуре образовательной программы

4. Semester of mastering and form of intermediate certification in the disciplin

Second semester, test

5. Entrance requirements for mastering the discipline

To successfully master the discipline, learning outcomes in the following disciplines are required: “Fundamentals of Programming”, “Algorithms and Data Structures”, “Object-Oriented Programming”.

6. Язык реализации

English.

7. Scope of discipline

The total labor intensity of the discipline is 2 credits, 72 hours, of which:

- lectures: 10 hours

- laboratory: 20 hours including

practical training: 0 h.

The volume of independent work of the student is determined by the curriculum.

8. The content of the discipline, structured by topics

Topic 1. General introduction to compilation theory Classification of approaches to creating compilers. Compilers. Interpreters. Virtual machines. Jit compilers. Assembler and object code. Compile-ahead compilers; Topic 2. A primer on compilers and translation principles Compilation phases. Lexical analysis. Syntactic analysis. Semantic analysis. Intermediate languages. Optimization. Code generation; Topic 3. Overview of modern languages Programming language paradigms. Generations of programming languages. TIOBE rating. Dynamics of language popularity since 2000. RedMonk rating. Popular languages by divisions. Popular languages by application. Promising languages; Topic 4. Programming languages, paradigms and classification Multi-paradigm languages. Language standardization. Internationalization. Data types. Flow control. Memory management. Syntactic sugar/salt; Topic 5. Python 3 Scripting Language Overview of Python 3 basic types. Lists, Comprehensions, map and filter operations. Dictionaries and Dict Comprehensions. Functions and Lambda functions. Variable functions. Errors and Exceptions. String formatting. Objects and classes. Methods, fields and property; Topic 6. Javascript Scripting Language Overview of interpreters for browsers and servers. Basic types, strings, numbers, NaN, undefined. Object types: Functions, Errors, Dates. Constructors and prototypes. Ajax requests, XMLHttpRequest and fetch; Topic 7. Go compiled language with garbage collector (golang) Data types. Functions. Control flow constructs. Structures and "objects". Methods and interfaces. Concurrency primitives: light-weight processes (goroutines), channels, and select statements; Topic 8. The Rust Compiled Language Variable declarations, mutable data, and life cycle. Basic types and type inference. Control flow constructs. Variable ownership. Classes, mixins, and methods. Race-free concurrency; 9. Текущий контроль по дисциплине

9. Ongoing evaluation

The current control of the discipline is carried out taking into account the specifics of the implementation of the discipline.

The discipline is implemented in a mixed format using the Plario online adaptive learning platform, which is integrated with TSU Moodle. It is a pull-up (leveling) course intended for students, undergraduates, graduate students, teachers of TSU, who need knowledge of basic mathematics in their educational or professional activities.

The student enters Plario through a personal Moodle account. In the Moodle system, the course teacher has the ability to track individual trajectories for each section, the degree of mastery of skills, control the amount of time spent in the system, the amount of material covered for each section. Once a week, the teacher conducts consultations in person, and there is also the possibility of online consultations in the Moodle system.

The form of attestation is a test. The offset is given if

- 1) for each section, the student showed mastery of skills at least 80 percent.

The Plario system records the mastery of skills for each section automatically.

- 2) The test is written with at least "good"

Typical control tasks or other materials necessary for assessing learning outcomes that characterize the stages of competency formation, and methodological materials that determine the procedures for assessing learning outcomes, are given in the Evaluation Tools for the discipline.

10. The procedure for conducting and criteria for evaluating the intermediate certification

The form of attestation is a test. The offset is given if

- 1) for each section, the student showed mastery of skills at least 80 percent.

The Plario system records the development of skills for each section in automatic mode - the formation of IOTC 1.1

- 2) The test is written with at least “good”

Typical control tasks or other materials necessary for assessing learning outcomes that characterize the stages of competency formation, and methodological materials that determine the procedures for assessing learning outcomes, are given in the Evaluation Tools for the discipline.

Typical control tasks or other materials necessary for the current certification, and methodological materials that determine the procedures for evaluating the results of the current certification, are given in the Evaluation Tools for the discipline.

11. Educational and methodological support

- a) An electronic training course in the discipline at the electronic university "Moodle"
- b) Evaluation materials of the current control and intermediate certification for the discipline are in the Evaluation tools of the discipline.
- c) Plan of seminars / practical classes according to the curriculum.
- e) To master the educational results of the discipline, it is necessary to complete 6 sections of the adaptive course. The mixed format of the discipline and adaptive technology (algorithmic), which is the basis of the course, allows you to pass the discipline at a pace convenient for the student using any device. It is necessary to follow the sequence of sections recommended by the teacher.

For the successful mastering of the discipline, regular classes in each section are necessary. Before studying each section, it is necessary to pass an input diagnostic test in the system, according to the results of which a digital twin (profile) of the student is formed and the level of proficiency in each skill is determined. The time spent in the system will depend on the results of the entrance test. Further, the system itself offers training exercises and theoretical material, forms an individual trajectory in real time, which is available to the student and the teacher. Lessons in the system are recommended as asynchronous lessons in remote mode (controlled by the SIW).

Practical classroom lessons can take place both in the classical form and in the format of consultations. 1.

12. List of educational literature and Internet resources

- a) Primary literature: – Alfred W. Aho, Minika S. Lam, Ravi Sethi, Jeffrey D. Ullman Compilers: Principles, Technologies, and Tools [translated from English and general editor by I. V. Krasikov]. – Moscow [and others]: Williams, 2011, 1175 p.: fig. – Wirth N. Compiler Design [translated from English by E. V. Borisov, L. N. Chernyshov]. – Moscow: DMK Press, 2010, 190, [1] p.: ill. 1 electronic optical disc– ... b) Further literature: – A. Aho, R. Sethi, D. Ullman Compilers: Principles, Technologies, Tools.– Moscow: Williams, 2003, 768 p. – Mozgovoy M.V. – Classics of programming. Algorithms, languages, automata, compilers. Practical approach. – SPb.: Science and Technology, 2006. 320 p. – Fernández M. Programming Languages and Operational Semantics. [Electronic resource]/ . –London: Springer London: Imprint: Springer, 2014. 209 p. 10 illus.: online resource. – URL: <http://dx.doi.org/10.1007/978-1-4471-6368-8/> (date of access: 14.10.2016). c) Internet resources: – open online courses – Expert Magazine - <http://www.expert.ru> – Official website of the Federal State Statistics Service of the Russian Federation - www.gsk.ru – Official website of the World Bank - www.worldbank.org – All-Russian Network ConsultantPlus Reference Legal System. <http://www.consultant.ru>

13. List of information technologies

- a) licensed and freely distributed software:
 - Microsoft Office Standard 2013 Russian: software package. Includes applications: MS Office Word, MS Office Excel, MS Office PowerPoint, MS Office OneNote, MS Office

Publisher, MS Outlook, MS Office Web Apps (Word Excel MS PowerPoint Outlook); - publicly available cloud technologies (Google Docs, Yandex disk, etc.).

b) information reference systems:

– Electronic catalog of the TSU Scientific Library
–

<http://chamo.lib.tsu.ru/search/query?locale=ru&theme=system>

– TSU electronic library (repository) –

<http://vital.lib.tsu.ru/vital/access/manager/Index>

– EBS Lan – <http://e.lanbook.com/>

– EBS Student Advisor – <http://www.studentlibrary.ru/>

– Urayt educational platform – <https://urait.ru/>

– EBS ZNANIUM.com – <https://znanium.com/>

- EBS IPRbooks - <http://www.iprbookshop.ru/>

14. Logistics

Audiences for conducting lecture-type classes (for an introductory lecture and conducting tests).

15. Authors information

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