Federal State Autonomous Educational Institution of Higher Education "Moscow Institute of Physics and Technology (National Research University)"

APPROVED
Head of the Phystech School of Applied Mathematics and Informatics
A.M. Raygorodskiy

Work program of the course (training module)

course:	Data Structures and Algorithms I/Структуры данных и алгоритмы I
major:	Applied Mathematics and Informatics
specialization:	Computer Science/Информатика
	Phystech School of Applied Mathematics and Informatics
	Chair of Algorithms and Programming Technologies
term:	1
qualification:	Bachelor

Semester, form of interim assessment: 2 (spring) - Grading test

Academic hours: 60 AH in total, including:
lectures: 30 AH.
seminars: 0 AH.
laboratory practical: 30 AH.

Independent work: 120 AH.

In total: 180 AH, credits in total: 4

Author of the program: V.V. Yakovlev, candidate of physics and mathematical sciences, associate professor

The program was discussed at the Chair of Algorithms and Programming Technologies 21.05.2020

Annotation

Algorithm is a step-by-step procedure, which defines a set of instructions to be executed in a certain order to get the desired output. Algorithms are generally created independent of underlying languages, i.e. an algorithm can be implemented in more than one programming language. The course studies classical algorithms on sorting, data access for various structures, and generic algorithms complexity.

1. Study objective

Purpose of the course

- consists in introducing students to algorithms and data structure.

Tasks of the course

- Statement of the basic algorithms and data structures, their main applications in modern programming;
- providing the student with guidelines for further independent study of individual issues in specialized sections of mathematical logic and programming.

2. List of the planned results of the course (training module), correlated with the planned results of the mastering the educational program

Mastering the discipline is aimed at the formation of the following competencies:

Code and the name of the competence	Competency indicators
Gen.Pro.C-1 Apply fundamental knowledge of physics, mathematics, and/or natural sciences in professional settings	Gen.Pro.C-1.1 Analyze the task in hand, develop appproaches to complete it
Gen.Pro.C-2 Use modern IT and software tools to perform professional tasks in compliance with information security requirements	Gen.Pro.C-2.1 Apply modern computing tools and Internet services in professional settings

3. List of the planned results of the course (training module)

As a result of studying the course the student should:

know:

- The role of programming in solving problems;
- the existing sets of programming tools, as well as trends and prospects for their development;
- theory and practice of lambda calculus.

be able to:

- Develop software applications for solving tasks in a programming language;
- develop algorithms for solving programming problems.

master:

- Up-to-date programming knowledge;
- knowledge of the basics of lambda calculus;
- skills in using lambda - calculus as a programming language;
- skills in the basics of object-oriented programming.

4. Content of the course (training module), structured by topics (sections), indicating the number of allocated academic hours and types of training sessions

4.1. The sections of the course (training module) and the complexity of the types of training sessions

№	Topic (section) of the course	Types of training sessions, including independent work			
		Lectures	Seminars	Laboratory practical	Independent work
1	Points, rays, segments, angles	6		6	20

2	Locus of points	6		6	25
3	Basic theorems about similar triangles	6		6	25
4	Polygons	6		6	25
5	Matrices. Arithmetic operations on matrices	6		6	25
AH in total		30		30	120
Exam preparation		0 AH.			
Total complexity		180 AH., credits in total 4			

4.2. Content of the course (training module), structured by topics (sections)

Semester: 2 (Spring)

1. Points, rays, segments, angles

Lines: intersecting, perpendicular, parallel.

2. Locus of points

Triangles: definition. types, properties.

3. Basic theorems about similar triangles

Basic theorems about congruent triangles.

4. Polygons

Elements of stereometry.

5. Matrices. Arithmetic operations on matrices

Vectors. Basic properties.

5. Description of the material and technical facilities that are necessary for the implementation of the educational process of the course (training module)

- a projector with the ability to connect via HDMI and / or VGA);
- blackboard with chalk or whiteboard with felt-tip pens;
- computer class equipped with a PC.

6. List of the main and additional literature, that is necessary for the course (training module) mastering

Main literature

Additional literature

7. List of web resources that are necessary for the course (training module) mastering

1. SimonPeytonJones (editor), Haskell 98 LanguageandLibraries (TheRevisedReport)
2. JohnHughes, IntroductiontoProgramminginHaskell, www.cs.chalmers.se/~rjmh
3. PaulHudak, JohnPeterson, Joseph H. Fasel ,A GentleIntroductiontoHaskell 98
4. CordeliaHall, JohnHugs, ThelittleHaskeller

5. PhilipWadler, Monadsforfunctionalprogramming, DepartmentofComputingScience, UniversityofGlasgow
6. AllAboutMonads , http://www.nomaware.com/monads/html/
7. EmeryBerger , FP + OOP = Haskell, DepartmentofComputerScience, TheUniversityofTexasatAustin
8. RexPage, TwoDozenShortLessonsinHaskell, a participatorytextbookonfunctionalprogramming, SchoolofComputerScience, UniversityofOklahoma
9. DamirMedak, GerhardNavratil, Haskell-Tutorial, InstituteforGeoinformationTechnicalUniversityVienna
10. Haskell, http://haskell.org.

8. List of information technologies used for implementation of the educational process, including a list of software and information reference systems (if necessary)

The lecture classes use multimedia technology, including the presentation of presentations. Electronic books are used.

9. Guidelines for students to master the course

A student studying a discipline must, on the one hand, master the general conceptual apparatus, and on the other hand, must learn to put theoretical knowledge into practice.

As a result of studying the discipline, the student must know the basic definitions, concepts, axioms.

Successful development of the course requires intense independent work of the student. The course program provides the minimum necessary time for the student to work on the topic. Independent work includes:

- reading and taking notes of recommended literature;
- study of educational material (according to lecture notes, educational and scientific literature), preparation of answers to questions intended for independent study, proof of individual statements, properties;
- laboratory work to understand the connections between theory and practical skills;
- preparation for differentiated classification.

The management and control of the student's independent work is carried out in the form of individual consultations.

It is important to gain an understanding of the material being studied, and not its mechanical memorization. If it is difficult to study individual topics, questions, you should consult a lecturer.

SUPPLEMENT

Assessment funds for course (training module)

major:	Applied Mathematics and Informatics
specialization:	Computer Science/Информатика
	Phystech School of Applied Mathematics and Informatics
	Chair of Algorithms and Programming Technologies
term:	1
qualification:	Bachelor

Semester, form of interim assessment: 2 (spring) - Grading test

Author: V.V. Yakovlev, candidate of physics and mathematical sciences, associate professor

1. Competencies formed during the process of studying the course

Code and the name of the competence	Competency indicators
Gen.Pro.C-1 Apply fundamental knowledge of physics, mathematics, and/or natural sciences in professional settings	Gen.Pro.C-1.1 Analyze the task in hand, develop appproaches to complete it
Gen.Pro.C-2 Use modern IT and software tools to perform professional tasks in compliance with information security requirements	Gen.Pro.C-2.1 Apply modern computing tools and Internet services in professional settings

2. Competency assessment indicators

As a result of studying the course the student should:

know:

- The role of programming in solving problems;
- the existing sets of programming tools, as well as trends and prospects for their development;
- theory and practice of lambda calculus.

be able to:

- Develop software applications for solving tasks in a programming language;
- develop algorithms for solving programming problems.

master:

- Up-to-date programming knowledge;
- knowledge of the basics of lambda calculus;
- skills in using lambda - calculus as a programming language;
- skills in the basics of object-oriented programming.

3. List of typical control tasks used to evaluate knowledge and skills

Not provided.

4. Evaluation criteria

1. Points, rays, segments, angles.
2. Lines: intersecting, perpendicular, parallel.
3. Locus of points
4. Triangles: definition. types, properties
5. Basic theorems about similar triangles
6. Basic theorems about congruent triangles
7. Polygons.
8. Circles.
9. Elements of stereometry.
10. Matrices. Arithmetic operations on matrices.
11. Matrix determinants: calculation of order 2 and 3. System of linear equations (Cremer's rule)
12. Vectors. Basic properties.
13. Basis, coordinates with respect to a basis.
14. Cartesian coordinate system. Transformation matrix.

Assessment “excellent (10)” is given to a student who has displayed comprehensive, systematic and deep knowledge of the educational program material, has independently performed all the tasks stipulated by the program, has deeply studied the basic and additional literature recommended by the program, has been actively working in the classroom, and understands the basic scientific concepts on studied discipline, who showed creativity and scientific approach in understanding and presenting educational program material, whose answer is characterized by using rich and adequate terms, and by the consistent and logical presentation of the material;

Assessment “excellent (9)” is given to a student who has displayed comprehensive, systematic knowledge of the educational program material, has independently performed all the tasks provided by the program, has deeply mastered the basic literature and is familiar with the additional literature recommended by the program, has been actively working in the classroom, has shown the systematic nature of knowledge on discipline sufficient for further study, as well as the ability to amplify it on one’s own, whose answer is distinguished by the accuracy of the terms used, and the presentation of the material in it is consistent and logical;

Assessment “excellent (8)” is given to a student who has displayed complete knowledge of the educational program material, does not allow significant inaccuracies in his answer, has independently performed all the tasks stipulated by the program, studied the basic literature recommended by the program, worked actively in the classroom, showed systematic character of his knowledge of the discipline, which is sufficient for further study, as well as the ability to amplify it on his own;

Assessment “good (7)” is given to a student who has displayed a sufficiently complete knowledge of the educational program material, does not allow significant inaccuracies in the answer, has independently performed all the tasks provided by the program, studied the basic literature recommended by the program, worked actively in the classroom, showed systematic character of his knowledge of the discipline, which is sufficient for further study, as well as the ability to amplify it on his own;

Assessment “good (6)” is given to a student who has displayed a sufficiently complete knowledge of the educational program material, does not allow significant inaccuracies in his answer, has independently carried out the main tasks stipulated by the program, studied the basic literature recommended by the program, showed systematic character of his knowledge of the discipline, which is sufficient for further study;

Assessment “good (5)” is given to a student who has displayed knowledge of the basic educational program material in the amount necessary for further study and future work in the profession, who while not being sufficiently active in the classroom, has nevertheless independently carried out the main tasks stipulated by the program, mastered the basic literature recommended by the program, made some errors in their implementation and in his answer during the test, but has the necessary knowledge for correcting these errors by himself;

Assessment “satisfactory (4)” is given to a student who has discovered knowledge of the basic educational program material in the amount necessary for further study and future work in the profession, who while not being sufficiently active in the classroom, has nevertheless independently carried out the main tasks stipulated by the program, learned the main literature but allowed some errors in their implementation and in his answer during the test, but has the necessary knowledge for correcting these errors under the guidance of a teacher;

Assessment “satisfactory (3)” is given to a student who has displayed knowledge of the basic educational program material in the amount necessary for further study and future work in the profession, not showed activity in the classroom, independently fulfilled the main tasks envisaged by the program, but allowed errors in their implementation and in the answer during the test, but possessing necessary knowledge for elimination under the guidance of the teacher of the most essential errors;

Assessment “unsatisfactory (2)” is given to a student who showed gaps in knowledge or lack of knowledge on a significant part of the basic educational program material, who has not performed independently the main tasks demanded by the program, made fundamental errors in the fulfillment of the tasks stipulated by the program, who is not able to continue his studies or start professional activities without additional training in the discipline in question;

Assessment “unsatisfactory (1)” is given to a student when there is no answer (refusal to answer), or when the submitted answer does not correspond at all to the essence of the questions contained in the task.

5. Methodological materials defining the procedures for the assessment of knowledge, skills, abilities and/or experience

The time for differentiated classification is 2 academic hours. During the differential test, students can use the discipline program and source texts.