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
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Programme for the final state attestation (defence of the graduation thesis)
Performance of and Defence of Graduation Thesis/Выполнение и защита выпускной квалификационной работы

by direction (speciality):	Applied Mathematics and Informatics
orientation (profile):	Computer Science/Информатика
	Phystech School of Applied Mathematics and Informatics
course:	4
qualification:	Bachelor
semester:	8 (Spring)

Программу составили:

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The programme was discussed at a meeting Phystech School of Applied Mathematics and Informatics 04.06.2020

1. Goals and objectives

Goals

The purpose of the implementation and defense of the final qualification work is to establish the level of preparation of the student to perform professional tasks and the compliance of the results of mastering the educational program with the requirements of the educational standard in the direction of training.

Objectives

- Assessment of the student's ability, relying on the acquired knowledge, skills, and formed competencies, to independently solve problems from the field of their professional activities at a modern level, to professionally present special information, correctly argue and defend their point of view;

- making a decision on awarding the graduate with the qualification "Bachelor" based on the results of the SIA and issuing to the graduate a document (diploma) on higher education;

- development of recommendations for improving the training of graduates in this area of training based on the results of the work of the state examination commission.

2. List of competences, the level of which is assessed in the defence of the graduation thesis

As a result of mastering the educational programme a graduate should develop universal / general cultural, general professional and professional competences. The competences are assessed in the course of interim certification of disciplines (modules), practices. During the defence of the graduation thesis graduates should demonstrate the following competences:

Code and name of competence	Indicators of competence achievement
Pro.C-1 Assign, formalize, and solve tasks, develop and research mathematical models of studied phenomena and processes, systematically analyze scientific problems, obtain new scientific outcomes	Pro.C-1.1 Locate, analyze, and summarize information on current research findings within the subject area
	Pro.C-1.2 Make hypotheses, build mathematical models of the studied phenomena and processes, evaluate the quality of the developed model
	ПК-1.3 Apply theoretical and/or experimental research methods to a specific scientific task and interpret the obtained results

3. Topics for final qualification theses

1. Comparative analysis of the TON blockchain.
2. Construction of vector models of the process.
3. Assessment of the quality of machine translation by means of crowdsourcing.
4. Investigation of the distributed ledger Radix Tempo using formal methods.
5. Training and testing of various models of the ruble exchange rate dependence on oil prices.
6. Formal verification of distributed systems.
7. Using models with a Markov regime change to assess the market risk of an oil portfolio.
8. Comparative analysis of the Libra blockchain.
9. Symbolic and numerical methods for analyzing financial information.
10. Parallel algorithms for big data processing.
11. Allocation of Java offheap objects.
12. New approaches to the problem of program code obfuscation.
13. Development of algorithms for detecting failures in a distributed system.
14. Credit risk management.
15. Methods of speech generation based on neural networks.
16. Design and development of a business process analysis subsystem for JIRA Server software.
17. Optimization of search in non-relational databases.
18. Monitoring cloud infrastructure.
19. System for efficient classification of messages from apache kafka.

20. Development of an algorithm for identifying the periodic part in the time series of readings from the orientation sensors.

21. Development of an algorithm for the selection of interior objects by video.

22. Solving the optimization problem of forming an investment portfolio of an oil company (using machine learning methods).

23. Development of a system for automatic containerization and control of the execution of Python scripts.

24. Testing competing data structures linearizability.

25. Development of an algorithm for the selection of interior objects by video.

26. Development of a web resource for interactive visual creation of neural networks.

27. High-precision indoor positioning using Wi-Fi access points.

28. Differential search methods for neural network architectures.

29. Development of event-driven web applications in Python.

30. Development of a web resource for interactive flexible configuration of the educational process.

31. Mechanism for automatic collection of dumps.

32. Development of an algorithm for the approximate solution of the traveling salesman problem in integers.

33. Development of a system for automatic containerization and control of the execution of Python-scripts.

34. Development of a system for automatic containerization and control of the execution of Python-scripts.

35. Development of a web resource for interactive flexible configuration of the educational process.

36. Locally decodable code.

37. Development of an algorithm for adaptive binarization of photographs of documents.

38. Modeling the impact of weather conditions on the efficiency of logistics companies.

39. Development of a code generation mechanism for creating neural networks.

40. Development of a web resource for interactive visual creation of neural networks.

41. Quantification of immunochromatographic tests using a smartphone application.

42. Development of a mechanism for recognizing complex multi-level road junctions using a vector map.

43. Modeling the influence of weather conditions on the efficiency of logistics companies.

44. Model of the optimal offer.

45. Early forecasting of a sufficient sample size for a generalized linear model.

46. Using machine learning methods to refine the prediction of the trajectory of artificial earth satellites.

47. Using generative models in the simulation of Cherenkov detectors.

48. Fight against similar phrases in Machine Translation.

49. Research of methods of distillation of neural language models to search for potential degradations on individual tasks.

50. Research of strategies for displacing computational tasks in a distributed system.

51. Generalization of the search algorithm for heavy elements Space Saving.

52. Localization of anatomical key points on three-dimensional cone-beam tomograms of the head.

53. Using offline ML factors to optimize online calculations in advertising auctions.

54. Classification of texts from social networks.

55. Analysis of optimization methods when using the Transformer architecture in machine translation tasks.

56. Automatic highlighting of hyperonymy in the text using deep learning.

57. Iterative and scalable methods for constructing embeddings of graph vertices.

58. Bayesian classifiers for definition.

59. Detection of plagiarism of executable code.

60. Investigation of excessive invariance in neural networks.

61. Photorealistic image change by ML methods.

62. Optimization of oil production by improving the constructed models of injection well modes using clustering methods.

63. Segmentation of tissues on 3D CT of the head.

64. search for clothing items in the database by photography.

65. Summarization of dialogues.

66. Clustering of queries of search recommendations.

67. Methods of joint language detection and text recovery after automatic speech recognition in conditions of multilingual input.

68. Proof of Vasiliev's theorem using the programmed proof system Coq.

69. Attention mechanisms in semantic role labeling.

70. Transfer Learning Between Different Games via Generative Models.

71. Testing multithreaded programs for the corresponding course.

72. Extraction of relations on the IEC corpus.

73. Comparison of genre-specific embeddings with additional training of pretrained ones.

74. Investigation of superconvergence in NLP problems.

75. Resolution of lexical ambiguity of contextual materials on the material of Oxford dictionaries.

76. Filtering texts from social networks.

77. Non-thematic classification of the region.

78. Comparison of self-perception and convolutional approaches in the recognition of handwritten characters.

79. ProxylessNAS for the problem of semantic segmentation of barcodes.

80. Multiscale semantic segmentation for searching text in document images.

81. Neural network angle document detector through key point regression.

82. Augmentation of images of symbols using probabilistic interpretation.

83. Research of methods of active learning as applied to the task of extracting fields from documents.

84. Detector of the country of origin of the document based on the image without using the recognized text.

85. Search for meaningful fields in business card images using CNN.

86. Application of capsule networks for recognition of printed and handwritten text.

87. Direct optimization of the mathematical expectation of the BLEU metric in the NLP problem.

88. Binarization of two-dimensional barcodes using a neural network.

89. Building systems End-to-end recognition of printed text in a multilingual scenario.

90. Reducing computational costs when using convolutional neural networks for image processing and analysis.

91. Hierarchical classification for the recognition of handwritten Chinese characters.

92. Characteristic features of the behavior of hidden channels of malicious software in DNS traffic and methods of their detection.

93. Formation of coalitions.

94. Kolmogorov complexity.

95. the theory of sum-products.

96. Search problems and their classification.

97. Tasks RL.

98. Approximate topic of research and development anomaly in time series.

99. Variational Bayesian inference in graphic models in the task of restoring the clonal structure of a tumor.

100. T-varieties.

101. Estimation of the maximum number of blue points, given by the set of red points in general position, on the plane.

102. Finding the number of induced forests on k vertices in a random graph G (n, p) for k ~ O (ln n).

103. Research of methods of convex optimization in the application of solving saddle problems.

104. Characteristic polynomials of the Shacon automorphism.

105. Write-Once codes in coding theory.

106. Evolutionary search for neural network architectures for the problem of object detection.

107. Import and markup of data on competencies.

108. Approximately: flexible varieties.

109. The division of public goods.

110. Investigation of mixed equilibrium in the Potts model.

111. Rational interactive evidence.

112. Chaconne polynomials.

113. An iconic picture of the world for reinforcement learning.

114. Precise localization of synchronization patterns in the problem of reading bar codes without using binarization methods.

115. The choice of representative local descriptors in the problems of object type recognition.

116. The problem of speech recognition.

4. Requirements for the text of a graduation thesis

The text of the final qualifying work is drawn up in accordance with the requirements of the Regulations on the final qualifying work of MIPT students and the Requirements for the content and structure, the rules for issuing FQP (bachelor's and master's theses) of FPMI students (https://mipt.ru/docs/download.php? code = prikaz_ob_utverzhdenii_polozheniya_o_vypusknoy_kvalikafitsionnoy_rabote_studentov_mfti_49_1_ot_ 21_01)

5. The procedure for defending a graduation thesis

The main questions on the defense of FQP are regulated by the Regulations on the final qualifying work of MIPT students.

The defense of the final qualifying work is carried out in the form of a report on the results of a scientific research (presentation). The duration of the student's report is no more than 15 minutes. At the end of the report, the student answers the questions of the SEC members without additional preparation time. The student's survey cannot last more than 1 astronomical hour.

Sample questions from members of the State Electoral Commission for the defense of the WRC:

1. What sources did you use when searching for scientific information on the topic of your research?

2. In which publications are the results of your work published?

3. What mathematical models did you use when processing research results?

4. What is the novelty of the results of your research? How would you characterize this novelty: a concept, an idea that enriches a well-known concept, or as a new technique that expands the boundaries of knowledge?

5. At what conferences were the results of your work presented?

6. Why did you choose this particular method for research?

7. What is the error of your chosen analysis method? Show the confidence interval on a graph.

8. Describe your chosen research method.

9. How was the processing of the experimental data carried out?

10. What is the reliability of your results?

11. Formulate the practical value of your research.

12. What is your contribution to the results of scientific works published by the team with your participation?

13. What justifies the theoretical significance of the results of your research?

14. What justified the practical significance of the results of your research?

15. Your forecast for the prospects of using the results of your work.

16. What new scientific facts (factors, hypotheses, tendencies, positions, ideas, proofs) are presented in your work?

17. In the FQP, did you manage to reveal significant contradictions in the known concepts of the subject you are studying (the phenomenon under study, the process under study), if you did, then what are they?

18. What is the result of comparing your author's scientific achievements with the data presented in independent sources on this topic?

19. What software did you use when performing the work and processing the results?

20. How did you substantiate in your work the representativeness of sample sets of units of observation (measurement)?

21. Can you state that there is a consistent research plan on the topic of WRCs? What did you fail in implementing it?

6. Description of the facilities required for the defence of a graduation thesis

Auditorium for the defense of the final qualifying work, equipped with workplaces for students and the state examination commission, a blackboard, multimedia equipment.

7. List of recommended reading

Main literature

1. Подготовка и защита бакалаврской работы, магистерской диссертации, дипломного проекта [Электронный ресурс], учеб. пособие / Ю. Н. Новиков. — СПб., Лань, 2019.— URL: https://e.lanbook.com/book/122187 (дата обращения: 29.01.2021). - Полный текст (Режим доступа : из сети МФТИ / Удаленный доступ)

Additional literature

1. Искусство писать научные статьи, научно-практическое руководство / Е. З. Мейлихов. — Долгопрудный, Интеллект, 2020.— URL: http://books.mipt.ru/book/301312 (дата обращения: 18.12.2020). - Полный текст (Режим доступа : из сети МФТИ / Удаленный доступ)

8. Guidelines for students on completion of the thesis and preparation for the defence

When performing an FQP and preparing for its defense, one should be guided by the Procedure for conducting state final certification for educational programs of higher education - bachelor's programs, specialist programs, master's programs at MIPT (https://mipt.ru/sveden/files/Poryadok_provedeniya_GIA_v_bakalavriate_i_specialistte. pdf) and the Regulation on the final qualifying work of MIPT students.

In the course of writing the FQP, the student is obliged to show the ability to systematize, generalize, consolidate and expand theoretical knowledge and practical skills; deeply and independently investigate a specific problem; apply the knowledge gained in solving specific problems of professional activity; develop practical recommendations in the field of study; present the results of their activities.

The FQP should demonstrate the level of readiness for independent professional activity and is a presentation of the results of the research work performed by him related to solving the problems of the type of professional activity to which the mastering educational program is focused. The FQP submitted for defense should be presented in compliance with the principles of consistency, argumentation, consistency and based on the study of theoretical and factual materials, the ability to argue their own proposals, and correctly use special terms.

9. Methodology and assessment criteria for the defence of the graduation thesis

The results of the FQP defense are determined by the grades "excellent", "good", "satisfactory", "unsatisfactory". The marks "excellent", "good", "satisfactory" mean the successful defense of the WRC with the assignment of the corresponding qualifications.

The grade for the FQP is given by the GEC taking into account the opinion of the scientific advisor, the graduate's report and public discussion, as well as taking into account the following criteria:

- the validity of the relevance of the research topic, the correspondence of the content to the topic, the completeness of its disclosure;

- the clarity of the structure of the work and the consistency of the presentation of the material, the methodological validity of the study;
- the effectiveness of using the selected research methods to solve the problem;
- possession of the scientific style of presentation;
- the validity and value of the research results and conclusions obtained, the possibility of their application in practice;
- compliance of the FQP submission form with all the requirements for registration of works;
- the quality of the oral presentation, fluency in the material of the WRC;
- the depth and accuracy of answers to questions, comments and recommendations during the defense of the work.

When evaluating FQPs, publications, copyright certificates, etc. can be taken into account.

The criteria for assessing the defense of FQP are given in the Regulations on the final qualifying work of MIPT students.

10. Peculiarities of final state examinations for persons with disabilities and persons with special needs

For students with disabilities, the final state attestation takes into account the particularities of their psycho-physical development, their individual capacities and health status (hereinafter referred to as "individual characteristics").

The following general requirements shall be ensured in the conduct of the FSA:
– Conducting state final examinations for persons with disabilities in the same room as students without disabilities, if this does not create difficulties for the students when taking the FSA;
– presence of assistant(s) in the classroom to provide students with disabilities with the necessary technical assistance, taking into account their individual characteristics (to take the workplace, move around, read and complete an assignment, communicate with members of the SEC);
– The use of technical aids for students with disabilities in taking the FSA, taking into account their individual characteristics;
– Ensure that students with disabilities have unhindered access to and stay in classrooms, toilets and other facilities.

At the written request of a student with a disability, the length of the student's speech at the defence of the final qualification thesis shall not exceed 15 minutes.

A student with a disability shall submit a written application no later than 3 months prior to the commencement of the State Attestation Examination regarding the need to arrange special conditions for him/her when conducting state attestation tests, indicating the specifics of his/her psychophysical development, individual capabilities and state of health. The application shall be accompanied by documents confirming the learner's individual characteristics (in the absence of these documents in the Directorate of the Institute).

In the application, the student indicates the need (or lack of need) for an assistant to be present at the state certification examination, the need (or lack of need) to increase the length of the presentation during the defence of the graduation thesis in relation to the prescribed duration.