Presentation Slides
N009-Sasan.Ansarian

Vilnius University

Doctoral student:

Sasan Ansarian Najaf Abadi

Title of the dissertation:

Design and Optimization of Quantum-Based and Hybrid Machine Learning Algorithms for Real-World Data Analysis Problems

Supervisor:

Dr. Ernestas Filatovas

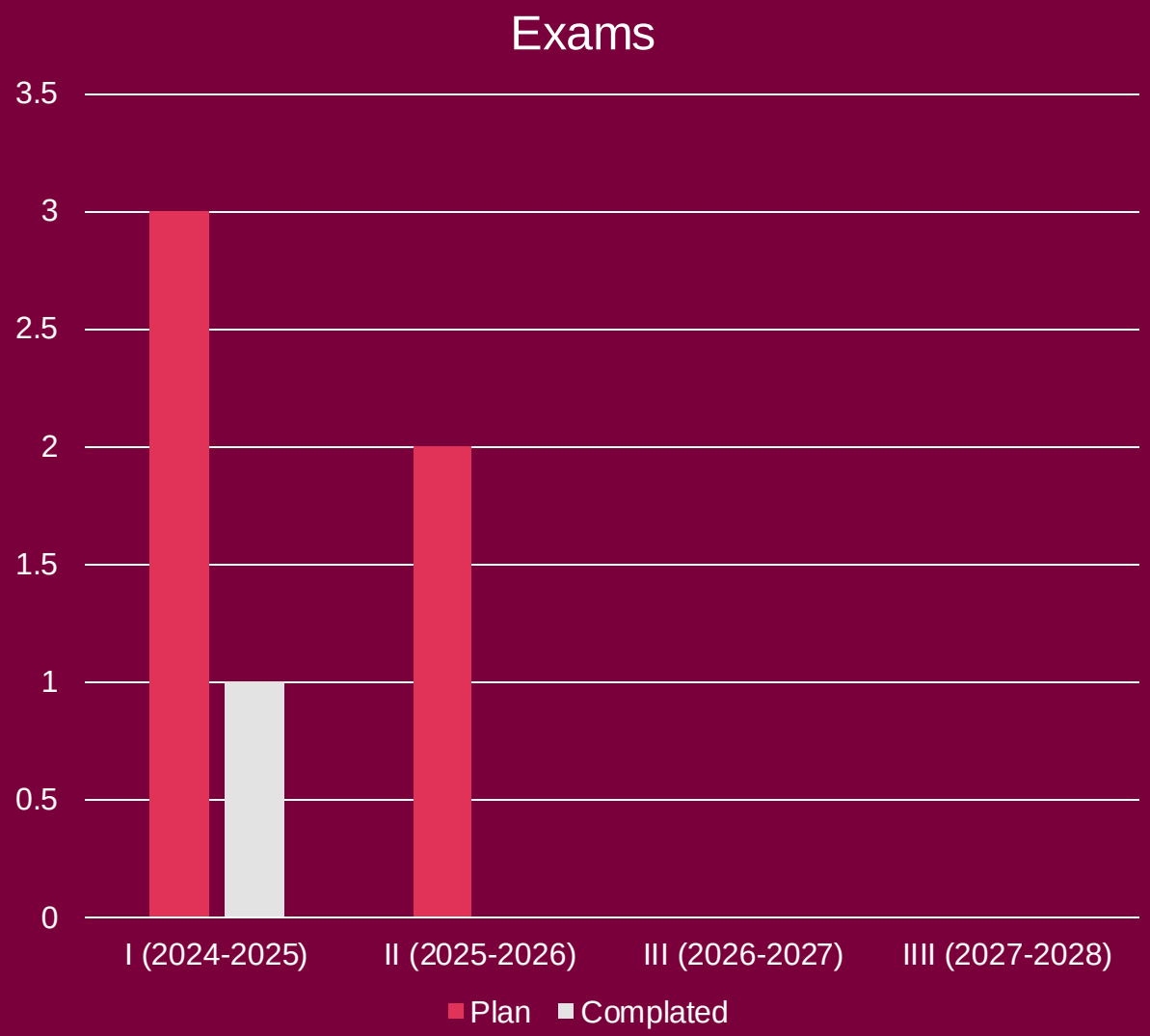
Start and end year of doctoral studies:

From 1 October 2024y To 30 September 2028y.

Year of study:

2024-2025

The plan of all doctoral studies and research and a summary of its implementation (Table 1).



YEAR OF STUDY	EXAMS	
	Plan	Completed
I (2024-2025)	3	1
II (2025-2026)	2	
III (2026-2027)		
IIII (2027-2028)		
Total	5	1

The plan of all doctoral studies and research and a summary of its implementation (Table 1).

Study years	Participation in conferences				Publications					
	International		National		With citation rate			Without citation rate		
	Plan	Completed	Plan	Completed	Plan	Completed	Status	Plan	Completed	Status
I (2024-2025)										
II (2025-2026)			1							
III (2026-2027)	1				1					
IIII (2027-2028)	1				1					
Total	3		1		2					

The work plan for the reporting semester and its implementation (Table 2), detailing what has been done this semester.

Exams 2024/2025 (1st semester)		
Plan	Completed	Status
Machine Learning (2025 y. I quarter)	Machine Learning (06.03.2025)	Retake
How to Sell Your Research? (2025 y. I quarter)	How to Sell Your Research? (06.03.2025)	Passed
Research Methods in Informatics and Informatics Engineering (2025 y. II quarter)		In progress

Conference participation 2024/2025 (first semester)		
Plan	Completed	Conference type

Publications 2024/2025 (First semester)			
Plan	Completed	Status	Publication type

Information about international events and publications that present the main results of the dissertation (articles with a citation index only) (Table 3). This information must be provided not only for the current year of study, but for all studies.

Participation in international conferences	
	Description
1.	

Publications (with citation rate only)		
	Bibliographic description	Condition
1.		

The stages of all doctoral research and dissertation preparation (see Table 4, it can be shortened slightly to fit 1–2 slides), detailing what has been done this semester.
(Plan the presentation so that the points already listed are presented within 2–3 minutes).

	Title of the work	Due dates	Notes
1.	Review and analysis of scientific research related with the theme of doctoral thesis (in Lithuania and abroad):		
1.1.	Understanding the Foundations: Literature Review: Conducting a comprehensive review of existing research on Quantum and hybrid machine learning approaches.	2025 I quarter	• completing the Machine Learning course • Collecting and conducting a literature review
1.2.	Quantum Computing Fundamentals: Grasping the basic principles and concepts of quantum mechanics, such as superposition, entanglement, and measurement, and studying essential quantum algorithms like Grover's search, Shor's factoring, and quantum Fourier transform. familiarizing yourself with different types of quantum hardware (e.g., superconducting qubits, trapped ions) and their limitations.	2025 II quarter	
1.3.	Machine Learning Basics: Exploring traditional machine learning techniques (e.g., linear regression, decision trees, neural networks) and their applications, and Exploring hybrid models that combine classical and quantum components	2025 III quarter	

	Title of the work	Due dates	Notes
2.	Prosecution of scientific research:		
2.1.	Formation of study methodology:		
2.1.1.	Designing effective quantum feature maps to encode classical data into quantum states.	2025 IV quarter	
2.2.	Theoretical study:		
2.2.1.	Experimenting with different feature maps to optimize performance for specific tasks.	2026 I quarter	
2.3.	Empirical study:		
2.3.1.	Implementing quantum variational circuits for training and optimization, and exploring techniques to mitigate noise and improve the efficiency of variational algorithms	2026 II quarter	
2.4.	Analysis of got facts, summing-up, drawing conclusions:		
2.4.1.	Developing hybrid models that leverage the strengths of both classical and quantum computing and considering using quantum computing for specific subtasks within larger classical models.	2026 III quarter	
3.	Preparation of separate parts of doctoral thesis (study methodology, got facts, defended propositions, inferences, etc.):		
3.1.	Industry Selection and Problem Identification: Choosing a specific industry to explore how quantum machine learning can be applied and Identify problems or challenges in that industry that could be solved or improved with quantum solutions.	2026 IV quarter	
3.2.	Data Preparation: Collecting and preparing relevant data for training and testing quantum machine learning models.	2027 I quarter	
3.3.	Model Development and Evaluation: Developed and evaluated quantum-based and hybrid models for the selected applications.	2027 II quarter	
3.4.	Benchmarking: Benchmarking, researching, comparing, and applying best practices to evaluate and enhance products, methods, and services to measure success and improve performance.	2027 III quarter	
3.5.	The summarizing of the findings and discusses:Summarizing and highlighting the new achievement insights and the impact of its ability to influence future research and practice.	2028 I quarter	
4.	Preparation of doctoral thesis and debating at the department:	2028 II quarter	
5.	Defending of doctoral thesis:	2028 III quarter	

Brief description of scientific results obtained during the semester.

- I am enrolled in a Machine Learning course under the expert guidance of Dr. Virginijus Marcinkevičius, where I am focusing specifically on developing and refining image classification algorithms. This course is instrumental in providing me with both the theoretical knowledge and practical skills necessary for my research.
- Additionally, I am actively collecting and conducting an extensive literature review on the applications of Quantum Machine Learning in image classification, particularly within healthcare contexts (e.g., cancer detection in images) Under the mentorship of Dr. Ernestas Filatovas,
- I am exploring how quantum techniques can enhance the accuracy and efficiency of image analysis in medical diagnostics. This dual focus on Machine Learning and Quantum Machine Learning positions me well to contribute novel insights to the field.
- Also, I am involved and working on a project closely related to my PhD studies.

Brief description of scientific results obtained during the semester.

Project Title: Data center for Machine Learning and Quantum Computing in Natural and Biomedical Sciences that is one of five research projects within the Centre of Excellence:

“Development and Validation of Quantum Machine Learning Methods Using Prebuilt Datasets.”

I. **Position**: junior researcher

II. **Implementation Period:** 2023–2027

III. **Project No.:** S-A-UEI-23-11

IV. **Funding Source:** Research Council of Lithuania, under the “University Excellence Initiatives” Program of the Ministry of Education, Science and Sports (Measure No. 12-001-01-01-01 “Improving the Research and Study Environment”).

V. **My task:** working on analysis and implementation of QML for image analysis in Healthcare

Work plan for the next semester

1. Completing the Machine Learning Course:

Considering that I wrote the primary code, but I did not meet the teacher's expectations. Therefore, I need to improve my code to fulfil those expectations.

2. Finalizing the Research Methods in Informatics and Informatics Engineering Course:

This involves not only completing the coursework but also revising and fine-tuning a research paper and a project proposal aligned with the course objectives. I will seek feedback from my peers and instructors to ensure the quality of my work and incorporate their suggestions into my final submissions.

3. Conducting a Literature Review on Quantum Machine Learning Applications in Image Classification with more focus on Image Analysis :

I will systematically gather and analyzes recent research studies, journal articles, and publications related to the intersection of quantum computing and machine learning, particularly focused on image classification tasks with more focus on Image Analysis. My goal is to compile an organized and comprehensive review that identifies key trends, challenges, and future research directions in this emerging field.

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Thanks for your attention

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