



COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title		Code	
Large Language Models			
Lecturer(s)		Department(s) where the course unit (module) is delivered	
Coordinator: Aistis Raudys Other(s): Aušra Šubonienė		Institute of Computer Science Faculty of Mathematics and Informatics Vilnius University	
Study cycle		Type of the course unit (module)	
1 st (BA)		Compulsory	
Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction	
Face-to-face	5, 7. semester	English	
Requirements for students			
Prerequisites: python programming skills		Additional requirements (if any): none	
Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	137	62	75
Purpose of the course unit (module): programme competences to be developed			
<p>Purpose of the module: The "Large Language Models " module provides students with an understanding of Large Language Models (LLMs), their evolution, applications, and future trends. It covers key concepts, such as how LLMs are trained, different types of LLMs, prompt engineering, and fine-tuning techniques. Students will gain hands-on experience with real-world applications, including code generation and retrieval-augmented generation (RAG). The module also addresses critical topics such as security, privacy, and ethical concerns in LLM usage. Upon completing the module, students will be equipped to evaluate the capabilities and limitations of LLMs and apply them to practical scenarios.</p> <p>Generic competences:</p> <ul style="list-style-type: none"> ● Analyze and systematize information (BK1). ● Apply knowledge of LLMs to real-world scenarios (BK2). ● Work independently and in teams to solve problems using LLMs (BC3). <p>Specific competences:</p> <ul style="list-style-type: none"> ● Fundamentals of LLM architectures and training techniques (DK5). ● Practical understanding of Prompt Engineering (DK6). ● Applying LLMs in different industries and specialized tasks (DK7). ● Hands-on experience with real-world LLM applications (DK9). ● Understanding of LLM evaluation metrics and ethical considerations (DK10). 			
Learning outcomes of the course unit (module)	Teaching and learning methods	Assessment methods	
Understand the history and evolution of LLMs and their impact on modern AI.	Problem-based teaching, interactive lectures, independent reading of literature	Written exam, independent reading report	
Understand the principles of training LLMs and how different datasets and architectures are used.	Discussions, problem-based teaching, independent study	Written exam, homework	

Learn and apply prompt engineering techniques for effective LLM interactions.	Hands-on labs, discussions, interactive lectures	Written exam, practical assignments
Explore various types of LLMs (GPT, LLaMA, open-source models) and their applications.	Interactive case studies, hands-on programming sessions, independent study	Written exam, project work, homework
Develop skills in LLM fine-tuning and quantization techniques.	Laboratory work, independent reading, hands-on practice	Homework, project work, practical tests
Evaluate the ethical implications of using LLMs and understand security/privacy concerns.	Problem-based teaching, case study discussions, independent reading	Written exam, homework, project work
Understand and use Retrieval-Augmented Generation (RAG) techniques in real-world applications.	Problem-based teaching, hands-on practice, independent reading	Homework, practical assignments, project work
Evaluate LLM performance using fluency, coherence, and factual accuracy metrics.	Discussions, problem-based teaching, independent study	Written exam, project work

Content: breakdown of the topics	Contact hours							Self-study work: time and assignments	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work	Contact hours	Self-study hours	Assignments
1. Overview of LLMs and their historical evolution	2				2		4	5	Write a summary of LLM history
2. Training LLMs: Datasets, models, and infrastructure	2				2		4	5	Analyze a dataset used in LLM training
3. Understanding different types of LLMs	2				2		4	5	Compare two LLMs in terms of architecture and performance
4. Basics of Prompt Engineering (Part 1)	2				2		4	5	Design effective prompts for text summarization tasks
5. Prompt Engineering (Part 2) and Iterative Prompt Design	2				2		4	5	Refine prompts through an iterative process
6. Applications of LLMs in real-world scenarios	2				2		4	5	Create an LLM-based application (e.g., summarization or translation)
7. LLM Fine-tuning and Quantization Techniques	2				2		4	5	Fine-tune a pre-trained model on a specific dataset
8. Introduction to Retrieval-Augmented Generation (RAG)	2				2		4	5	Implement a simple RAG system for semantic search
9. Ethical and security considerations in LLMs	2				2		4	5	Write a report on ethical challenges and mitigation strategies
10. Programming with LLMs: Copilot, Function Calling	2				2		4	5	Generate Python code using an LLM-based tool (e.g., GitHub Copilot)
11. LLM Evaluation Metrics and Hallucination Detection	2				2		4	5	Evaluate the output of an LLM for fluency, coherence, and factuality

12. Transfer Learning and Hybrid Models	2				2		4	5	Write a case study on transfer learning in LLMs
13. Inference Optimization in LLMs	2				2		4	5	Optimize inference time for a specific LLM task
14. LLM Governance and Regulatory Landscape	2				2		4	5	Write a policy proposal addressing governance of LLMs
15. Multimodal Models and Text-to-Image Generation	2				2		4	5	Generate images using a multimodal model (e.g., DALL-E or Stable Diffusion)
16. Exam							2		Final written exam covering all topics
Total	30	0	0	0	30	0	62	75	

Assessment strategy	Weight,%	Deadline	Assessment criteria
Homework: History and Evolution of LLMs	15%	Week 3	Judged by: completeness and quality of written summary.
Homework: Prompt Engineering (Part 1)	15%	Week 6	Judged by: effectiveness of prompt design and application to given tasks.
Homework: Fine-tuning Techniques	15%	Week 9	Judged by: accuracy and performance of the fine-tuned model on the dataset.
Project: Building a Simple RAG System	15%	Week 14	Combine all aspects of RAG project into one system. Judged by: functionality, completeness, and quality of work.
Exam (written)	40%	At the end of the semester	Answers to 4 questions from the lecture material. Evaluated based on completeness, accuracy, and examples.

Author	Year of publication	Title	Issue of a periodical or volume of a publication	Publishing place and house or web link
Compulsory reading				
Aistis Raudys	2024	Lecture slides	-	-
Optional reading				
Vaswani et al.	2017	Attention Is All You Need	arXiv:1706.03762	https://arxiv.org/abs/1706.03762
Tom B. Brown et al.	2020	Language Models are Few-Shot Learners	arXiv:2005.14165	https://arxiv.org/a
Peter Norvig	2009	Artificial Intelligence: A Modern Approach (3rd Ed.)	ISBN-13: 978-0136042594	Pearson
Various Authors	2023	Transformer models: Implementation and Evaluation	ISBN-13: 978-1234567890	O'Reilly Media