Cyber-physical Systems Institute			Optional subject 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Generative Artificial Intelligence	NKVGM1EMNF	5	full-time	2	0	2
Responsible person for the subject: Prof. Dr. Felde Imre			Classification: professor			
Subject lecturer(s): Szigeti Mark Bence						
Prerequisites:	-					
Way of the assessment:	mid-term grade					

Course description	
Goal:	The goal of this course is to provide students with hands-on, practical mastery of generative artificial intelligence systems, with a strong focus on image generation and text generation using modern deep learning models. By the end of the course, students will be able to design, implement, fine-tune, and deploy generative AI solutions, critically evaluate their outputs, and apply them responsibly in real-world scenarios.
Course description:	This course offers a practice-focused introduction to Generative Artificial Intelligence, centered on two core application domains: AI image generation and AI text generation. Rather than emphasizing mathematical derivations, the course prioritizes implementation, experimentation, and project-based learning. Students will work hands-on with state-of-the-art generative models such as diffusion models and large language models (LLMs), using modern frameworks and tools. Through two major semester projects, students will build complete generative AI pipelines, from data preparation and prompt engineering to fine-tuning, evaluation, and deployment considerations. Ethical, legal, and societal implications of generative AI are integrated throughout the course, with a focus on responsible use, bias, copyright, and reproducibility.

Lecture schedule	
Education week	Topic
1.	Introduction to Generative AI & Course Setup
2.	Image Classification Baselines
3.	Generative Models Overview
4.	Generative AI for Data Augmentation
5.	Ethical concerns in synthetic data
6.	Introduction to Text Generation and LLMs
7.	Prompt Engineering and Control
8.	LLM Evaluation, Hallucinations & Safety
9.	Retrieval-Augmented Generation (RAG): Concepts
10.	RAG in Practice
11.	Advanced RAG & System Design
12.	Applied LLM Systems & Deployment
13.	From Models to Systems: Limits, Responsibility, and Real-World Impact of Generative AI
14.	Replacement project presentation

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Participation at both project works**

Assessment schedule	
Education week	Topic
5.	Image Generation project presentation
13.	LLM project presentation

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Both project work results need to exceed 51%. The final grade will be the average of the results.

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	**If any project does not reach 51% the student can replace the project in the form of a test in the 14th week.**

Type of the exam (to be filled out only for subjects with exams)

-

Calculation of the exam mark (to be filled only for subjects with exams)

-

Final grade calculation methods:

The final grade will be calculated using the following scale:

Achieved result	Grade
87% - 100%	excellent (5)
75%- 86%	good (4)
64% -74%	satisfactory (3)
51% - 63%	pass (2)
0 - 50 %	failed (1)

References

Obligatory:	– Jurafsky, Daniel; Martin, James H. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. 3rd Edition, 2025. Pearson. ISBN: 978-0131873216. – Babcock, Joseph; Bali, Raghav. Generative AI on AWS: Build and Deploy Large Language Models and Diffusion Models for Real-World Applications. Packt Publishing, 2023. ISBN-13: 978-1804612034 – Foster, David. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play. 2nd Edition. O'Reilly Media, 2023. ISBN: 978-1492081914.
Recommended:	– Vaswani, Ashish, et al. "Attention Is All You Need." Advances in Neural Information Processing Systems 30 (NIPS 2017), 2017. Available: https://arxiv.org/pdf/1706.03762.pdf – Rombach, Robin, et al. "High-Resolution Image Synthesis with Latent Diffusion Models." Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2022. Available: https://arxiv.org/abs/2112.10752 – "W3Schools Python Tutorial." W3Schools Online Web Tutorials, 2025. Available: https://www.w3schools.com/python/ – "PyTorch Tutorial." PyTorch Official Documentation, 2025. Available: https://pytorch.org/
Other references:	– Internet