Applied AI

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Instructor(s):

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Short description of the Course:

Artificial Intelligence has rapidly evolved from a research-focused discipline into a key driver of real-world software systems and digital products. Recent advances in generative AI, large language models (LLMs), and multimodal AI systems now enable developers to build intelligent applications that interact with users through text, images, audio, video, and other media.

This course focuses on the practical application of modern AI technologies, with special emphasis on Generative AI, large language models, multimodal AI systems, and multimedia-related tools. Students will gain hands-on experience with state-of-the-art tools and frameworks, learn how to run and integrate models locally, and explore how AI can be embedded into real software products and services.

In addition to core AI concepts and development-oriented workflows, students will also learn about a range of multimodal and multimedia tools and technologies. The course provides insight into how AI is transforming multimedia generation and shaping 3D, audio, image, and video technologies, with attention to both creative and engineering use cases.

The course combines conceptual understanding with practical sessions and project work. Students will design and implement AI-powered applications, experiment with orchestration frameworks, and evaluate the capabilities and limitations of current models in realistic development scenarios.

Special attention will be given to real-world engineering aspects such as model integration, local inference, retrieval-augmented generation, multimodal workflows, deployment constraints, privacy, cost considerations, and maintainability. The course will also include classes on the legal and ethical aspects of AI technologies, with particular emphasis on responsible use and the requirements and expectations commonly encountered in industry.

Aim of the Course:
The aim of the course is to provide students with practical, application and engineering oriented knowledge of modern AI systems, enabling them to design, implement, fine-tune, and evaluate AI-powered solutions.

By the end of the course, students will be able to work with generative and multimodal AI models, integrate them into software applications, understand their limitations, and make informed decisions about real-world deployment, ethical considerations, and responsible use.

Prerequisites:
Basic programming skills (e.g. Python, JavaScript, or similar).

Detailed Program and Class Schedule:

Foundations and Engineering of Generative AI Systems

- Course introduction. Overview of Applied AI. From classical AI to Generative AI. Use cases and project ideas.

- Introduction to Generative AI. Large Language Models (LLMs): concepts, capabilities, and limitations.
- Prompt engineering, structured prompting, and evaluation of LLM outputs.
- Running AI models locally: open-source LLMs, local inference, and performance considerations.
- AI application architectures. Integrating LLMs into software systems.
- LangChain fundamentals: chains, tools, memory, and agents.
- Advanced workflows with LangGraph. Orchestration of complex AI-driven systems.
- Retrieval-Augmented Generation (RAG) and knowledge-based AI applications.
- Agentic AI solutions.

Multimodal and Creative AI Applications

- Introduction to multimodal AI: text, image, and audio models.
- Multimedia AI systems: image generation, video generation, and creative AI tools.
- Multimodal application design: combining vision, language, and audio models.
- Ethical, legal, and security aspects of AI based solutions.
- Explainable AI and responsible AI.
- Deployment considerations: performance, cost, privacy, and maintainability.
- Project demonstrations and presentations.

Method of instruction:
Lectures, hands-on practical sessions, project work, and guided discussions.

Grading:
Assessment is based on a combination of guided practical assignments, project-based work, and active participation. Students complete two homework assignments and two larger module projects covering the main course topics. One of the module projects is further extended into a final project, which is presented and demonstrated at the end of the course.

Module 1: Foundations and Engineering of Generative AI Systems
Homework Assignment 1 (Generative AI Systems and Intelligent Agents): 10%
Module Project2: 30%

Module 2: Homework Assignment 2 (Multimodal AI and Creative Computing): 10%
Module Project 2: 30%

Additional elements:
Class Participation and In-Class Activities: 5%
Final Project Presentation and Demonstration: 15% (from the chosen Module Project)

Instructors' bio:

Péter Ekler is a senior lecturer at Budapest University of Technology and Economics, Department of Automation and Applied Informatics. He received his Ph.D. degree at BME in 2011. He has been working with mobile P2P and social networks for six years. He is the creator of the first BitTorrent client for mainstream mobile phones based on Java ME platform. He was co-author of several mobile related scientific papers and book chapters. His field of research covers mobile-based social networks, P2P solutions, data analysis and power law distributions in large networks. He has participated in several data warehouse and business intelligence related projects. He teaches mobile software development for several mobile platforms.

István Keszei (born in 1974) graduated from the Moholy-Nagy University of Art and Design (MOME) in Budapest as an industrial designer. He commenced his Ph.D. studies at MOME in 2012, where he has been lecturing since 2010. His Ph.D. thesis is titled “design for disaster situations.” He is currently teaching a course at MOME on intelligent materials and technology and presentation skills with 2D/3D. He has received several national and international design awards and honors, including the 2009 Pál Takács

Scholarship for Academic Achievement for best industrial design student of the year. He currently also works as an industrial lighting and electronics designer.