



FDD3559 Large Language Models for Computer Scientists 7.5 credits

LLMs för datavetare

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FDD3559 valid from Spring 2025

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Enrolled as doctoral student in Computer Science

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

ILO1: Describe the fundamental concepts of key LLM model architectures and their application areas

ILO2: Identify and describe the fundamental building blocks in LLMs, prompting and RAG

ILO3: Demonstrate conducting key steps of building LLMs in frameworks LangChain and Llama Index

ILO4: Analyze and evaluate fine-tuning strategies and optimization techniques for LLMs

ILO5: Design and conduct a qualified and quantifiable use case that applies LLM techniques related to own research

Course contents

This course aims to prepare students with a deep understanding of the principles and practices involved in building Large Language Models. The course combines theoretical knowledge with practice via demonstration in use cases to support students to apply the learnt knowledge in their own research work. The main topics covered in the course include:

1)Module 1: Introduction to LLMs: History and evolution of LLMs; Building Blocks of LLMs; Key LLM architectures; Environmental, Computational, and Ethical considerations

2)Module 2: Foundations of LLMs: LLMs in practice; Prompting; RAG; LangChain and Llamaindex.

3)Module 3: Building LLMs: Prompting with LangChain; Indexes, retrievers, and data preparation; Advanced RAG; Agents;

4)Module 4: Fine-Tuning LLMs: Understand Fine-tuning; Low-Rank Adaptation; LLM Deployment; Quantization and Pruning

The course has four modules that are specifically designed to prepare students for the first four intended learning outcomes. In addition, The students must apply their acquired knowledge in the final project and write and present the project to demonstrate the fifth learning outcome is also achieved.

The first two modules focus on basic theoretical knowledge while the third and fourth modules deepen the knowledge from the first two modules by applying the theoretical knowledge in practical use cases. At the end of each module, students will be assessed with quizzes and assignments.

Examination

- LAB1 - Laboratory work, 1.0 credits, grading scale: P, F
- LAB2 - Laboratory work, 1.0 credits, grading scale: P, F
- LAB3 - Laboratory work, 1.0 credits, grading scale: P, F
- LAB4 - Laboratory work, 1.0 credits, grading scale: P, F
- PRO1 - Project, 3.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

The course has four modules and each module consists of an assignment and one quiz. The course is designed so that a later module relies on the completion of previous modules, so that the knowledge can accumulate and build up.

Each student must also complete a final project, including writing up a final report and giving a presentation. The project will evaluate the learning outcomes via designing and conducting a qualified and quantifiable use case that applies LLM techniques to their own research context.

The course is evaluated progressively through multiple components throughout the whole course. The components for the 7.5 credits course are:

- **Quiz x 4:** Four tests in the form of quizzes that test the knowledge students have acquired in the modules. One test per module. P /F.
- **Assignments x 4:** Four assignments that consist of a set of theoretical questions that test student's understanding of knowledge and concepts and a set of programming tasks that test student's practice in applying the knowledge in LLM frameworks. One assignment per module. P /F.
- **Final Project x 1:** The final project requires each student or group to submit a report that applies the subject areas of the course in their own research and give an oral presentation.

Other requirements for final grade

None

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.