TUM

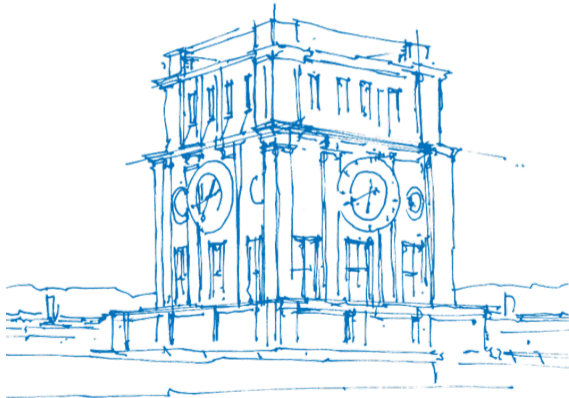# Seminar on Large Language Models

Prof. Dr. Alexander Fraser

Chair for Data Analytics & Statistics
TU München

Summer 2024

Outline

TUM

1 Introduction

2 Bachelor Seminars

3 Large Language Models

4 Seminar on Large Language Models

Who We Are

- **Prof. Dr. Alexander Fraser**
  - Primary Lecturer
  - New permanent professor (chair) for Data Analytics & Statistics, also teaching Discrete Probability Theory
  - Research on Machine Translation, Natural Language Processing, Machine Learning
- **Dr. Marion Di Marco**
  - Lecturer on Language and N-Gram Language Models, Organization of the Student Presentations
  - Researcher at the chair
  - Research on Machine Translation, Linguistic Information in Large Language Models

Outline

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Bachelor Seminars at TUM

- Learn how to read the scientific literature
- How to present scientific ideas (such as a particular scientific paper and papers it is related to)
- How to be the primary discussant of a presentation (e.g., answer questions on your presentation and the literature)
- How to write scientifically
- How to ask questions to the presenter of a scientific idea

Course Information
Contents and goals of this course

This course will look at Large Language Models:

- **Primarily from a computational side**
  - ☐ Understanding the challenges of modeling language
  - ☐ Basic understanding of the challenges of language modeling
  - ☐ In-depth understanding of n-gram language models
  - ☐ In-depth understanding of deep learning and neural language modeling

- **But also a little bit from a linguistic side**
  - ☐ Understanding the linguistic challenges of language modeling
  - ☐ Understanding some differences in terms of the (human) language modeled

Course material

We will mostly use the primary scientific literature. This course will involve an unusually high amount of reading for a computer science course.

Course Requirements

- To pass this course ...
    - ☐ Regular attendance to the lectures at the beginning of the course
    - ☐ Presentation on a scientific paper using, e.g., latex-beamer or powerpoint
    - ☐ A discussion of "your" scientific paper
    - ☐ Written summary of your presentation (using the formatting of a scientific paper, e.g., citations)
    - ☐ Regular attendance and participation in the presentations of the scientific papers of other students

Questions?

Any questions about logistics, etc., before I briefly introduce Large Language Models and some specifics of this class?

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Outline

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Large Language Models

- Large Language Models (such as GPT2, GPT3, GPT4, RoBERTa, T5) and Intelligent Chatbots (such as ChatGPT, Bard and Claude) are a very timely topic.

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- Large Language Models (LLMs) are the framework underlying intelligent chatbots like OpenAI's ChatGPT

- A LLM is designed to compute the posterior probability of any word, conditioned on a string of proceeding words

- LLMs can be sampled from, and used in a chain of repeated operations to generate a (random) text

- Perhaps most famous LLMs: GPT3, GPT4

- Intelligent Chatbots (such as ChatGPT) are LLMs which are extended through instruction tuning and "human alignment" to become discussion partners with humans

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1. Introduction

2. Bachelor Seminars

3. Large Language Models

4. Seminar on Large Language Models

Topics In the First Half (Intensive Lecture Format, with assigned readings)

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- Language (lecture from Dr. Di Marco today), important language phenomena
- N-gram Language Models
- Neural Language Modeling
- Word2Vec (static embeddings) and word embeddings in general
- Recurrent Neural Networks (RNNs)
- Transformers
- BERT
- Instruction Fine-Tuning
- RLHF
- ChatGPT

Some Ideas Of Topics For Student Presentations

- Multilingual alignment
- Prompting
- Transfer learning
- Domain adaptation
- Linguistic knowledge in large language models

Topics will be presented here in a few weeks, you will apply for topics, and then you will have time to prepare them.

Questions?

Any questions before I handoff to Dr. Di Marco to lecture on language?

Dankeschön

Thank you for your attention

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