Artificial Intelligence
Advanced Topics in AI & ML
Final Exam

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ML Research

Content

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Exam information

- Exam format: **hand-written on paper**
- Exam duration: **1.5 hrs**
- Materials allowed to be used: **hand-written notes (1 sheet of paper, both sides can be used))**
- No one is allowed to use either the **phone**, **laptop** or **printed materials**
- Exam parts:
  1. AI Design: 60%
  2. Short questions about the course content: 40%

Exam process

Exam procedure:

- Exam Assignment will be open in **Canvas** for the **time of Exam** (and **only** during this time!)
- You'll need to write Exam Assignment on paper sheets and when you finish, take a photo / convert to pdf and **submit** as a 'File Upload' to Canvas
- You'll have only **1 attempt** to submit, so please be careful!
- After submission, please **deliver** the written sheets to **Professor / Classroom Manager** (to be collected, stored, and probably scanned for better quality)

Remarks on process

- You need to add your name at the top left of the each side of every sheet
- You need to add the page number at the top right of the each side of every sheet (1, 2, 3, 4, 5, ...)
- Allowed: Only one person at a time may leave the room

Exam topics: design

Demonstration the ability to design and apply the discussed during the Course AI techniques. It should consist (but not limited to) of the following sub-steps:

- Justification of a chosen direction (GenAI, NLP, CV, ASR)
- Clear AI task statement: motivation, reasonableness, potential benefits
- Clarification of choosing a trending AI solution over the classical one
- Objective metrics proving the approach selection
- An iterative process of dealing with the new emerging paradigms / change in trends

Exam topics: concepts

- AI History overview
- Deep Learning and Neural Nets approach
- GenerativeAI concept (and its connection to DL and NN)
- GenAI: GAN-based and Diffusion-based approaches
- Transformer properties and Transformer-based encoders (BERT) and decoders (GPT)
- LLM concept (and its connection to Transformers)
- DL applications: Computer Vision (and Convolution Neural Nets)
- DL applications: Automatic Speech Recognition (and Recurrent Neural Nets)
- Multi-tasking concept (and its connection to optimization)
- Meta-learning (including few-shot learning) framework
- Multi-modality concept (including architectural considerations)
- Neural Net Robustness problem
- Adversarial attacks (including digital and real-world)
- EmbodiedAI main principle
- Autonomous Driving Automation levels
- Autonomous Driving Stack

Exam problems (note: use comparison tables whenever it's possible)

AI Design

Given: you need to create the AI system for translation — a Personal Universal Translator (PUT) between any two known languages. PUT is capable to perceive, understand, translate, and pronounce the processed phrase.
Task: to design the PUT using the concepts covered in lectures. Need to clarify the reasonableness of usage of any different ideas / modules (and arguing against the classical ones if possible). Propose the iterative process of upgrading PUT when a change in paradigm / trends happens.

Simple questions about AI/ML concepts

1. Describe the key feature(s) of the Transformer architecture?
2. What is common and different between BERT and GPT models?
3. ...and Multi-tasking, meta-learning, few-shot-learning, and multi-modality?
4. Main aims of Perception, Prediction, and Planning modules of Autonomy Stack

Thank you *all*!