

Deep Learning and Artificial Intelligence
WS 2024/25

Exercise 8: Self-supervised Learning

Exercise 8-1 Contrastive Learning

- (a) What are positive and negative samples in contrastive learning?
- (b) How are negative samples chosen in SimCLR? What would happen if we did not use negative samples in SimCLR?
- (c) Discuss and compare the contrastive learning frameworks SimCLR, SwAV, BYOL, and SimSiam from the lecture. Thereby, pay specific attention to the training objectives, the usage of negative samples, the usage of (different) networks, and gradient flow.
- (d) How does CLIP differ from the contrastive methods above? What are the advantages of that?

Exercise 8-2 Self-supervised Training in NLP

- (a) What are CBOW and Skip-gram in Word2Vec?
- (b) What are Next Sentence Prediction (NSP) and Masked Language Modeling (MLM)? What famous model were they used for? These two objectives are self-supervised as no labels or data annotations are used but solely the sequentiality of language and text are leveraged to define pre-training tasks. These tasks are used in the pre-training of BERT.

Exercise 8-3 Autoencoder Techniques

- (a) What is an autoencoder? Why "auto"?
- (b) What three examples of autoencoders have you seen in the lecture? What are the key ideas behind these methods? What is the central high-level similarity of these methods?