

DATA.ML.200 Deep Learning

Exam 11.12.2024

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Use of a non-programmable calculator is allowed (but not necessary for the completion). You can answer either in English or Finnish.

1. Describe shortly (max. 25 words each) what the following operations do in deep neural networks (max. 5 points each)
 - a) Softmax
 - b) Backpropagation
 - c) Attention
 - d) Positional encoding
 - e) Sigmoid
 - f) Binary cross-entropy

2. A convolutional neural network consists of multiple blocks, each having a convolutional layer, max pooling layer, and batch normalization layer. Answer shortly the following questions.
 - a) What does the convolution operation in neural networks do? What can it do better than fully connected layers used in multilayer perceptrons? (10 points)
 - b) What does the max pooling operation in convolutional neural networks do? Why they are useful? (10 points)
 - c) What does the batch normalization layer do? Why they are useful? (10 points)

3. Three tasks (a-c) below need to be solved by deep neural network based methods based on three available architectures: 1) multilayer perceptron, 2) convolutional neural network, 3) transformer. Choose the most suitable architecture for each task below. Justify shortly (maximum 40 words) each answer. Each architecture can only be used once (max. 10 points each).
 - a) Generating a textual answer based on a textual prompt
 - b) Recognizing the species of an animal based on its weight and height
 - c) Classifying whether a 1-second audio sample is speech or music

4. List three methods which can be used to prevent overfitting in deep neural networks, and describe shortly (max. three sentences each) how they operate (max. 30 points).

5. A Transformer decoder model is used in a machine translation task where a sequence of words in source language is converted to a sequence of words in the target language (30 points).
 - a) What could be an input and the corresponding target output when training the model?
 - b) What representation of the input and output would be good?
 - c) What should be the input to the model and the corresponding output at the inference stage?