Python - Convolutional neural networks

Course code: PYTHON_ML_CNN

Convolutional Neural Networks (CNN) are a type of neural networks that are often used to solve image processing problems, such as image classification, object detection, and image segmentation.Convolutional networks are based on convolutions, which are mathematical operations that allow applying a filter to input data. In the case of images, these filters are often small matrices that loop over the image input and perform calculations. In this way, convolutional networks can detect various image features and learn to recognize certain patterns in images.Convolutional networks consist of multiple layers, which are usually alternated with max-pooling layers or other layers that reduce the dimensions of the image. At the end of the network, there are usually several fully connected layers that decide on the output of the network.Convolutional networks are very successful in solving image processing problems and also have many other applications, such as in speech recognition and natural language processing.

Participant requirements

- Knowledge of Python programming at the PYTHON_INTRO course level, but knowledge at the PYTHON_ADV course level is an advantage
- Knowledge of the basics of data analysis at the level of the PYTHON_DATAAN course
- Knowledge of the basics of machine learning at the level of the PYTHON_ML_INTRO course
- Knowledge of the basics of neural networks at the level of the PYTHON_ML_NN course

Teaching methods

- Professional explanation with practical examples, exercises on computers.

Study materials

- Presentation of the subject matter in printed or online form.

Course outline

Day 1:

- Introduction to convolutional networks and working with data
- Basics of convolutional networks
- Work with image data
- Convolution, max-pooling and other operations
- Training and testing of models
- Implementation of a simple convolutional network in PyTorch or TensorFlow

Day 2:

- Advanced convolutional networks
- Multilayer convolutional networks
- Reducing the dimensions of images in the network
- Regularization and overfitting
- Convolutional networks with residual blocks
- Transfer learning and the use of pre-trained models

Day 3:

- Solving problems in image processing
- Classification of images
- Object detection
- Image segmentation
- Practical exercises for solving these problems

Day 4:

- Practical use of convolutional networks
- Use of convolutional networks on specific applications
- Natural language processing using convolutional networks

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- Speech recognition and the use of convolutional networks in audio applications
- Discussion on specific uses of convolutional networks in the participants' industry

Day 5:

- Optimization and expansion of convolutional networks
- Optimization and adjustment of network parameters
- Networks with variable architecture and design of new architectures
- Comparing the performance of different models
- Modification of convolutional networks for special cases, such as mobile devices or computers with limited resources
- Discussion on the future of convolutional networks and their applications
- Each day would include a theoretical part and practical exercises, where participants could use the learned techniques in practice
- Regenerate response

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