Deep Learning in NLP: Summary / Takeaway

Christian Wurm & Tatiana Bladier

Heinrich-Heine-Universität Düsseldorf
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Overview

What was it all about?

- ⋆ Introductory course to Deep Learning in NLP and applications with Keras.
- ⋆ Now you are able to understand and build neural network models using Keras and Python.
- ⋆ You can solve some NLP Problems using deep learning architectures: POS-tagging, named entity recognition, chunking, sentiment analysis, text classification, semantic role labeling, text generation.
- ⋆ You can better understand and adapt code you find on GitHub according to your deep learning task (or write your own code based on some scientific article).

Deep Learning Projects: 6 Basic Steps

1. Problem or task: machine translation, sentiment analysis, text classification, part-of-speech tagging, text generation etc.

2. Input data points (features): files of people speaking, text files, images etc.

3. Examples of the expected outputs (tags or labels): transcripts of sound files, positive/negative, cat/dog/fish etc.

4. Suitable algorithm to train on those data.

5. Way to evaluate how good the algorithm and the model is (distance between the algorithm's output and expected output).

6. Present your results.

Neural Network Models we used in class

- ⋆ Feed-Forward Network (FFN) (Boston housing)
- ⋆ Simple Recurrent Neural Network (RNN) (Name recognition)
- ⋆ Long Short-Term Memory (LSTM) (POS-tagging)
- ⋆ Gated Recurrent Unit (GRU) + Bidirectional GRU (used for sequence labeling)
- ⋆ Bidirectional Recurrent Neural Network (BiLSTM) (POS-tagging, chunking, named entity recognition)
- ⋆ Convolutional Neural Network (CNN) for character models → capture morphological information
- ⋆ Multichannel CNN (sentiment analysis)
- ⋆ Conditional Random Field (CRF) + BiLSTM (semantic role labeling, sequence labeling in general)

Use embeddings

- ⋆ Character-level embeddings (to encode characters in words).
- ⋆ Word-level embeddings (one-hot, pretrained, own embeddings: Word2Vec).
- ⋆ Sentence-level embeddings + text-level embeddings.

What else?

- ⋆ Use Keras and Keras functional API.
- ⋆ Prepare (vectorize) your data for training.
- ⋆ Visualize your neural network model (using plt model).
- ⋆ Save and re-use pre-trained models.
- ⋆ Make predictions with the model.
- ⋆ Evaluate the model performance with the following metrics: accuracy, recall + precision + F1 score, confusion matrix.
- ⋆ Use early stopping to save the best model and stop training.
- ⋆ Use fit generator to avoid out-of-memory (OOM) issues.
- ⋆ Use LaTeX to describe your experiments and results.

Books on Deep Learning in NLP

- ★ Chollet (2017) *Deep Learning with Python*.

- ★ Goldberg and Hirst (2017) *Neural Network Methods for Natural Language Processing*.

- ★ Brownlee (2016). *Deep Learning for Natural Language Processing. Develop Deep Learning Models for Natural Language in Python*.

- ★ Geron, Aurelien (2017) *Hands-on machine learning with Scikit-Learn and TensorFlow : concepts, tools, and techniques to build intelligent systems*.

- ★ Harrison and Honnibal (2020) *Deep Learning with Text: A Modern Approach to Natural Language Processing with Python and Keras*.

Some good tutorials

- ⋆ https://keras.io/
- ⋆ https://machinelearningmastery.com/

AP Projects: Evaluation Criteria

- $\star$ Clarity of writing / presentation: 1-5
- $\star$ Research question / hypothesis: 1-5
- $\star$ Soundness / correctness: 1-5
- $\star$ Empirical evaluation: 1-5
- $\star$ Dataset / effort: 1-5

References I

Brownlee, J. (2016). *Deep Learning for Natural Language Processing. Develop Deep Learning Models for Natural Language in Python.*

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Goldberg, Y. and Hirst, G. (2017). *Neural Network Methods for Natural Language Processing.* Synthesis Lectures on Human Language Technologies. Morgan & Claypool Publishers.

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