

Call for Bachelor/Master Thesis “Deep Learning + Knowledge Graphs” (in English or German)

What is the topic?

Graph neural networks [1] are a group of neural network architectures which are very powerful, as they combine deep learning architectures with graphs. Consequently, decisions made by deep learning systems become explainable. Furthermore, these models are often outstanding in their performance.

The focus of the proposed thesis is to apply graph neural networks to existing knowledge graphs like DBpedia and Wikidata. The student will apply existing implementations of graph neural networks to new application areas (e.g., information extraction from text). Furthermore, own basic approaches for graph neural networks will be developed.

```
def GCN(nhid: int, nclass: int, dropout: float):  
    """  
    This function implements the GCN model that uses 2 Graph Convolutional layers.  
    """  
    gc1_init, gc1_fun = GraphConvolution(nhid)  
    _, drop_fun = Dropout(dropout)  
    gc2_init, gc2_fun = GraphConvolution(nclass)  
  
    init_funs = [gc1_init, gc2_init]  
  
    def init_fun(rng, input_shape):  
        params = []  
        for init_fun in init_funs:  
            rng, layer_rng = random.split(rng)  
            input_shape, param = init_fun(layer_rng, input_shape)  
            params.append(param)  
        return input_shape, params  
  
    def apply_fun(params, x, adj, is_training=False, **kwargs):  
        rng = kwargs.pop('rng', None)  
        k1, k2, k3, k4 = random.split(rng, 4)  
        x = drop_fun(None, x, is_training=is_training, rng=k1)  
        x = gc1_fun(params[0], x, adj, rng=k2)  
        x = nn.relu(x)  
        x = drop_fun(None, x, is_training=is_training, rng=k3)  
        x = gc2_fun(params[1], x, adj, rng=k4)  
        x = nn.log_softmax(x)  
        return x  
  
    return init_fun, apply_fun
```

Figure 1. Example of a GNN implementation [2].

[1] <https://arxiv.org/pdf/1812.08434.pdf>

[2] <http://gcucurull.github.io/deep-learning/2020/04/20/jax-graph-neural-networks/>

Which prerequisites should you have?

- Hands-on experience in machine learning, no fear to implement neural network models (under guidance of the supervisors).

In case of good results, the findings of the thesis can be published as scientific paper together with the supervisor.

Starting date: As soon as possible.

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