Hierarchical Temporal Memory: Analysis and Application

Final Project Proposal

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1 Research Object

In this project we focus on the comparative study between the brain-like unsupervised learning algorithm – Hierarchical Temporal Memory (HTM) [2] with state-of-art sequence learning algorithms. We want to show several excellent properties of HTM over deep learning sequence models.

2 Research Content

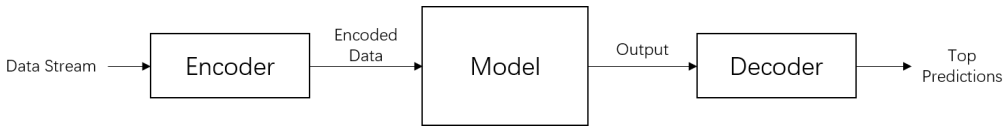

Figure 1: Flow of Experiment

Our main form of research is sequence learning, as is shown in figure 1. In the real-time data stream, we encode each element in the data stream into the input that conforms to the model, and get the input after the input model. And then get the predicted value through decoding. In the actual implementation process, the encoders and decoders of different algorithms are different.

2.1 Model included

The main model is Hierarchical Temporal Memory (HTM). The comparative include RNN, LSTM, Transformer(eg. BERT).

2.2 synthetic data

By designing experiments of synthetic data, we studied hierarchical time memory networks from the aspects of continuous learning, long-term dependency, multiple prediction, noise resistance and encoding methods. The synthetic data was manufactured to simulate many kinds of situations in sequence learning. We can change its cycle period, noice level, where to apply diturbance etc.

2.3 real data

By designing real data experiment, the application ability of hierarchical time memory network in practical problems is studied. This experimental data set is from dataset 1 of Kaggle's DJIA 30 Stock Time Series. DJIA 30 Stock Time Series contains the stock information of 30 Dow Jones companies from January 1, 2016 to January 1, 2018. for gold Mathematical modeling of time series data.The stock information of each company contains the following contents: Date, opening price, high, low, close, trading volume.

3 Feasibility Analysis

3.1 Previous achievement

Some previous works have been down in recent years. Cui, Yuwei (2016) et al [1] have study the continuous learning effectiveness of HTM and other models. But reproduction of their work shows several mistakes of their codes. And they didn't include the state-of-art sequence models.

3.2 Current Resources

Currently we are equipped with 1 RTX 2080 GPUS and 16GB of memory, which is sufficient for our research.

3.3 Platforms

This experiment was done on the experimental platform based on PyExperimentSuite.PyExperimentSuite is an open source software tool written in Python.It reads parameters (or range of parameters) from a configuration file, runs experiments using multiple kernels, and records the results in a file.A combination of parameters can be evaluated as a grid or a list.PyExperimentSuite also supports continuing any experiments that were interrupted when execution was interrupted (for example, power failure, process termination, etc.).

References

[1] Yuwei Cui, Subutai Ahmad, and Jeff Hawkins. "Continuous online sequence learning with an unsupervised neural network model". In: *Neural computation* 28.11 (2016), pp. 2474–2504.

[2] Jeff Hawkins and Subutai Ahmad. "Why neurons have thousands of synapses, a theory of sequence memory in neocortex". In: *Frontiers in neural circuits* 10 (2016), p. 23.