Assignment 5

ADTA 5560.701 - Recurrent Neural Networks for Sequence Data

PART I: RNN: LSTM: Core Concepts: Cell (C) State

In LSTM networks, the state of the cell is like an information highway that allows data to traverse without side barriers across time. This process works by not enforcing any transformation, preserving long-term dependencies accordingly. In writing, index-like behavior helps generate a continuous flow of info from Ct-1 to Ct: it not only preserves the gradient during backpropagation through time but maintains relevant information over prolonged sequences. The cell state, as a snapshot mechanism, is the fixed-point capture of the network memory. This representation enables us to encode temporal dependencies numerically and secure the information through a gating mechanism while maintaining stable memory over time.

A diagram of a gate

Description automatically generated

PART II: RNN: LSTM: Core Concepts: Gates

The architecture, learning strategy, and independent functioning of the gate components in LSTM networks exhibit features characteristic of independent neural networks. Following the connection matrix and gate update cycle, gates include trainable weight matrices, bias terms, and an activation function (such as sigmoid/tanh), through which data is processed in a matrix operation. These gates can learn parameters through backpropagation and, therefore, become able to adapt for pattern recognition or, better yet, be parameterized autonomous decision-making systems. We have multiple gates; each gate gets its weight matrices and has its own activation function and information processing role. The forget gate can remove what we don’t need to remember; the input gate just holds new helpful information, while output gates are used to ignore unessential outputs.

References

1. Hochreiter, S., & Schmidhuber, J. (1997). Long Short-Term Memory. Neural Computation.

2. Graves, A. (2012). Supervised Sequence Labelling with Recurrent Neural Networks.

3 Images from the lecture note.