Time Series Classification for Human Activity Recognition with LSTMs using TensorFlow 2 and Keras

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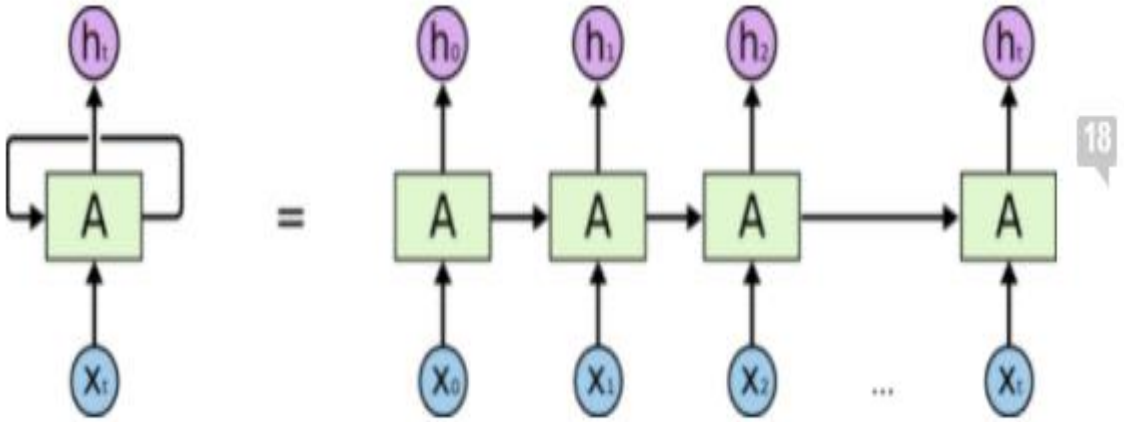
HUMAN ACTIVITY RECOGNITION

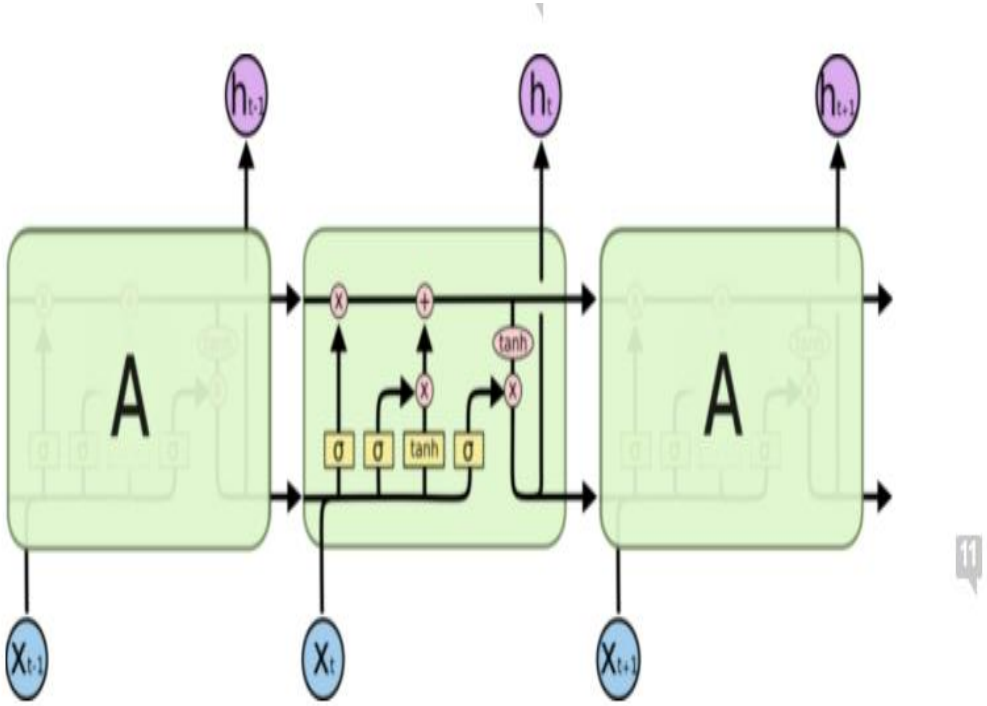
- Human activity recognition, or HAR, is a challenging time series classification task.
- Human activity recognition(HAR) is a broad field of study concerned with identifying the specific movement or action of a person based on sensor data.
- It involves predicting the movement of a person based on sensor data and traditionally involves deep domain expertise and methods from signal processing to correctly engineer features from the raw data in order to fit a machine learning model.
- Recently, deep learning methods such as convolutional neural networks and recurrent neural networks have shown capable and even achieve state-of-the-art results by automatically learning features from the raw sensor data.

Recurrent Neural Network Models

- Recurrent neural networks (RNNs) are a type of neural network that was designed to learn from sequence data, such as sequences of observations over time, or a sequence of words in a sentence.
- A recurrent neural network can be thought of as multiple copies of the same network, each passing a message to a successor.
- If we are using the activation functions, then it becomes very tedious to process long sequences.
- It faces issues like Exploding or Gradient Vanishing.



Long Short-Term Memory Network (LSTM)



The repeating module in an LSTM contains four interacting layers.

- Long Short Term Memory networks are a special kind of RNN, capable of learning long-term dependencies.
- A layer in an LSTM model is comprised of special units that have gates that govern input, output, and recurrent connections, the weights of which are learned.
- Each LSTM unit also has internal memory or state that is accumulated as an input sequence is read and can be used by the network as a type of local variable or memory register.
- The LSTM is trained in a way that pays specific attention to observations made and prediction errors made over the time steps in the input sequence, called backpropagation through time.

TensorFlow 2.0 and Keras

- TensorFlow 2 is an end-to-end, open-source machine learning platform.
- TensorFlow 2.0 focuses on simplicity and ease of use, with updates like eager execution, intuitive higher-level APIs, and flexible model building on any platform.
- Keras is the high-level API of TensorFlow 2.
- An approachable, highly-productive interface for solving machine learning problems, with a focus on modern deep learning. It provides essential abstractions and building blocks for developing and shipping machine learning solutions with high iteration velocity.

Dataset

- Data is collected through controlled laboratory conditions. It is provided by the WISDM: WIreless Sensor Data Mining lab.

Statistics

Raw Time Series Data

- Number of examples: 1,098,207
- Number of attributes: 6
- Missing attribute values: None
- Class Distribution
  - Walking: 424,400 (38.6%)
  - Jogging: 342,177 (31.2%)
  - Upstairs: 122,869 (11.2%)
  - Downstairs: 100,427 (9.1%)
  - Sitting: 59,939 (5.5%)
  - Standing: 48,395 (4.4%)

References

- https://arxiv.org/abs/1707.03502
- https://ieeexplore.ieee.org/document/7026300
- https://www.mdpi.com/1424-8220/17/11/2556
- https://www.youtube.com/watch?v=XOEN9W05_4A&ab_channel=JorgeLuisReyesOrtiz

THANK YOU