Machine Learning and Data Analytics
ME 5013- Fall 2019

Lectures 21

- Recurrent Neural Network

UTSA
The University of Texas at San Antonio™

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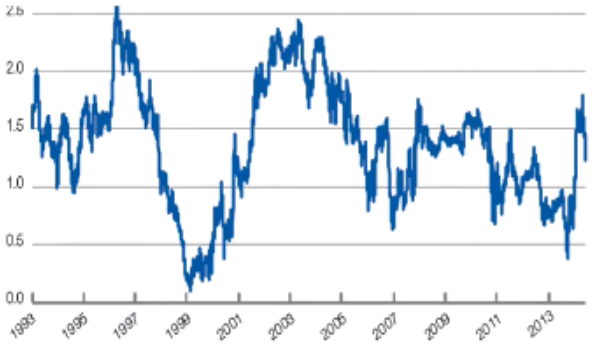
Disclosure: the slides are adopted from IBM developer skills network class

Sequential Data

- Sequential Data – data points with dependencies



A **recurrent neural network** (**RNN**) is a class of artificial neural ne
inputs. This makes them applicable to tasks such as unsegmentec

The term "recurrent neural network" is used indiscriminately to refe
unrolled and replaced with a strictly feedforward neural network, w

Both finite impulse and infinite impulse recurrent networks can hav
gated memory, and are part of long short-term memorys (LSTMs)

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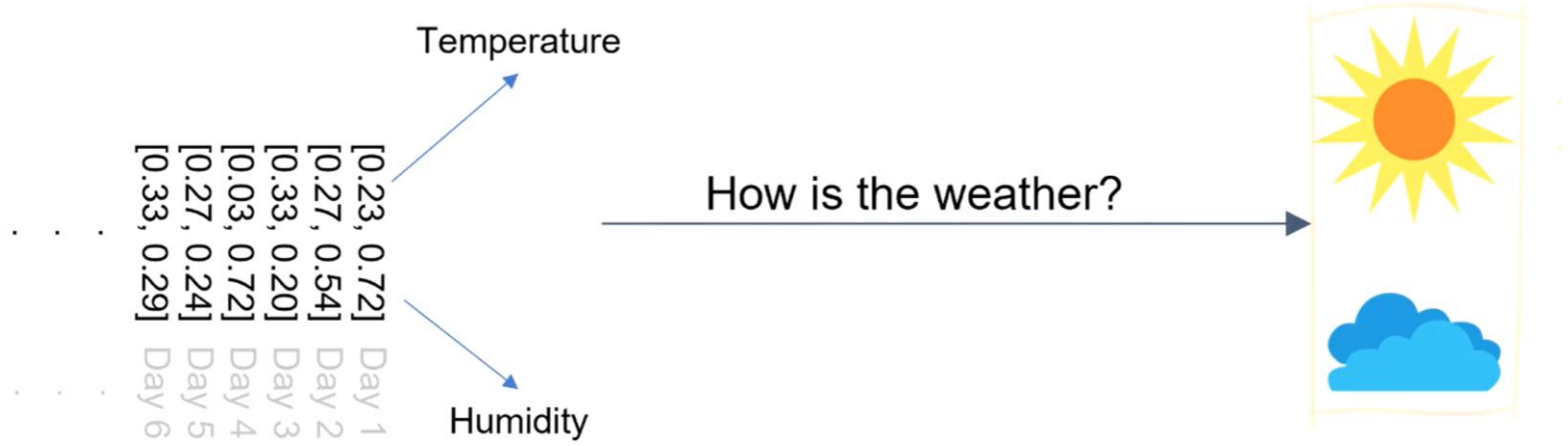
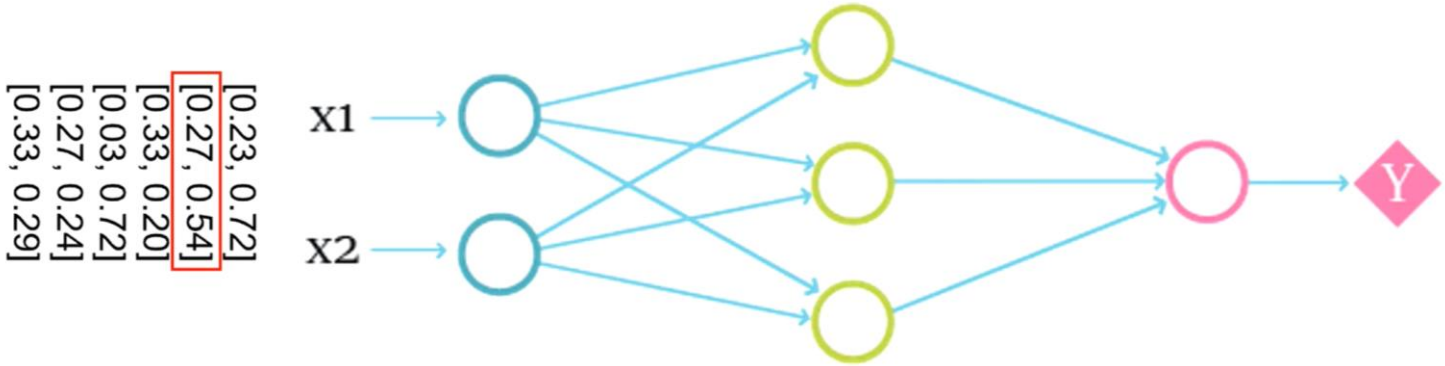
- Not handled well by traditional Neural Networks

The Sequential problem

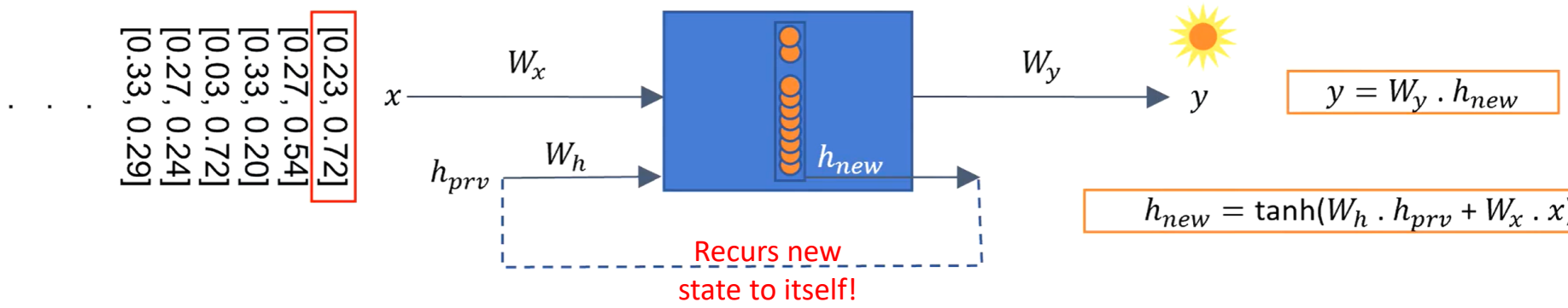




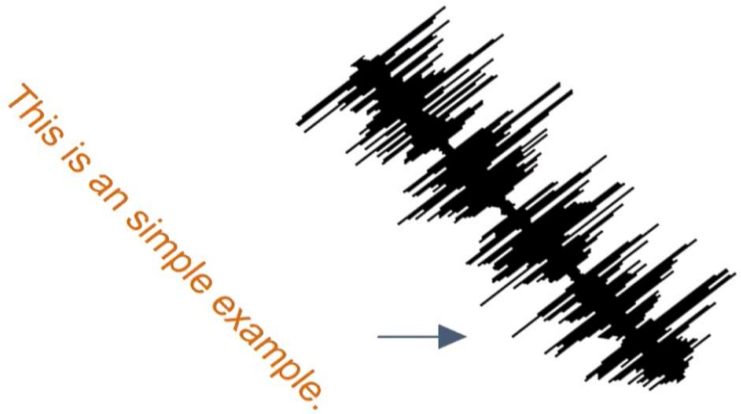
This network does not remember what it output.
It just accepts the next data point.

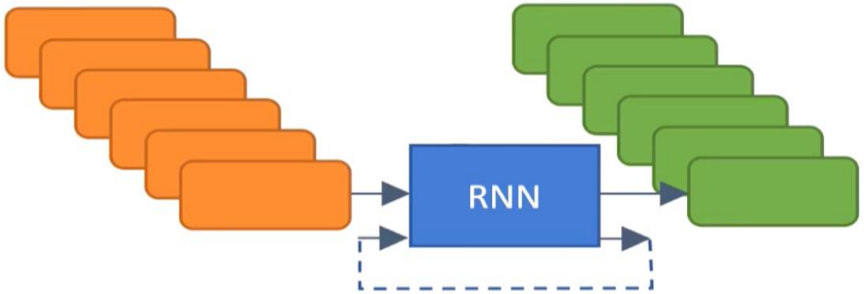
The Recurrent model

- RNN: Maintain the state
- State (context/memory): Information of what has been previously calculated



- Application: Speech recognition

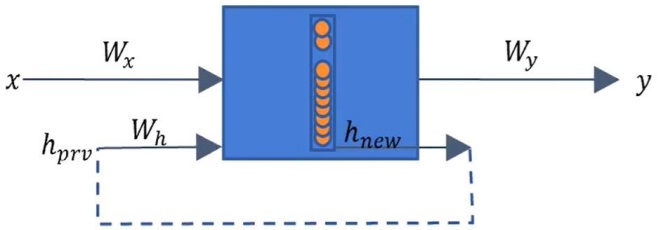




Recurrent Network Problem

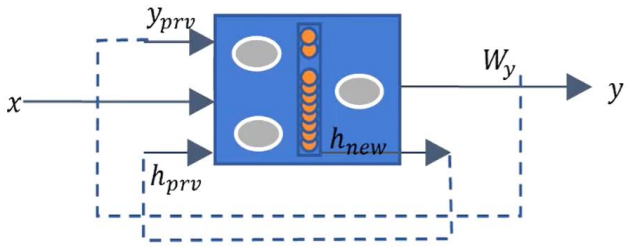
Scaling up : Tracking of state &training:

- Maintaining states is expensive
- Vanishing gradient
- Exploding gradient
- Solution: Long Short-Term Memory



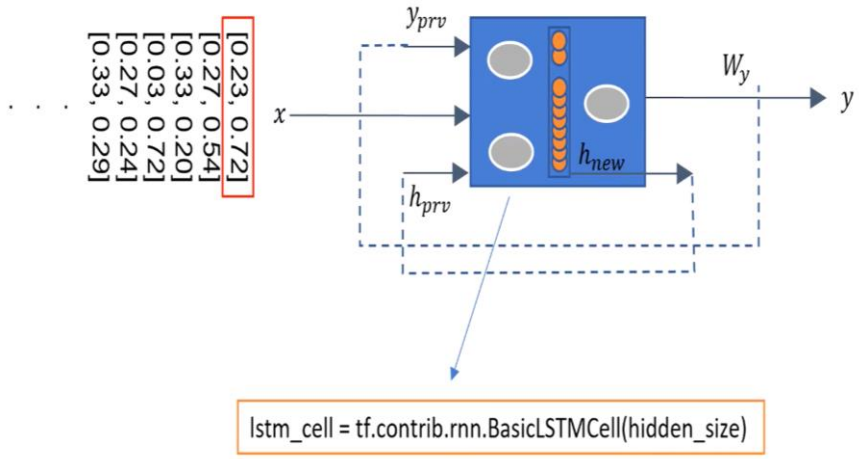
LSTM:

- A type of RNN
- In addition of the memory (hold data) has 3 logistic gate (conduct 3 operations)
- The gates define the flow of data
  - Write to the memory
  - Read from memory and send back the RNN
  - Forget or maintain the data from information cell (weather or not forget old information)

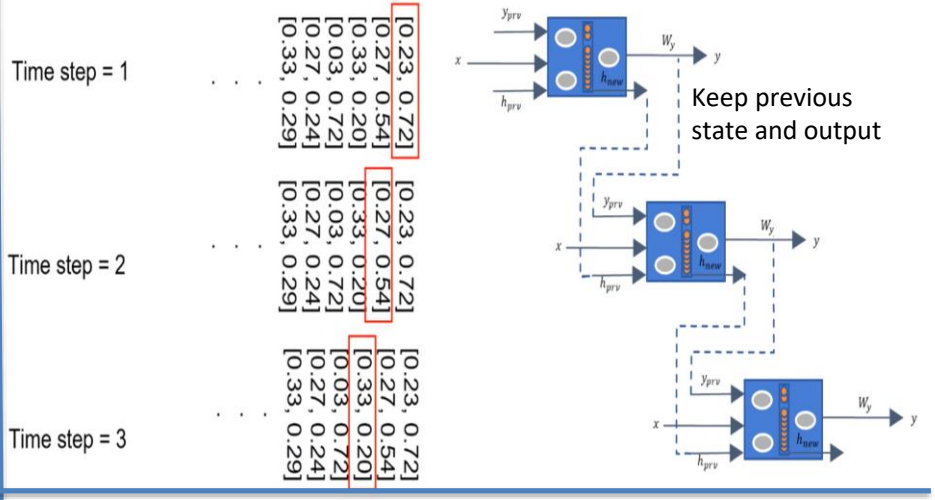


The LSTM unit

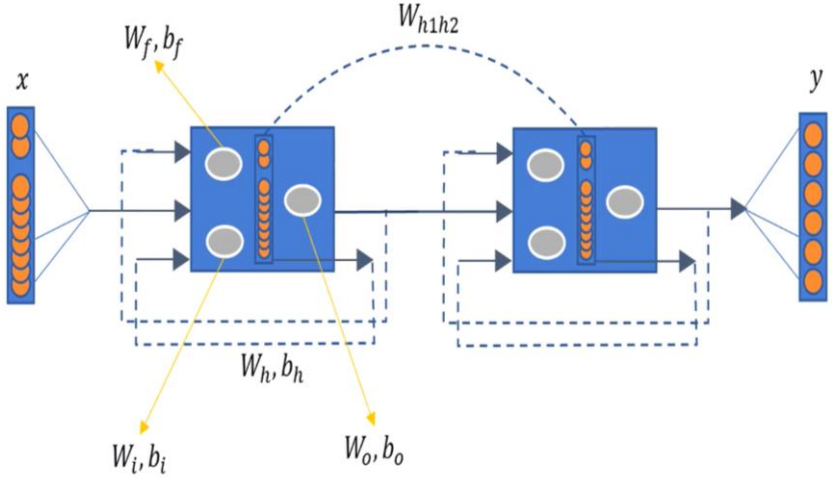
LSTM unit



Unfolded LSTM



LSTM training



Stacked LSTM