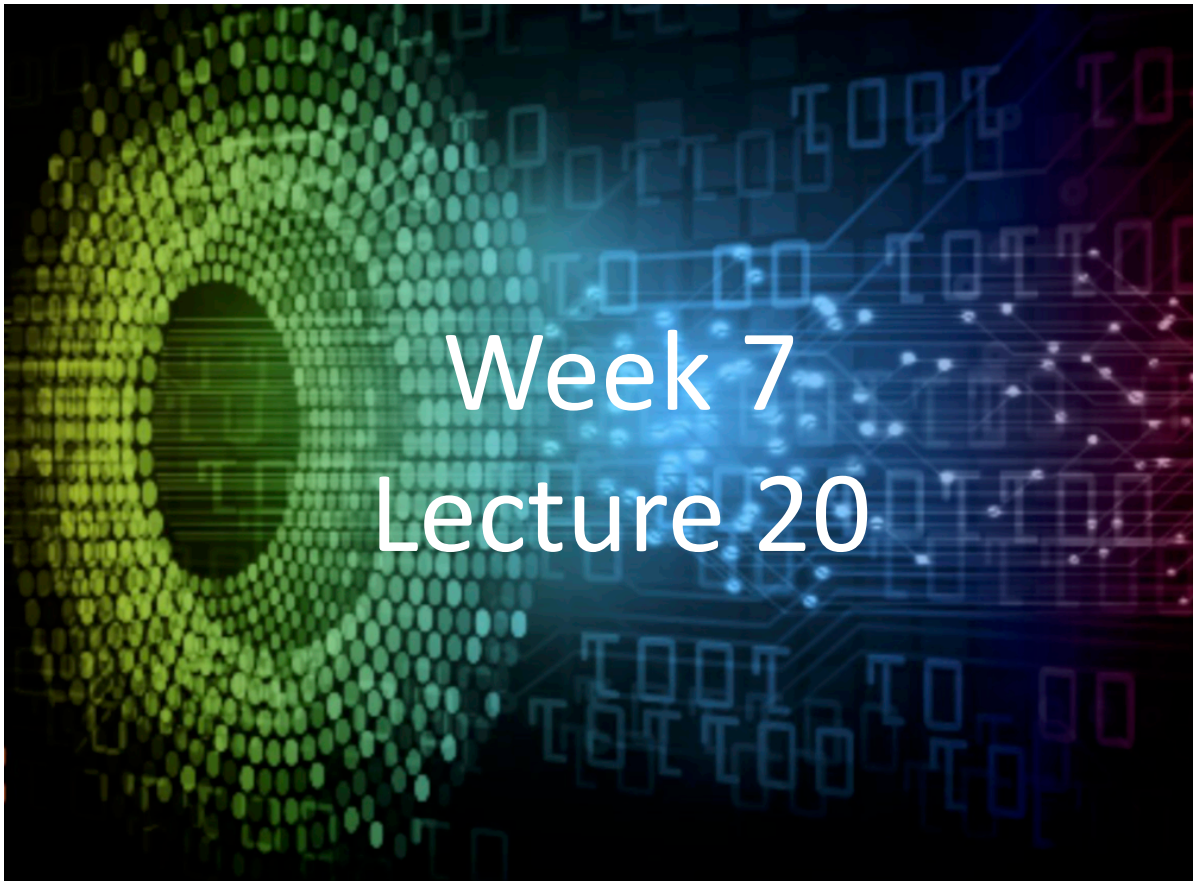
Introduction to Deep Learning
Applications and Theory



ECE 596 / AMATH 563

Previous Lecture: RNNs NLP Applications

- NLP Applications
  - Word embeddings
  - Word2vec approaches
  - Negative Sampling
  - Sentiment Classification

This Lecture:
Advanced Applications of RNNs

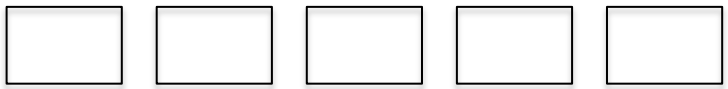
- Multivariate Timeseries Applications
  - Preparation
  - Filtering
  - Semantic Analysis
  - Prediction

Preparation

- Time stamp format - time alignment

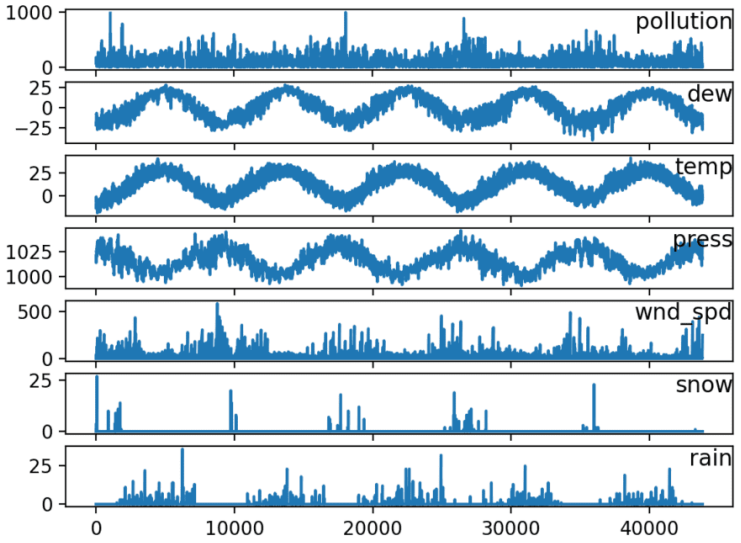
Sensor	Date	Value	Date	Value	. .
Pollution (AQI)	07/12/2020 15:22 PST	**215**	07/12/2020 17:22 PST	**318**	
	Date	**Value**	**Date**	**Value**	**. .**
Temp (F)	08/12/2020 16:22 PST	**86**	08/12/2020 16:23 PST	**74**	

Pollution (AQI)



t0 **t1** **t2** **t3** **t4**

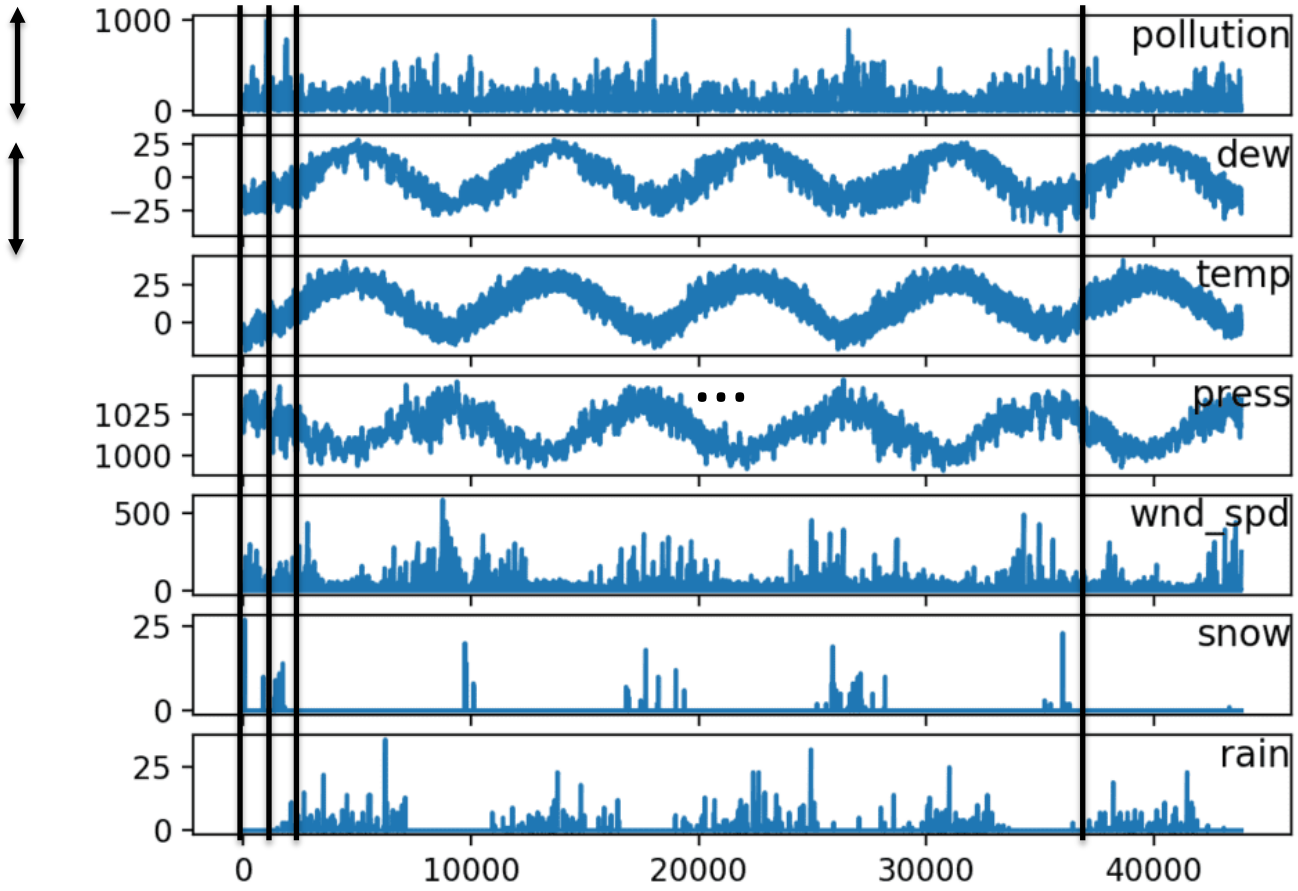
sensor



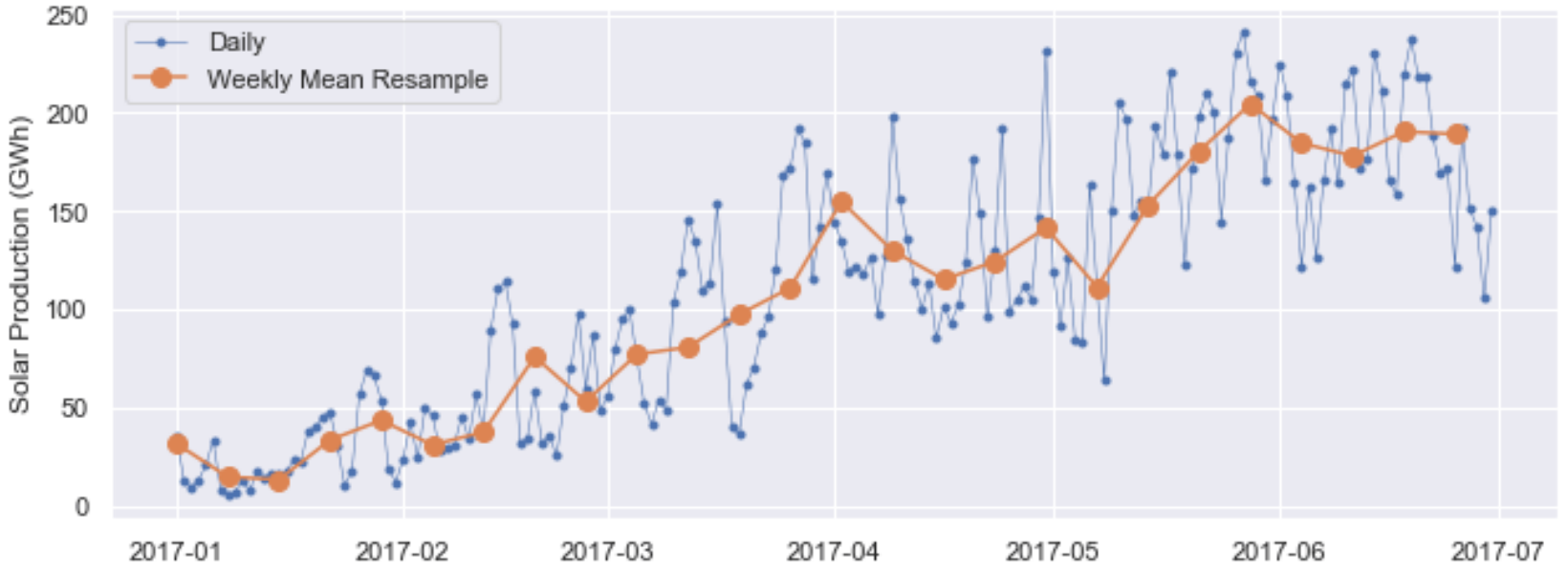
time

Preparation

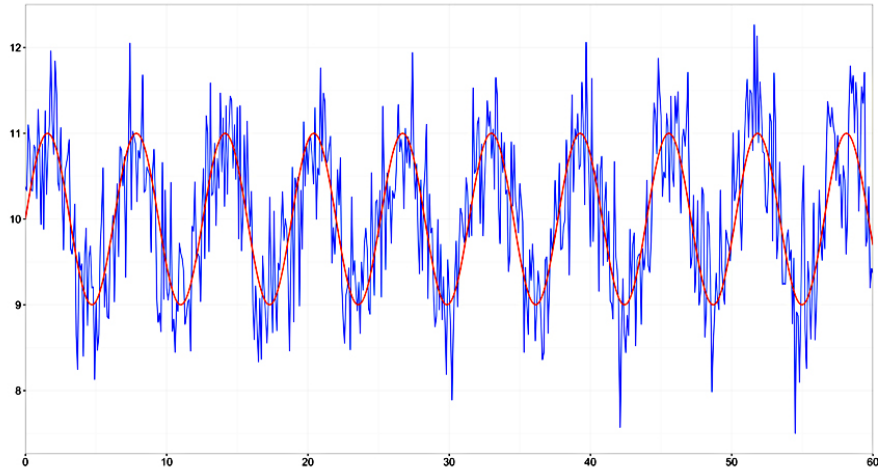
- Scales

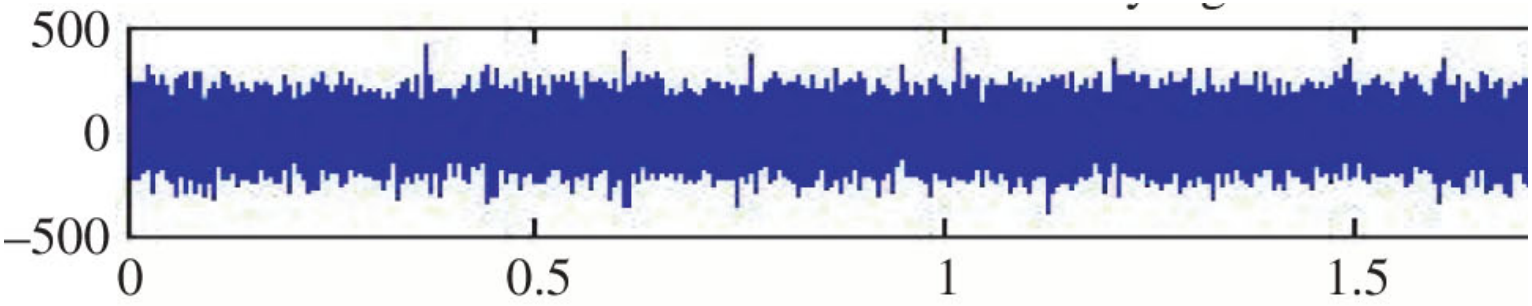


Proxy timeseries

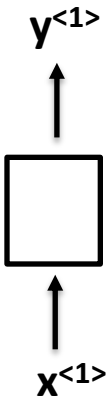


Filtering

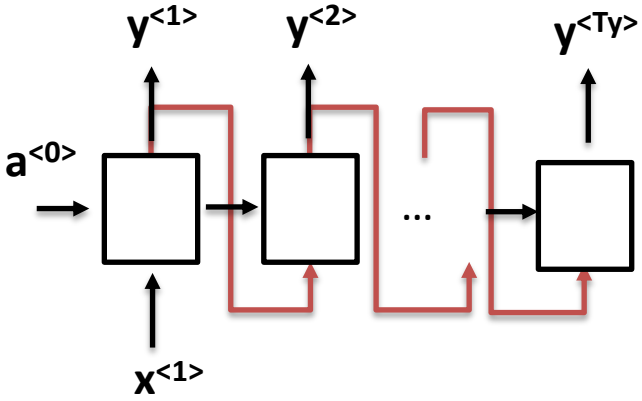




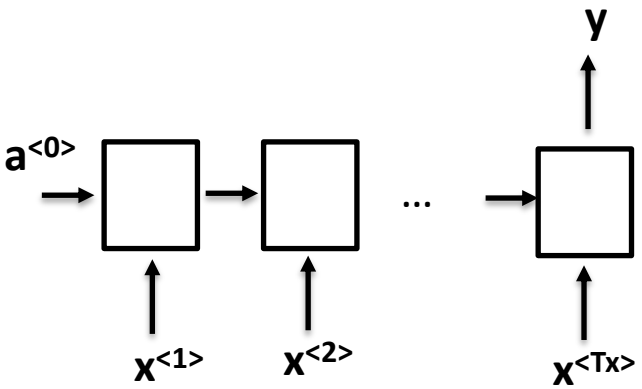
Types of RNNs



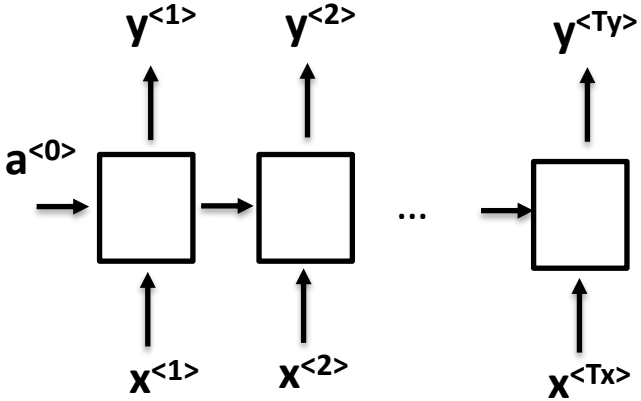
One to one



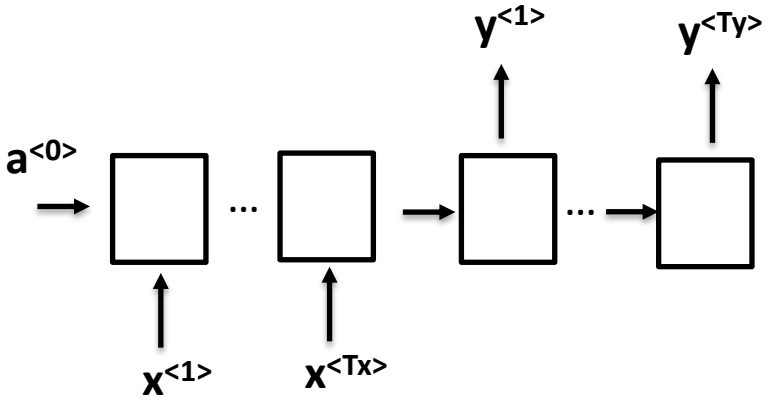
One to many



Many to one

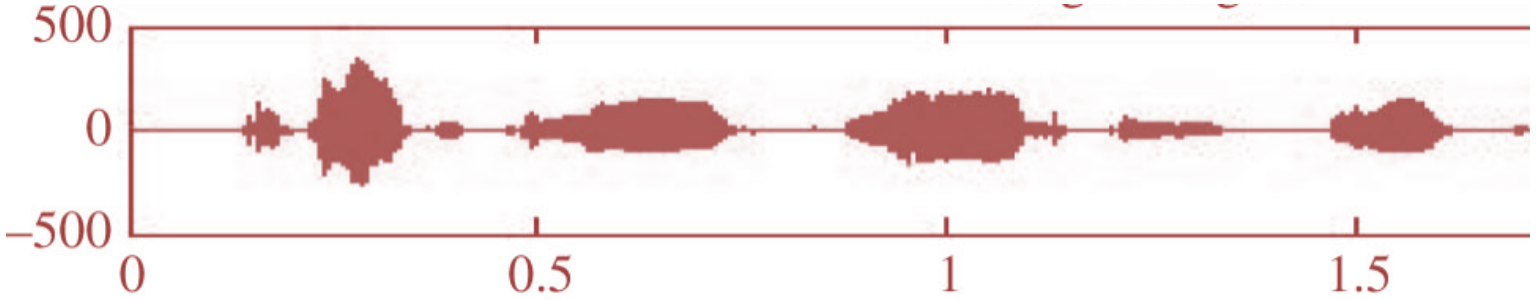


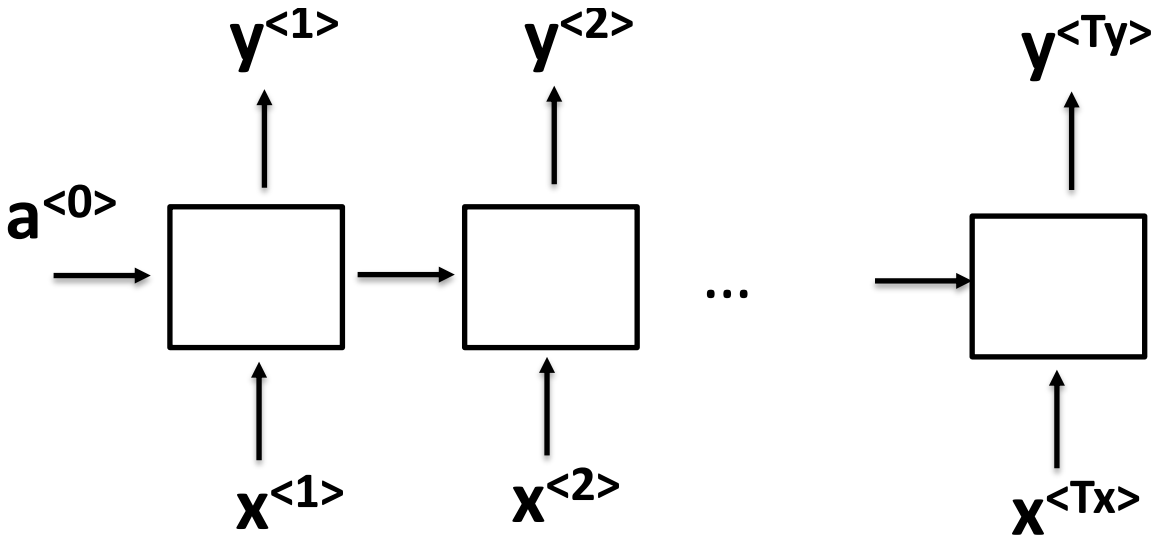
Many to many

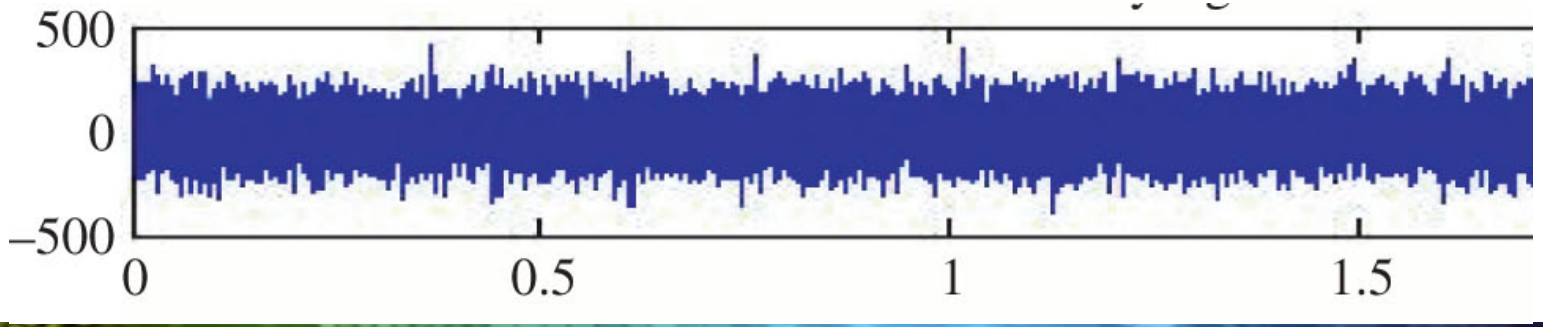


Many to many

Filtering





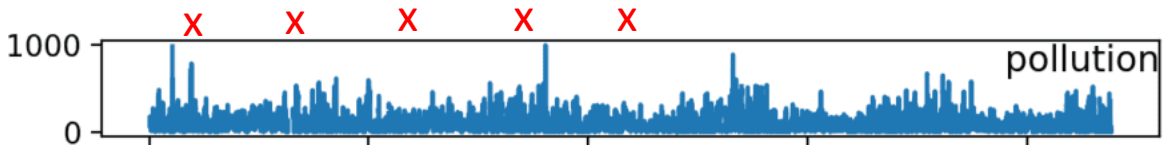


Filtering

- Many to Many
- Large number of original signal examples
- Continuity in signal
- Fixed noise distribution
- Loss will determine filtering results

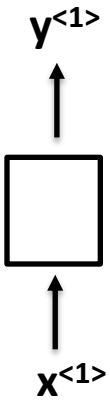
Completion

sensor

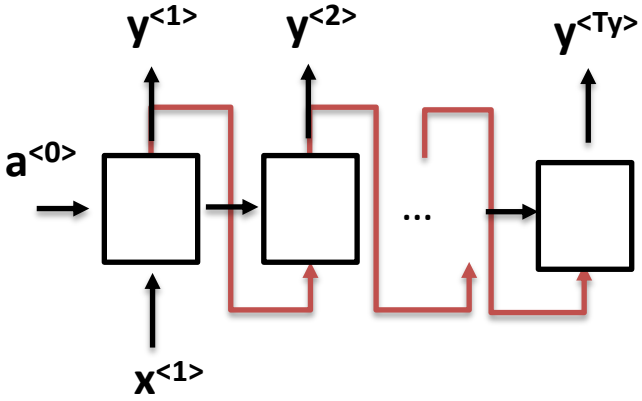


time

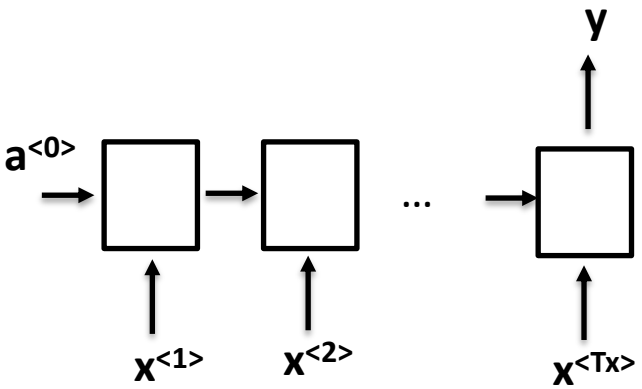
Types of RNNs



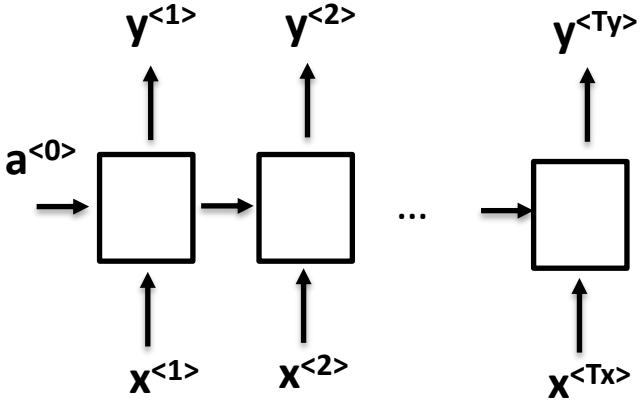
One to one



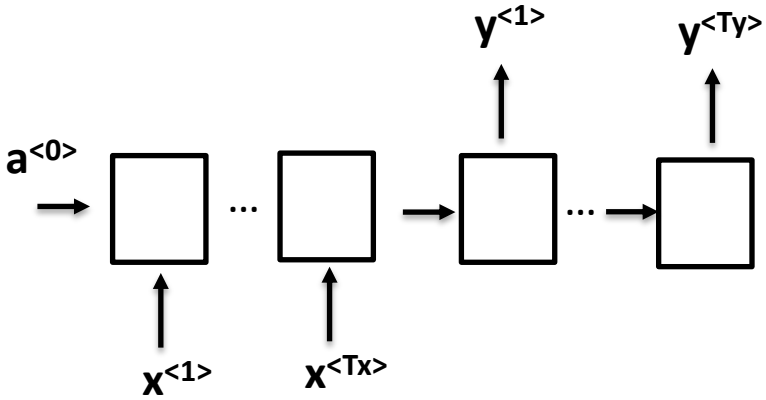
One to many



Many to one

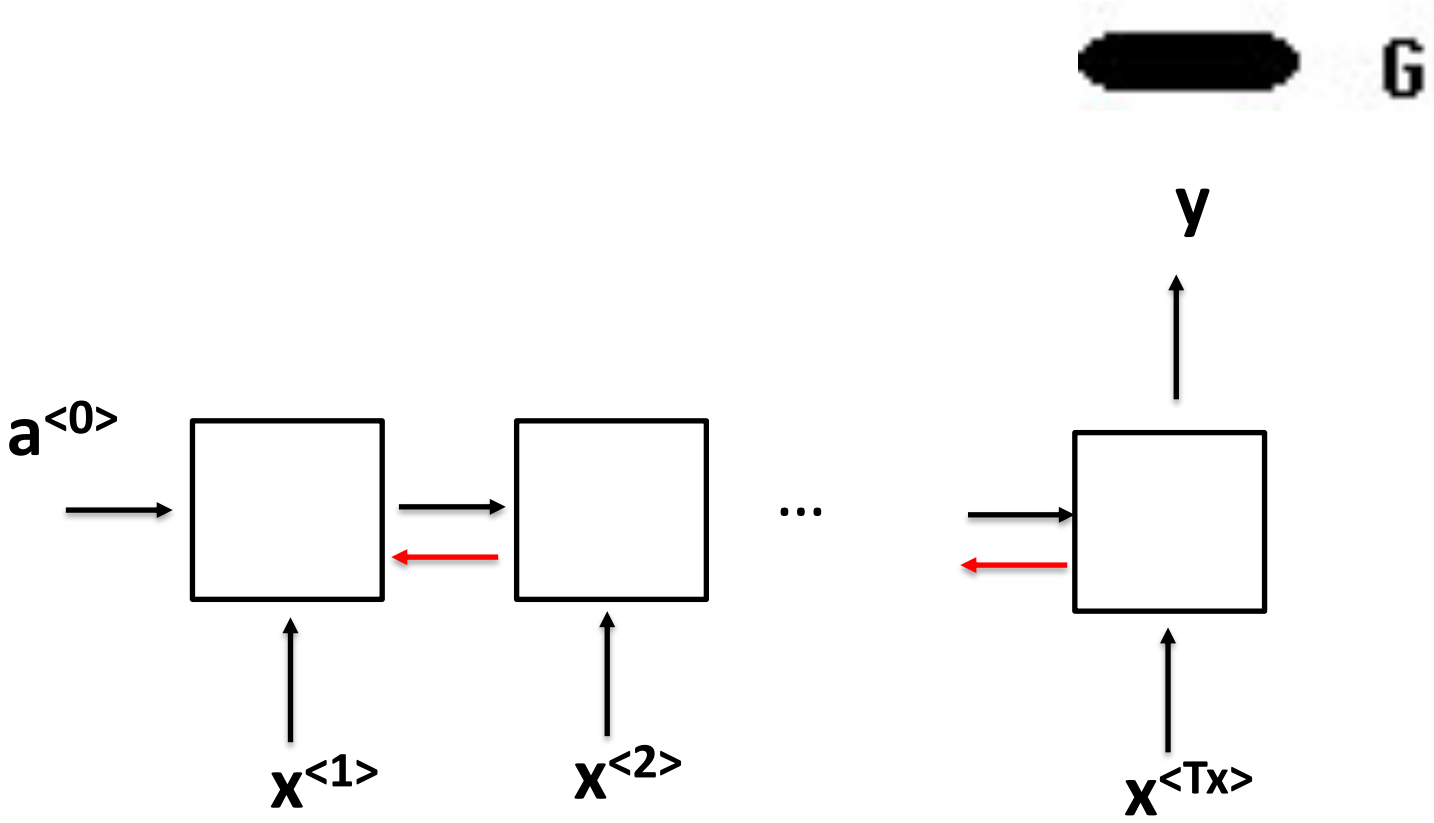


Many to many

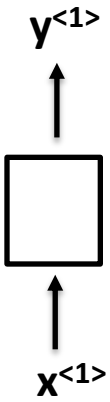


Many to many

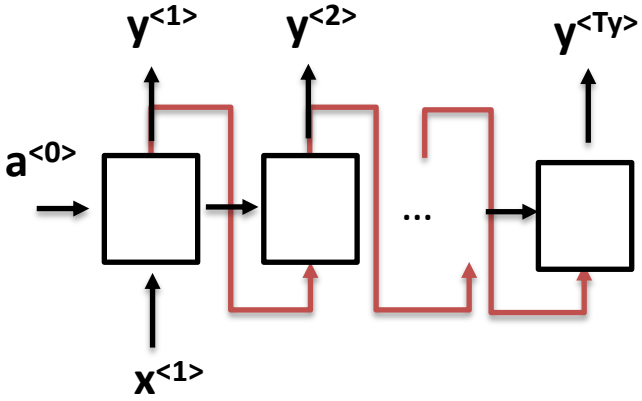
Fixed Length Completion



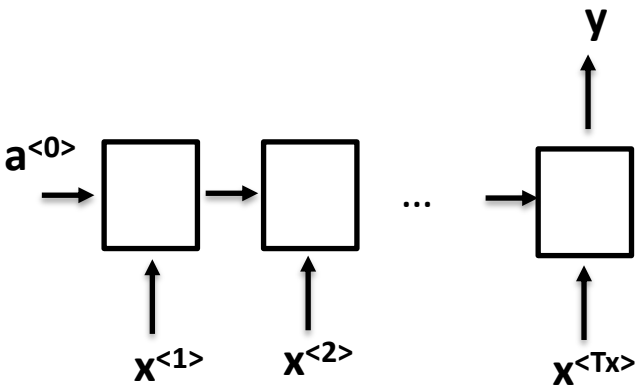
Types of RNNs



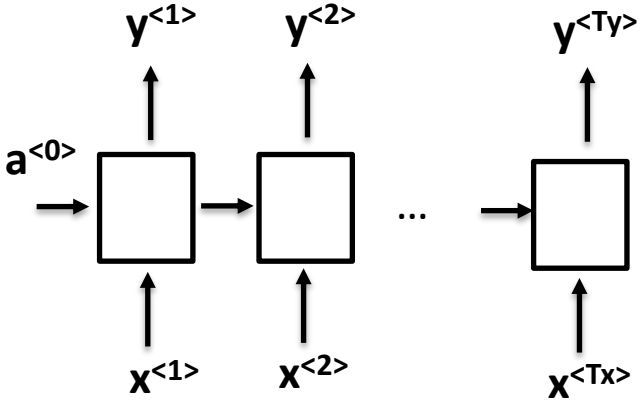
One to one



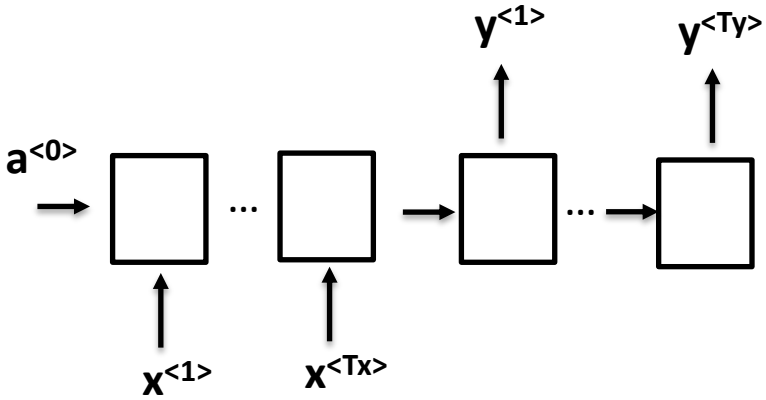
One to many



Many to one

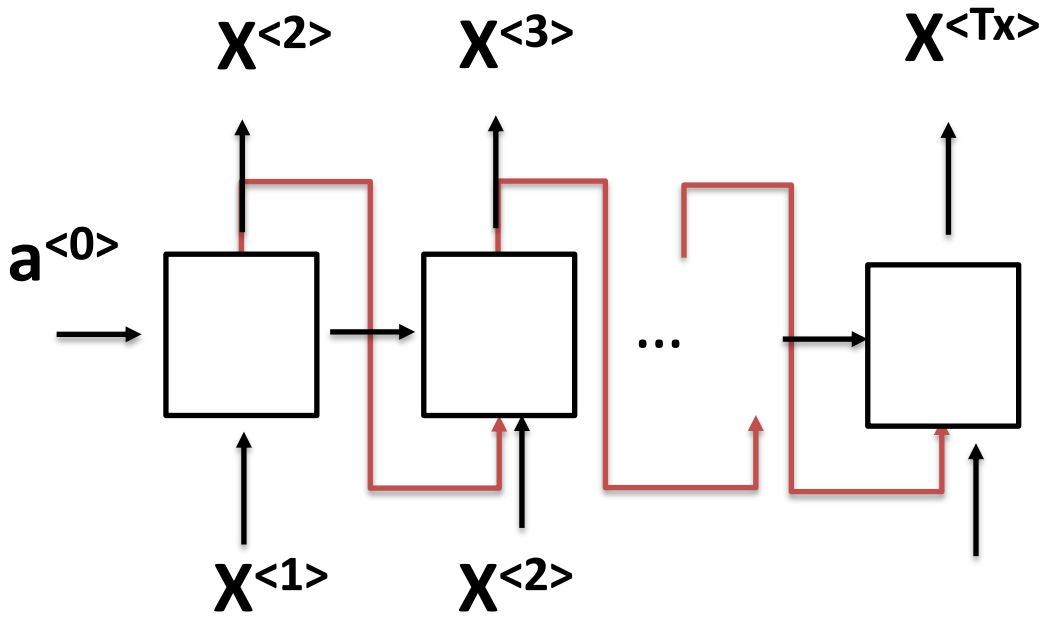


Many to many



Many to many

Random Completion

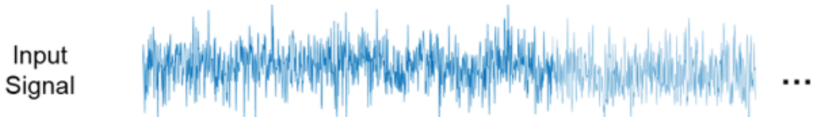


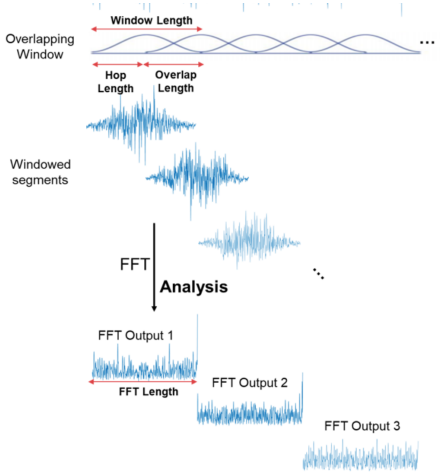
Completion

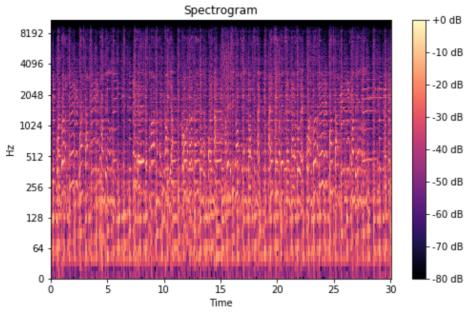
- Many to One, Bidirectional, Many to Many, One to Many + Attention
- Ablation
- Regularization
- Multivariate Setup

Multi Variate Setup

- Extension of signal dimensions
  - Derivatives
  - Mean and higher moments
  - Superpositions of sub-signals
  - Transforms
  - Windowed transforms (EMA)







Multi Variate Setup

- Projections of Signal dimensions
  - Projections (PCA, FFT truncation)
  - Embedding
  - Proxy timeseries