Sequence Modeling

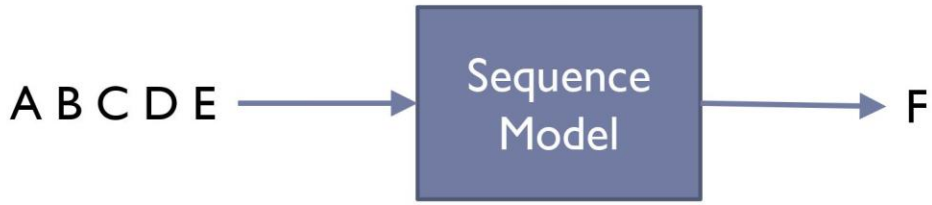
성균관대학교 소프트웨어학과
이 지 형

Sequential Data Modeling

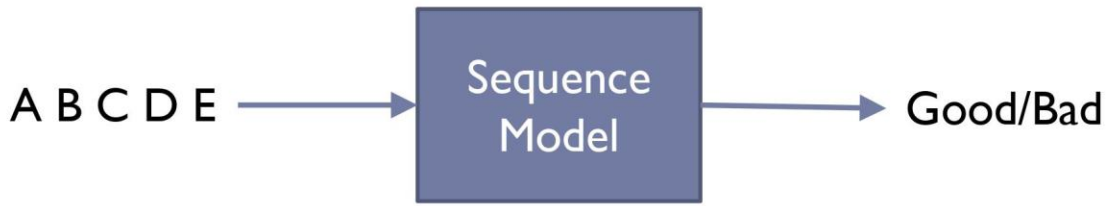
- **Sequential Data**
  - **Most of data are sequential**
  - **Speech, Text, Image, …**
- **Deep Learnings for Sequential Data**
  - **Convolutional Neural Networks (CNN)**
    - Try to find local features from a sequence
  - **Recurrent Neural Networks: LSTM, GRU**
    - Try to capture the feature of the past

Sequential Data Modeling

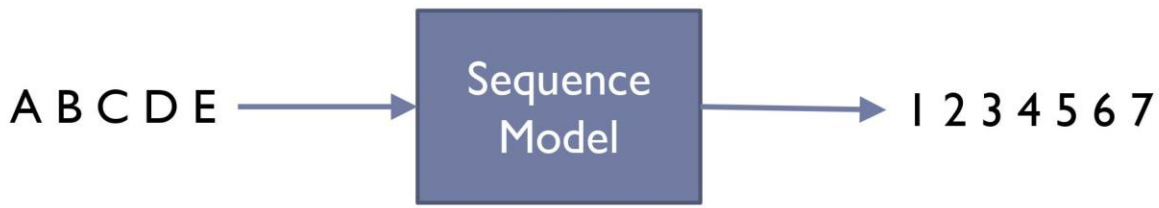
- Three Types of Problems
  - Next Step Prediction



  - Classification



  - Sequence Generation



Sequential Data Modeling

- **Sequence Generation**
  - **Machine Translation**

This is a very good wine → C'est un très bon vin

  - **Speech Recognition**

 → This is a very good wine

  - **Image Caption Generation**

 → A bird is flying

Types of Processes

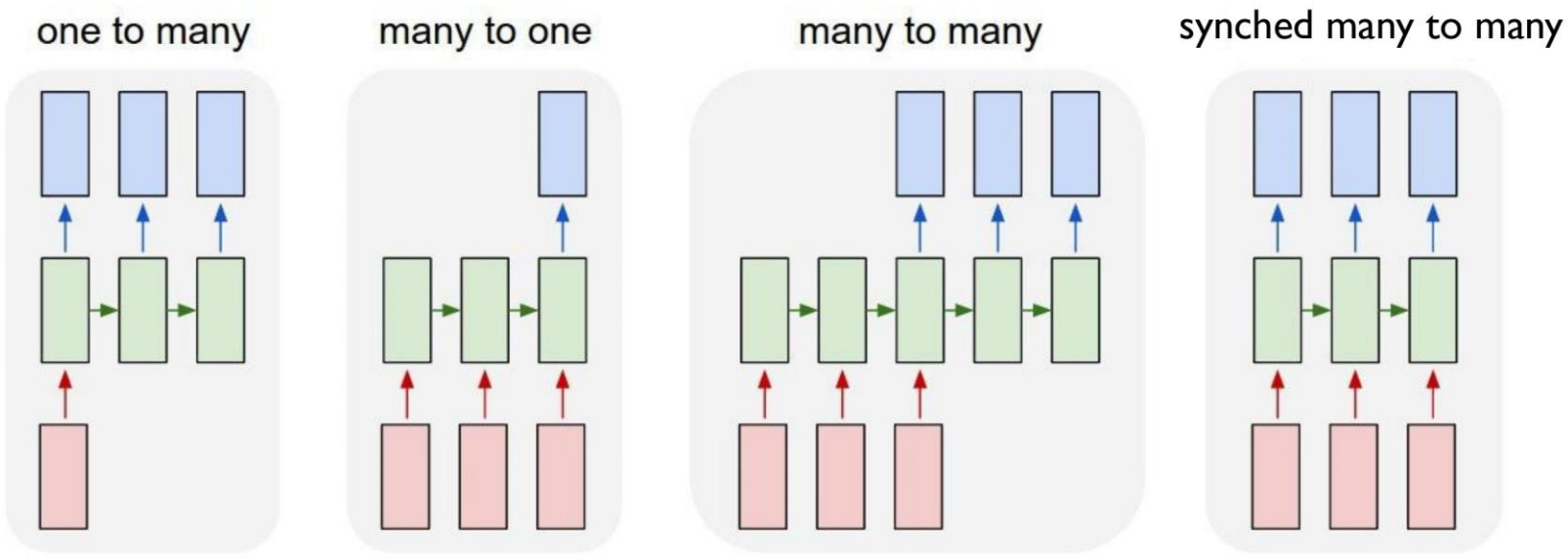
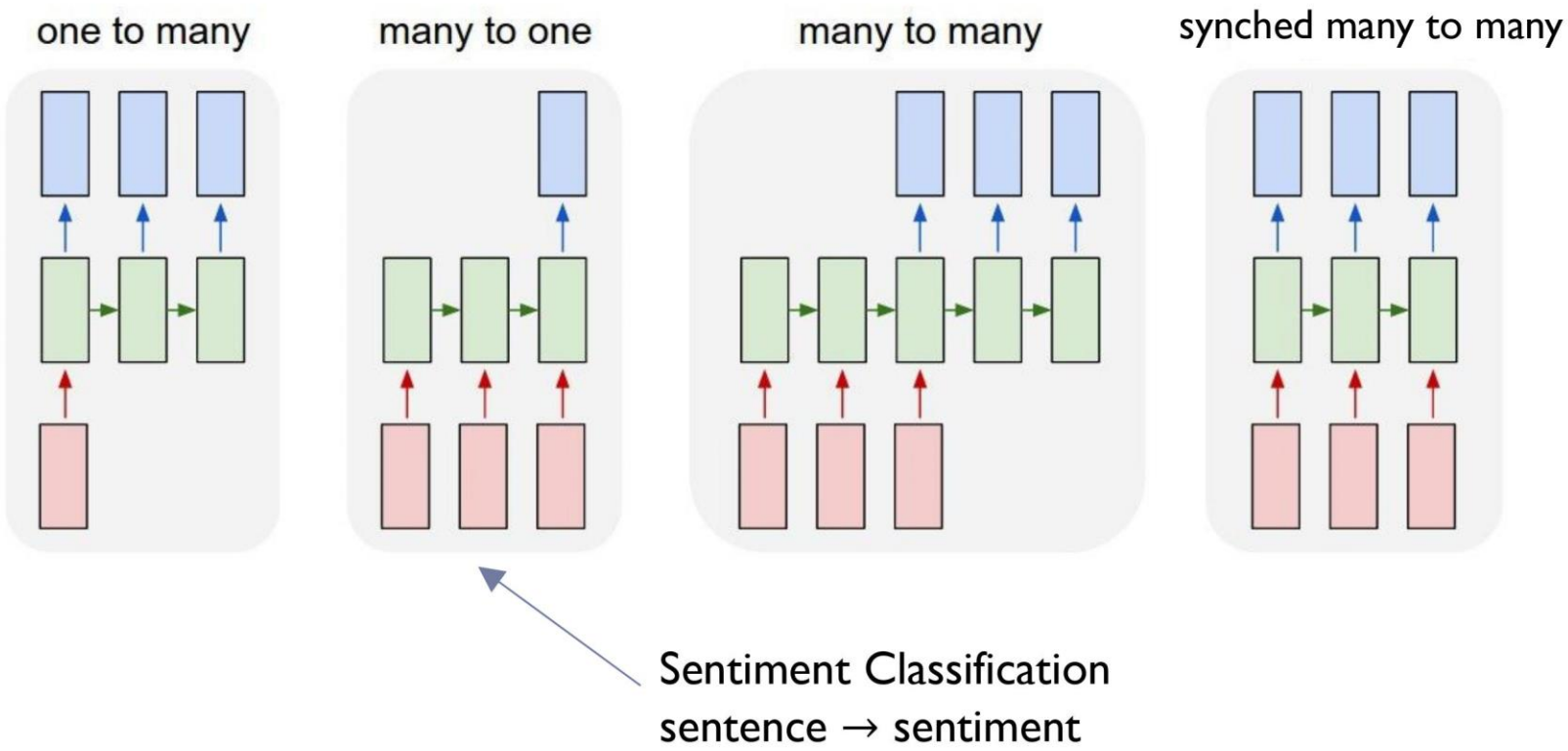
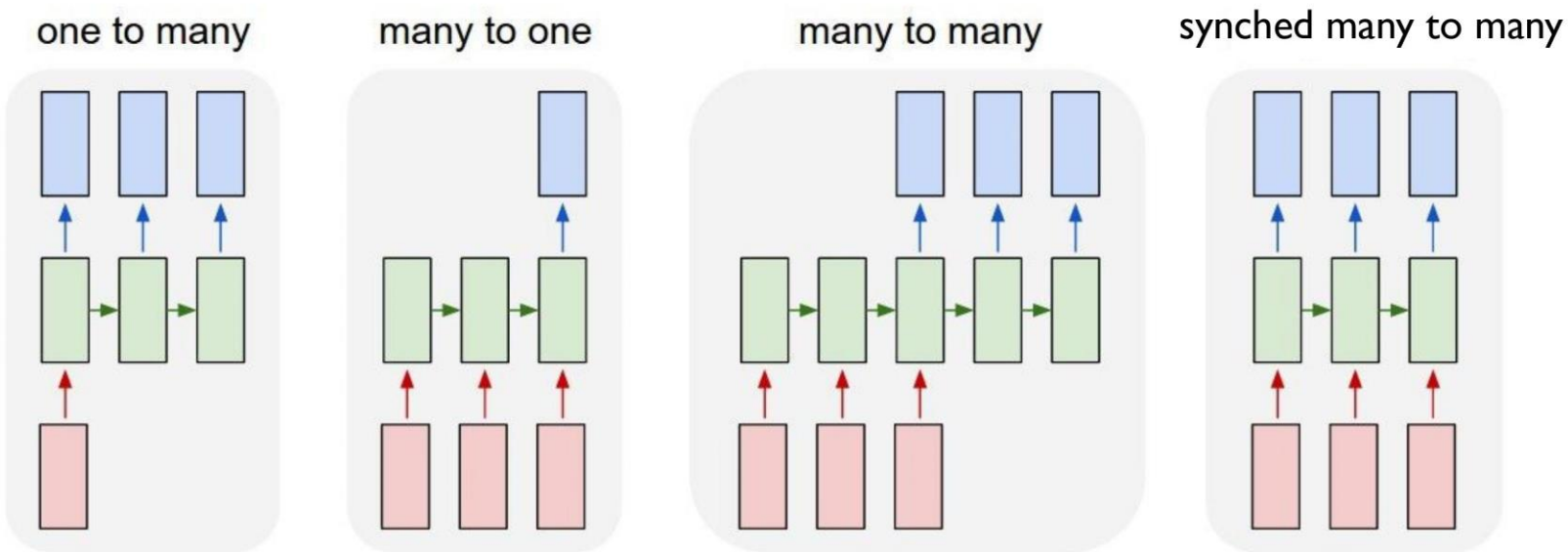


Image Captioning
Image → sequence of words

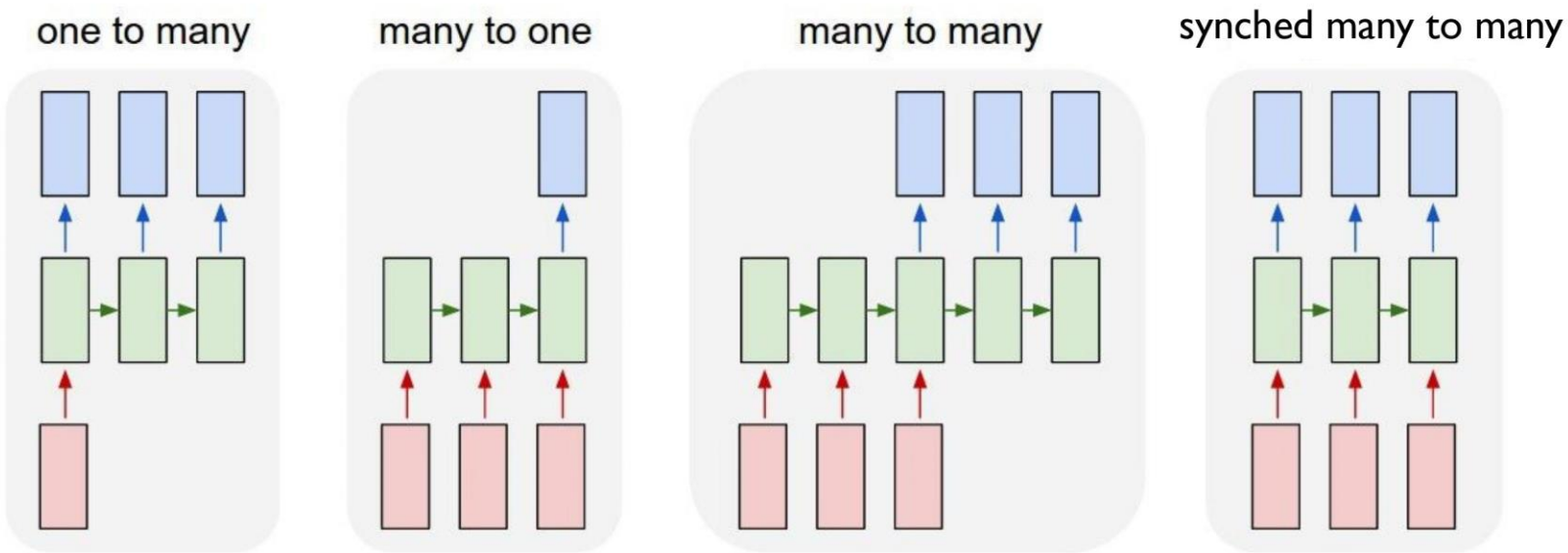
Types of Processes



Types of Processes



Types of Processes



Stock Price Prediction,
Prediction of next word

Classical Approach for Time Series Analysis

이 자료는 2019 KAIST idea factory 의 " 딥러닝 홀로서기” 자료를 대부분 참고하였음을 밝힙니다.

Classical Approach for Time Series Analysis

- Time domain analysis → width, step, height of signal
- Frequency domain analysis → Fourier analysis or wavelets
- Nearest neighbors analysis → Dynamic time warping (DTW)
- Probabilistic Model → Language modeling
- (S)AR(I)MA(X) models → Autocorrelation inside of time series
- Decomposition → Time series = trend part + seasonal part + residuals
- Nonlinear Dynamics → Differential Equation (ordinary, partial, stochastic, etc..)
- Machine Learning → Use ML model with hand-made features

https://medium.com/@alexrachnog/deep-learning-the-final-frontier-for-signal-processing-and-time-series-analysis-734307167ad6

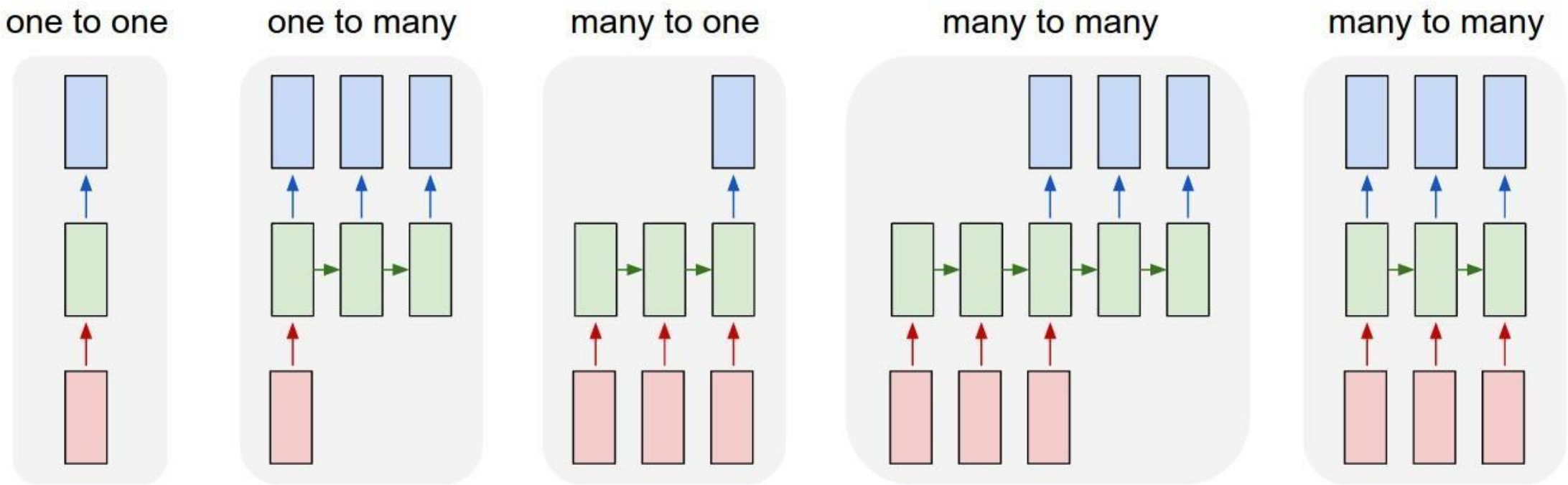
Classical Approach for Time Series Analysis

- Time domain analysis
- Frequency domain analysis
- Nearest neighbors analysis
- Probabilistic Model
- (S)AR(I)MA(X) models
- Decomposition
- Nonlinear Dynamics
- Machine Learning

https://medium.com/@alexrachnog/deep-learning-the-final-frontier-for-signal-processing-and-time-series-analysis-734307167ad6

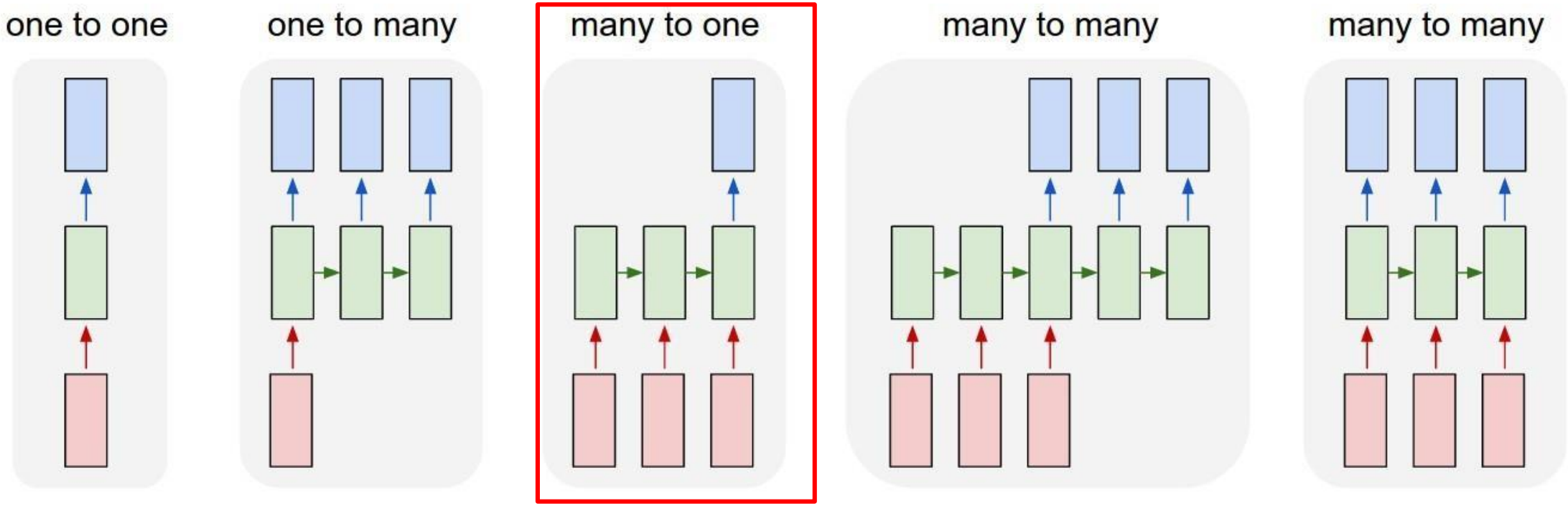
Deep Learning Dealing with Sequential Data

Types of Task Dealing with Sequential Data



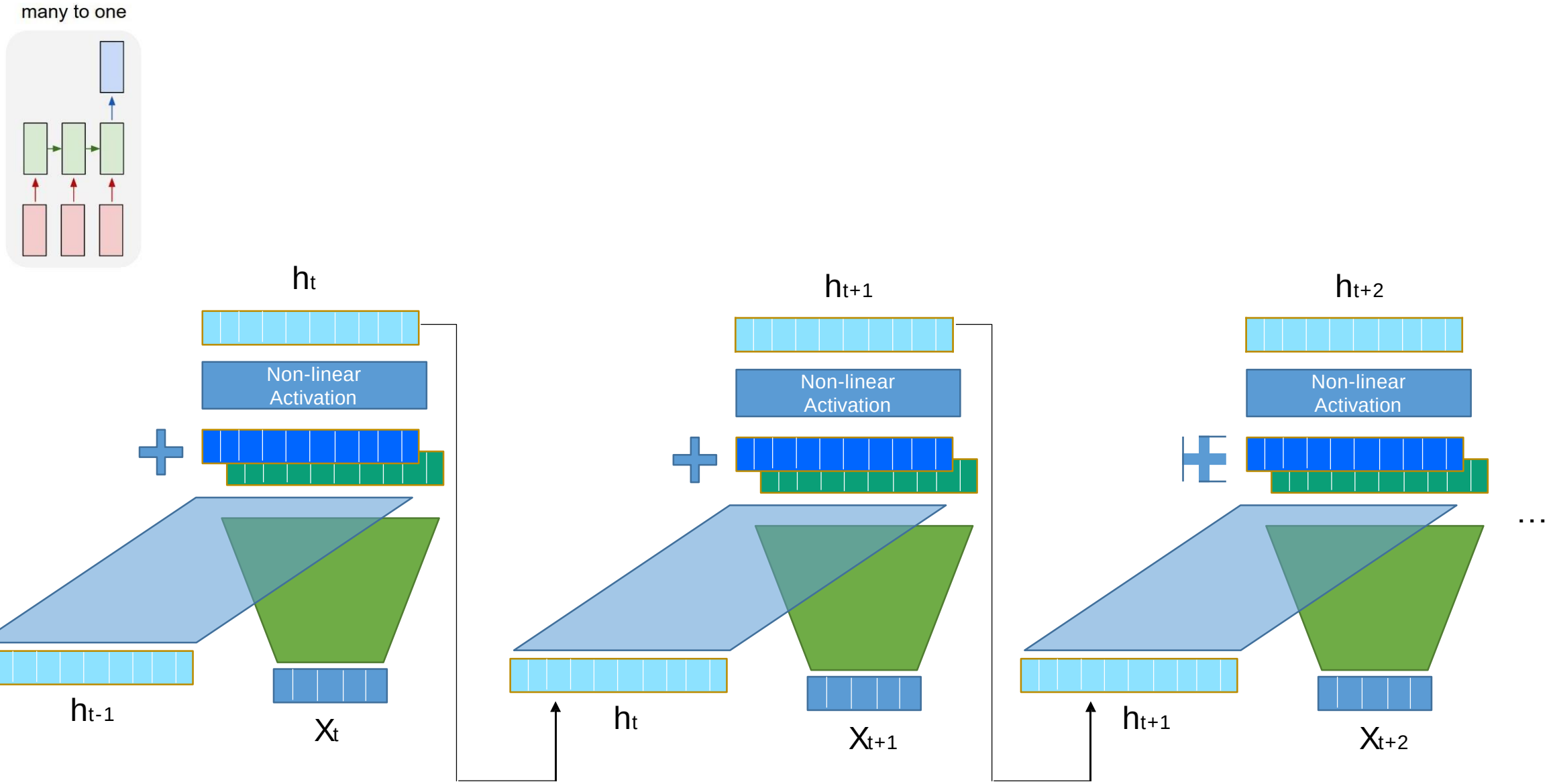
http://karpathy.github.io/2015/05/21/rnn-effectiveness/

Types of Task Dealing with Sequential Data

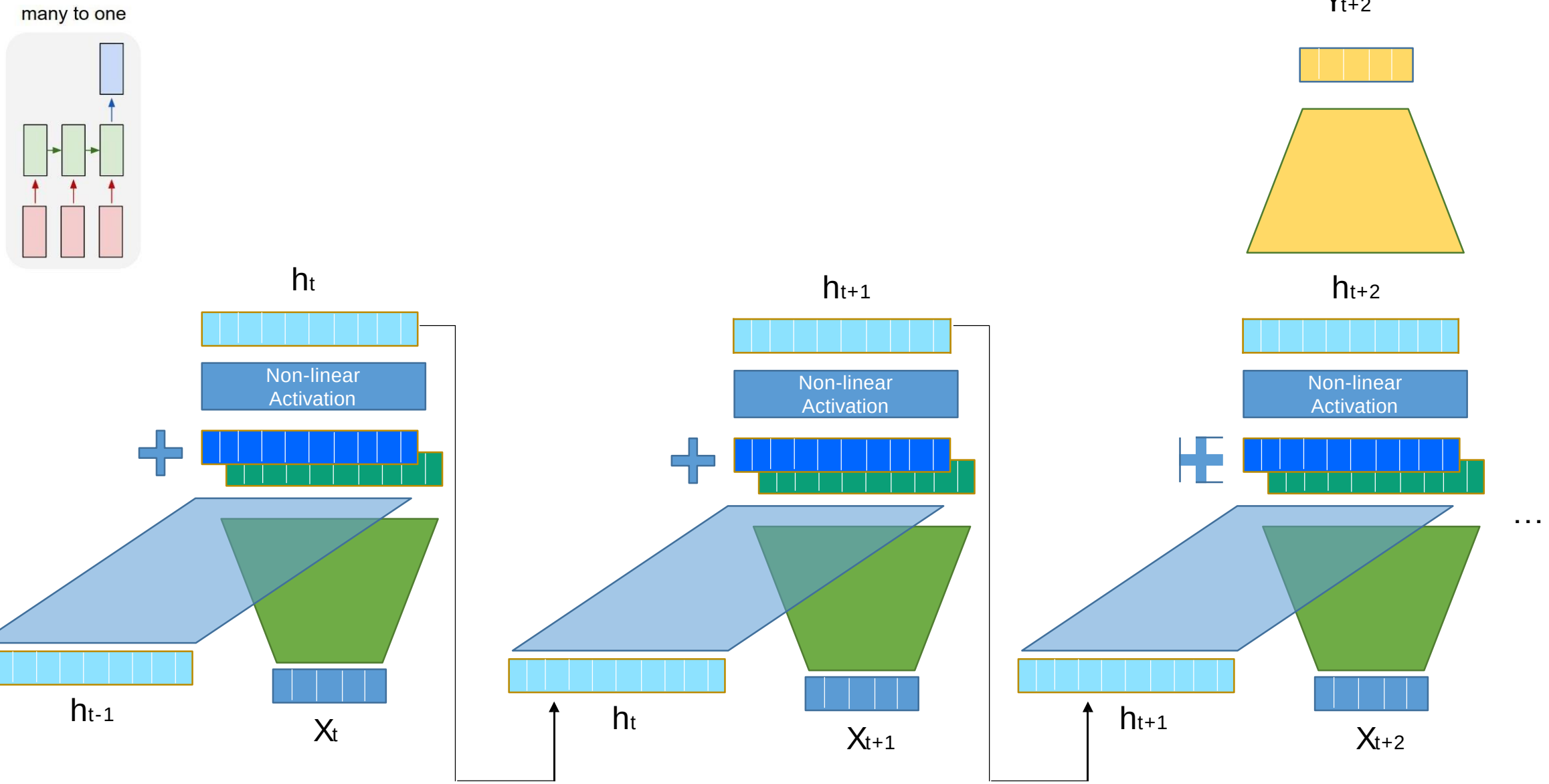


http://karpathy.github.io/2015/05/21/rnn-effectiveness/

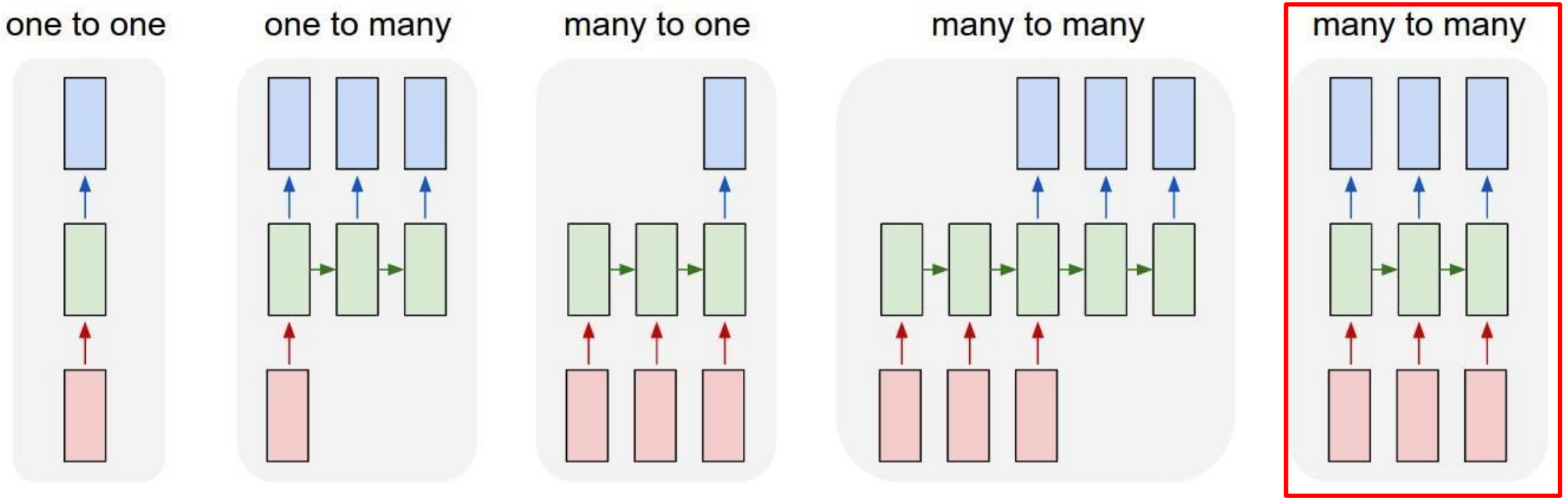
Recurrent Neural Network



Recurrent Neural Network

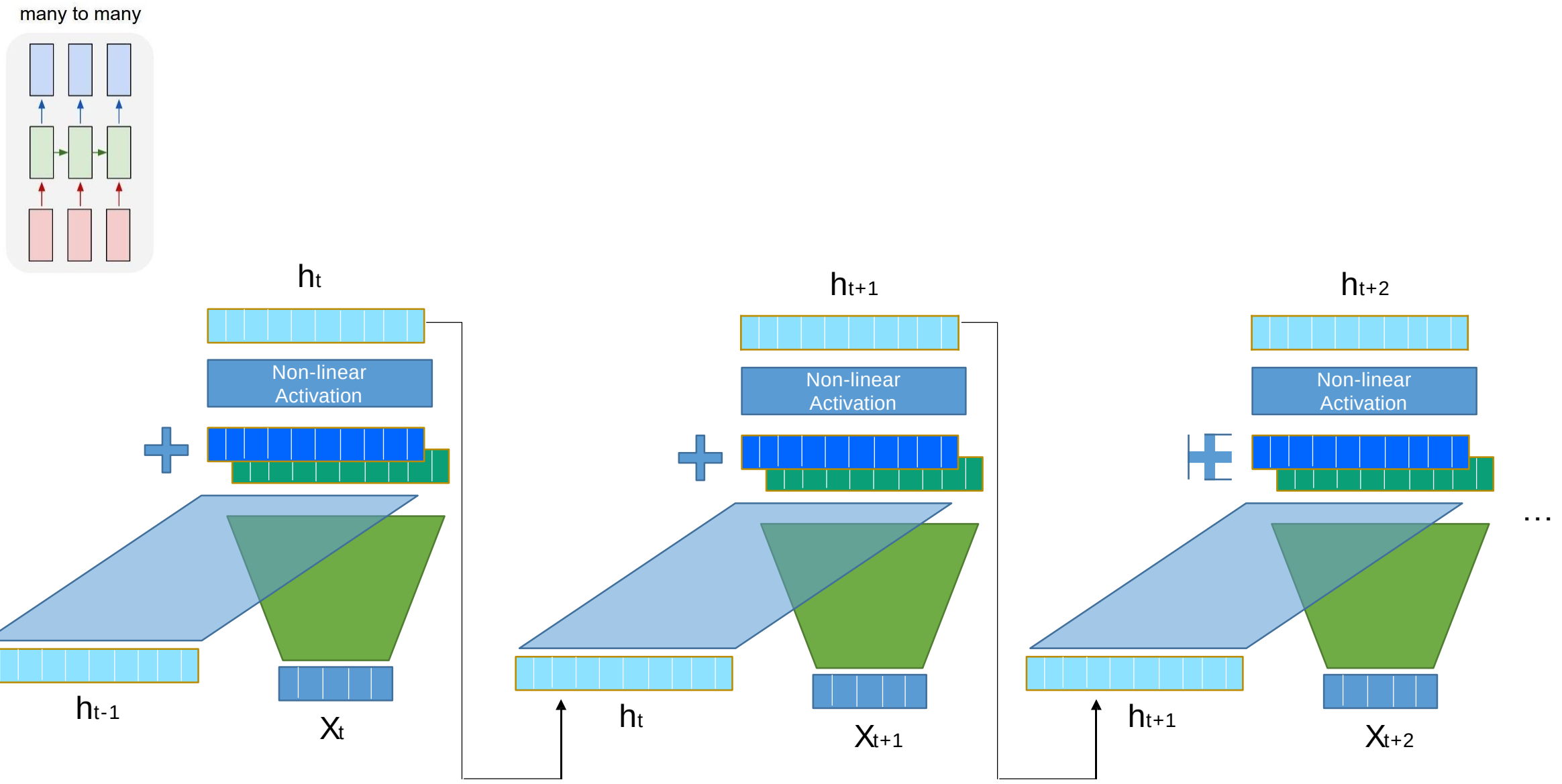


Types of Task Dealing with Sequential Data

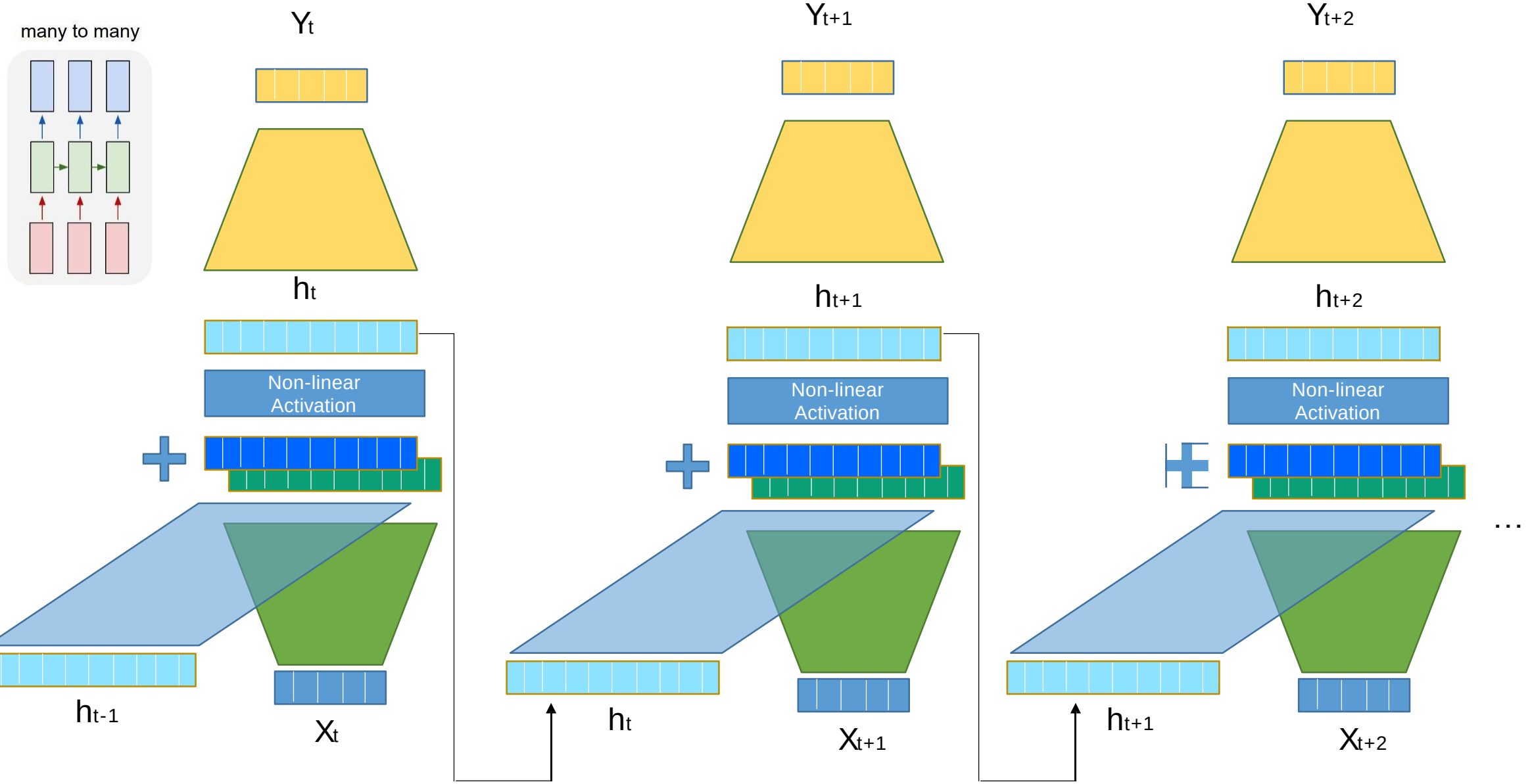


http://karpathy.github.io/2015/05/21/rnn-effectiveness/

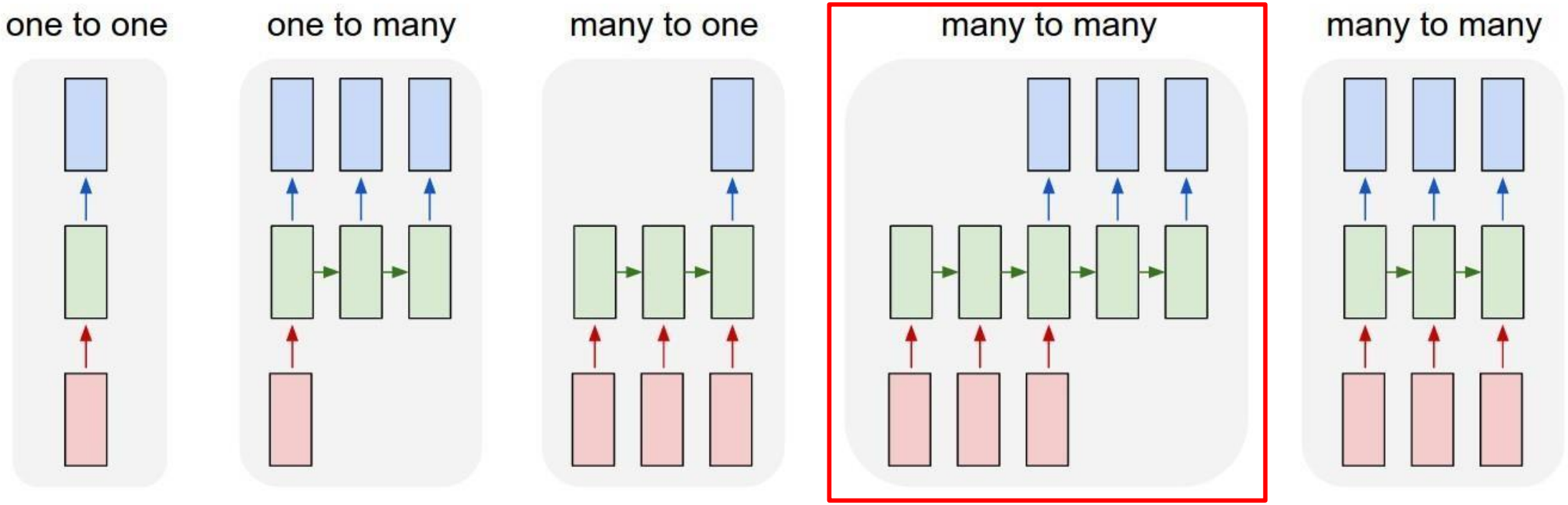
Recurrent Neural Network



Recurrent Neural Network

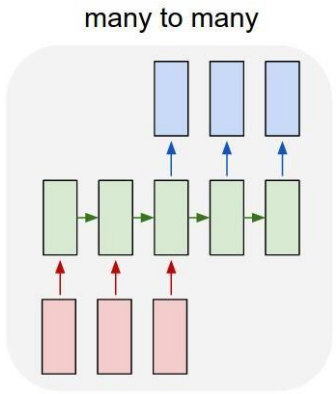


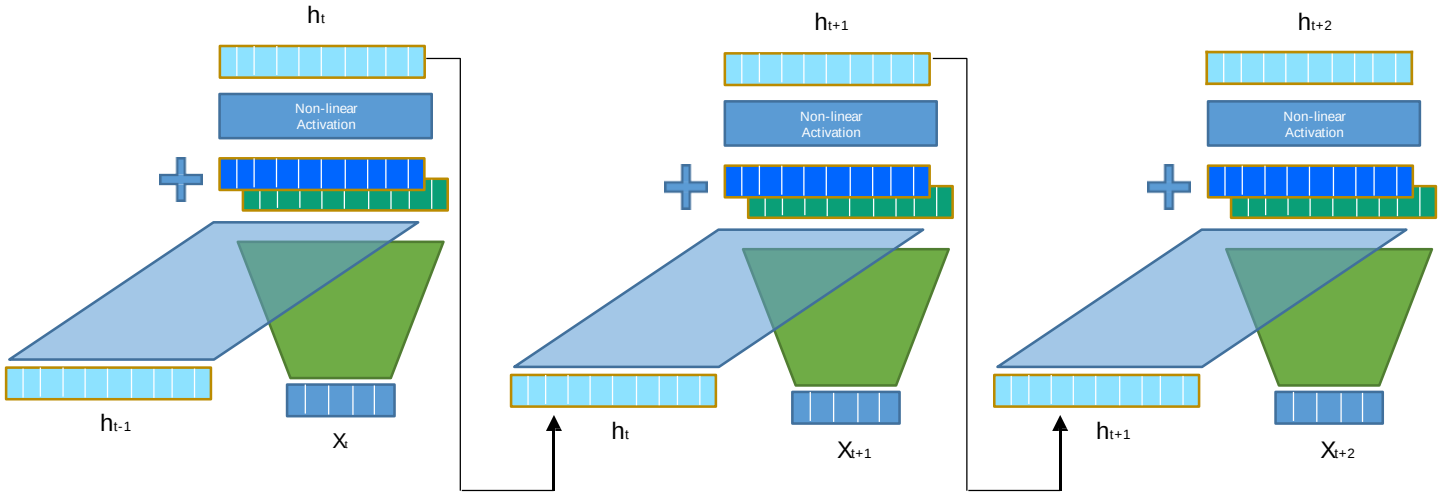
Types of Task Dealing with Sequential Data



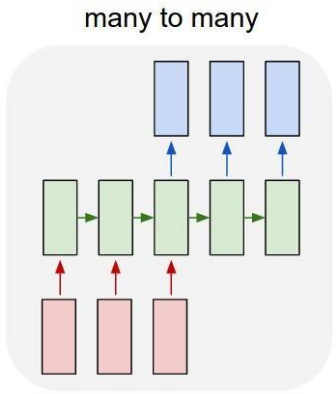
http://karpathy.github.io/2015/05/21/rnn-effectiveness/

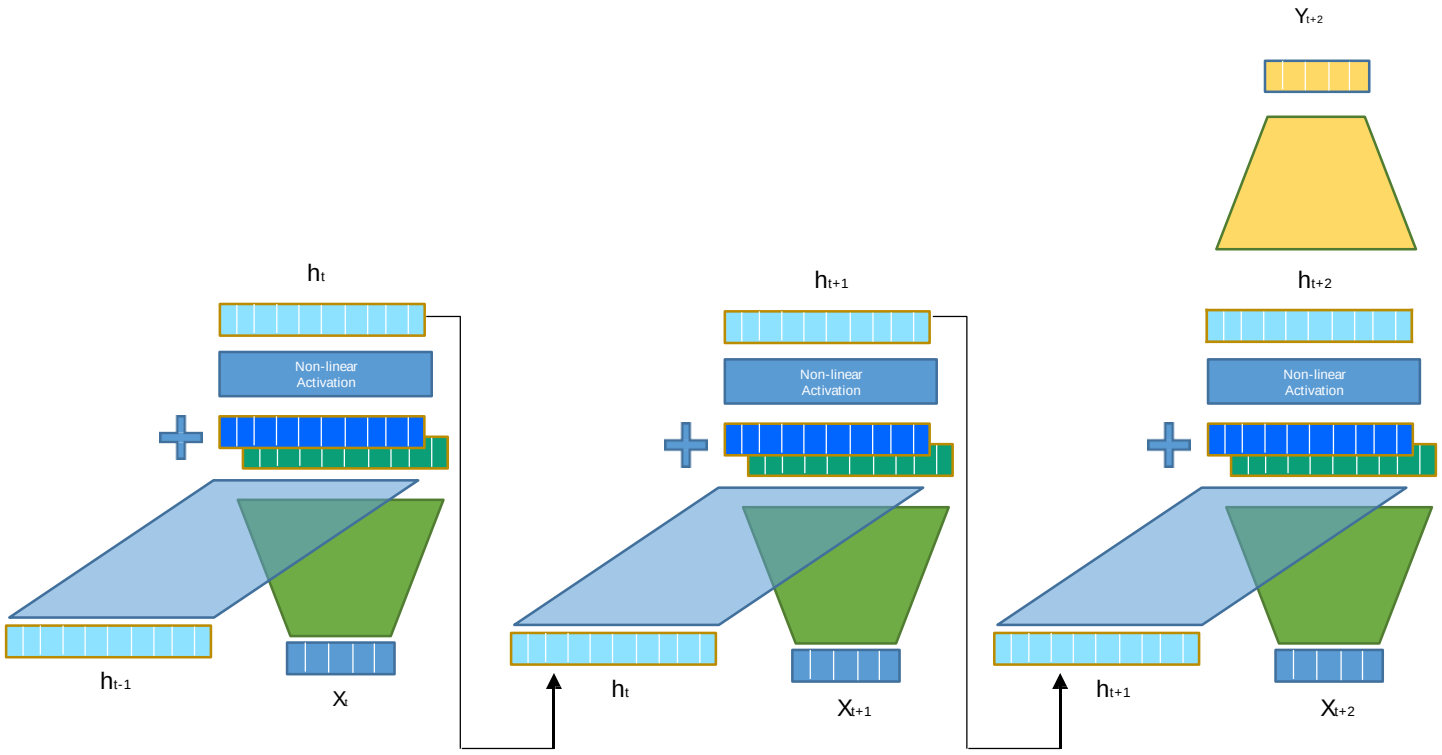
Recurrent Neural Network



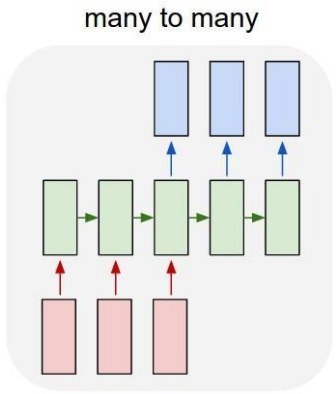


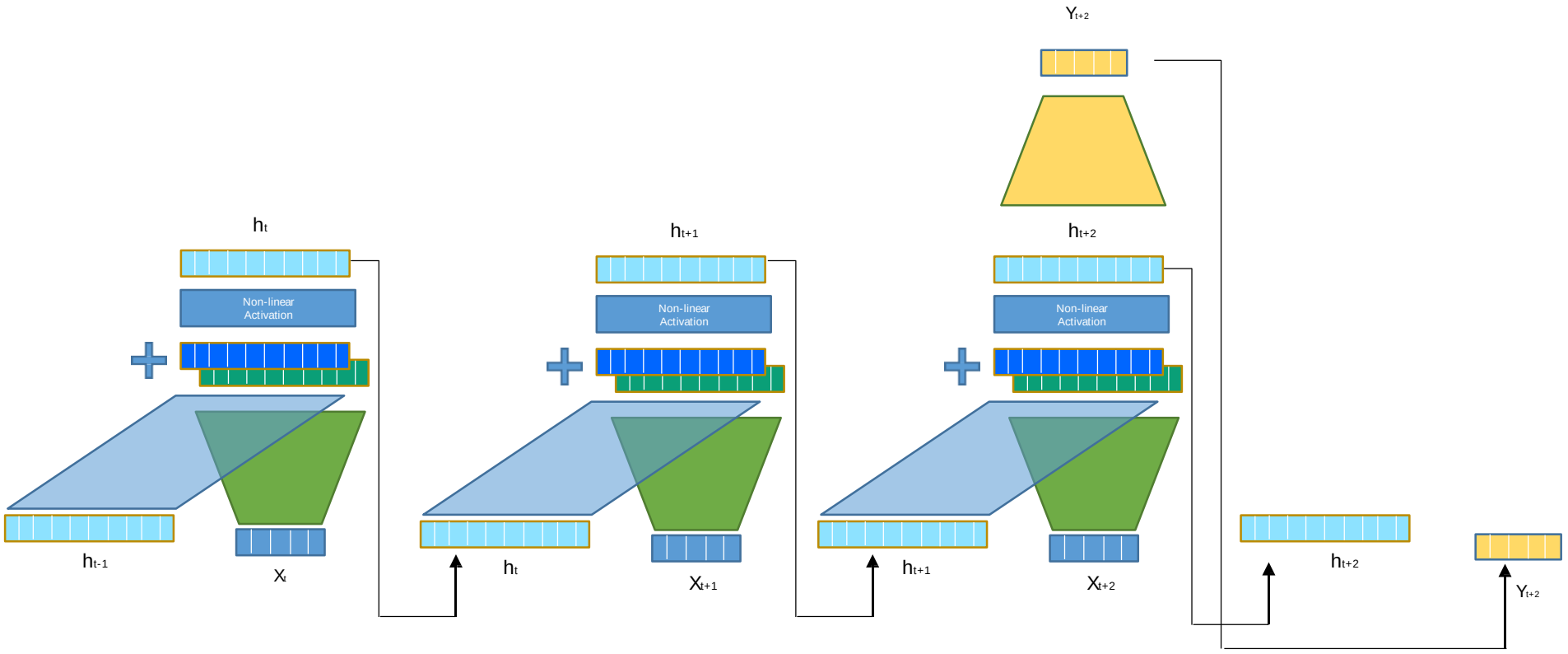
Recurrent Neural Network



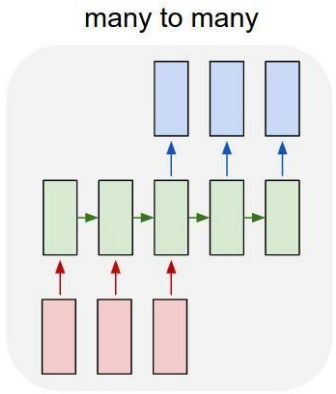


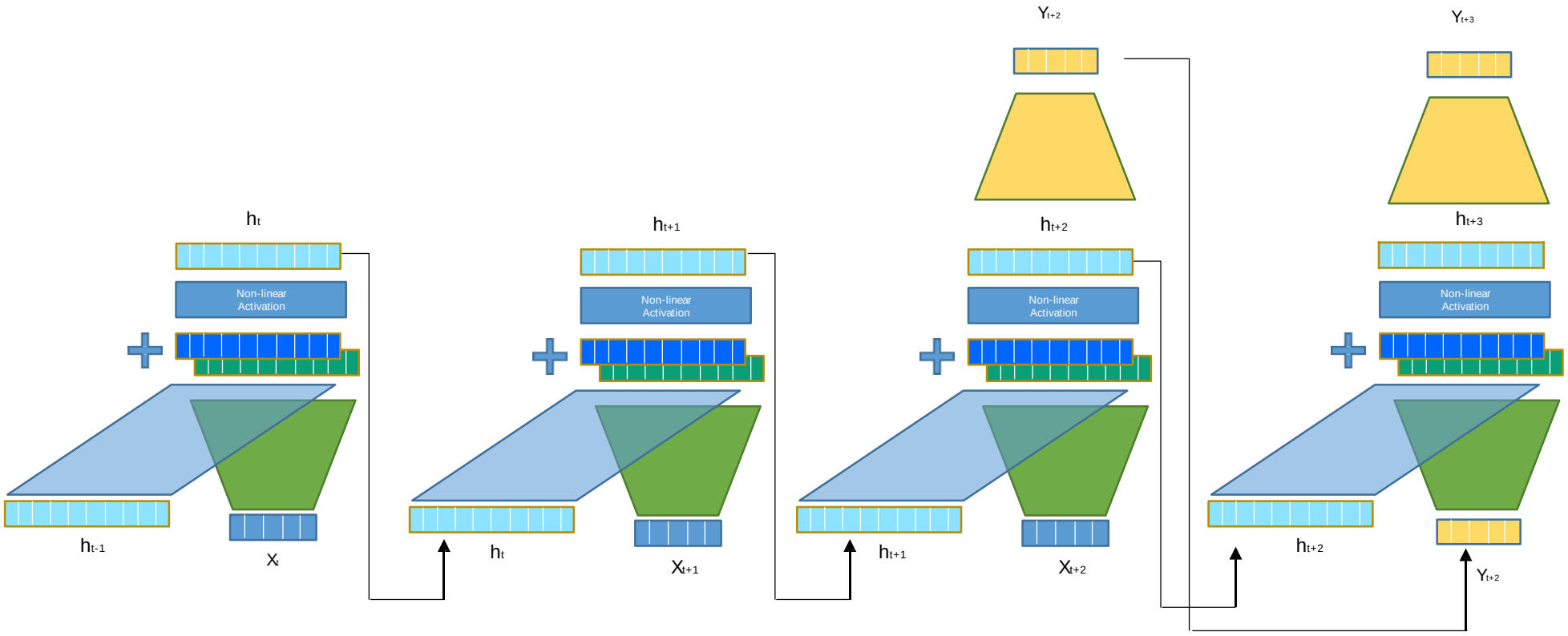
Recurrent Neural Network



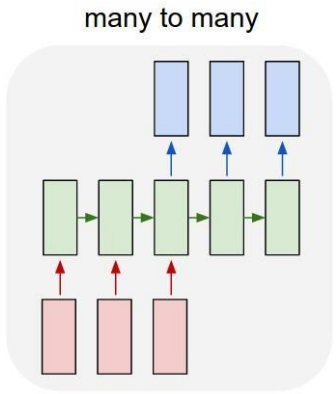


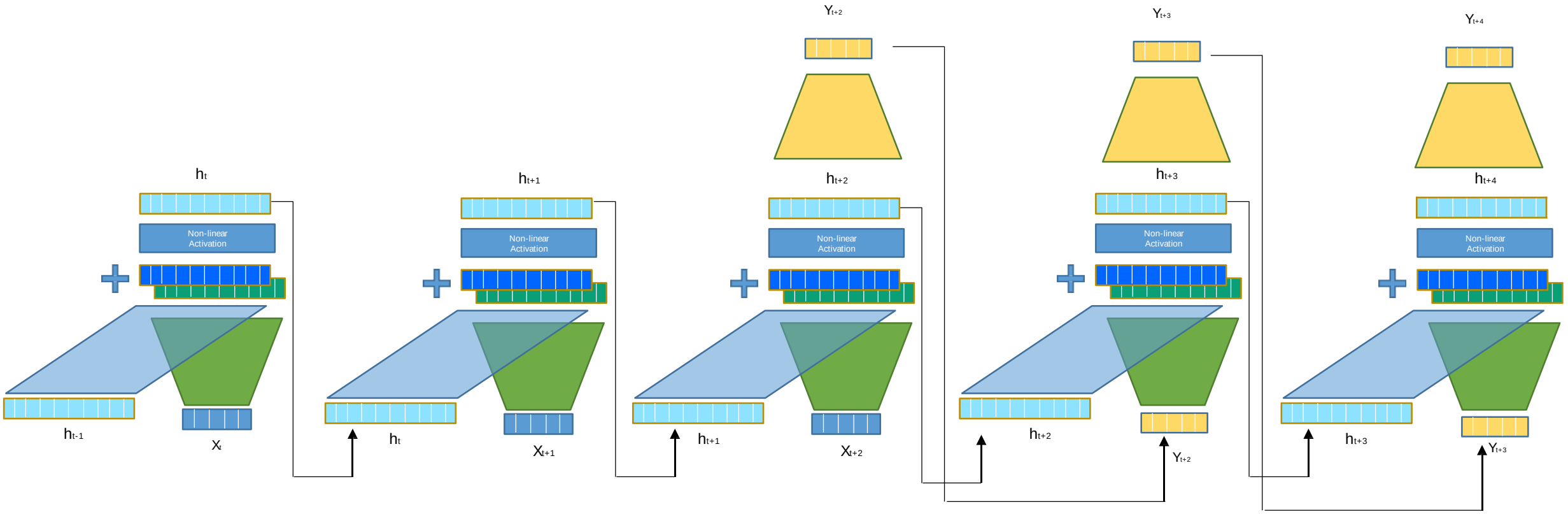
Recurrent Neural Network



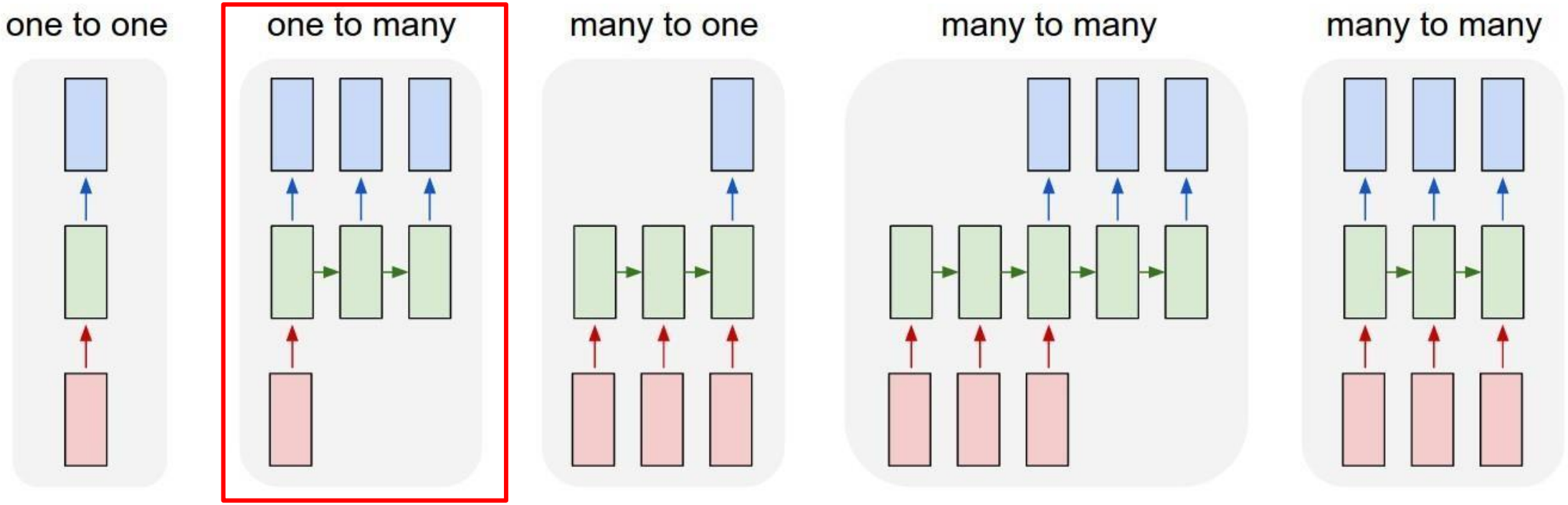


Recurrent Neural Network



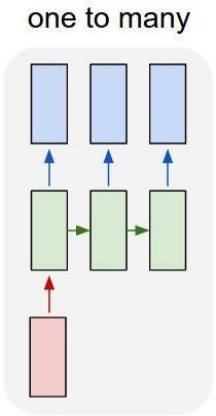


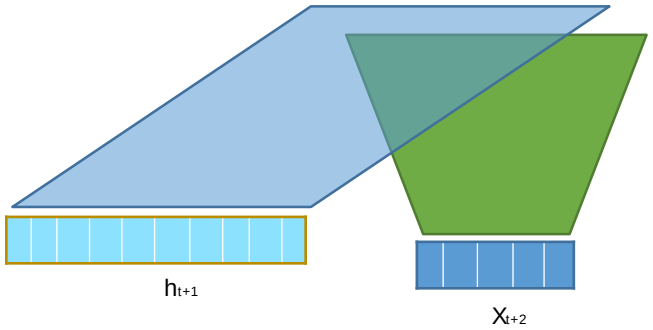
Types of Task Dealing with Sequential Data



http://karpathy.github.io/2015/05/21/rnn-effectiveness/

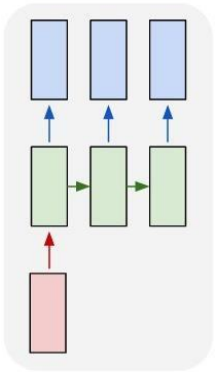
Recurrent Neural Network

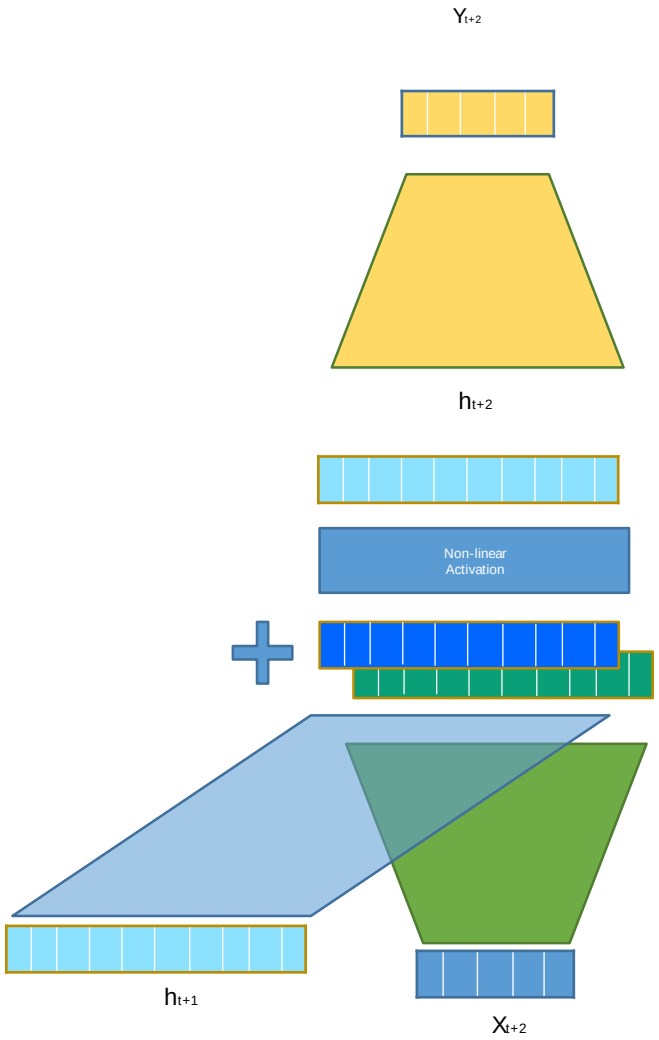




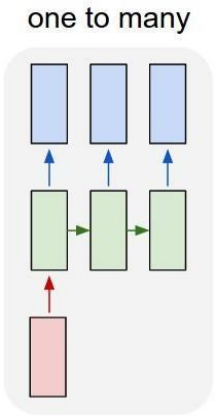
Recurrent Neural Network

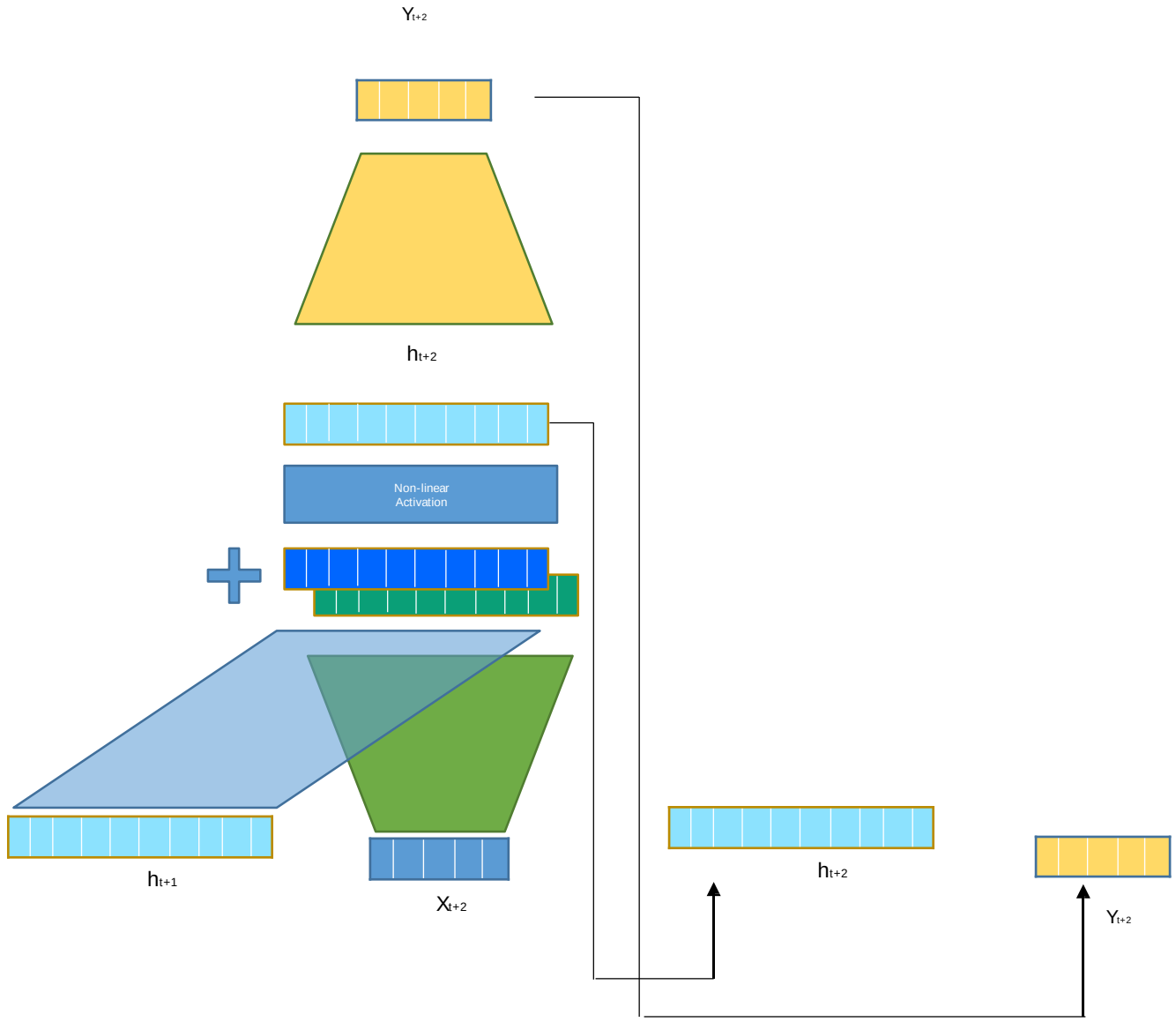
one to many



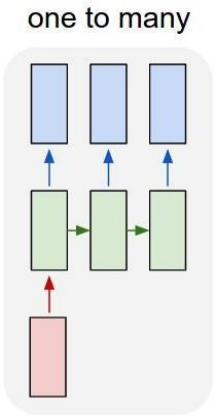


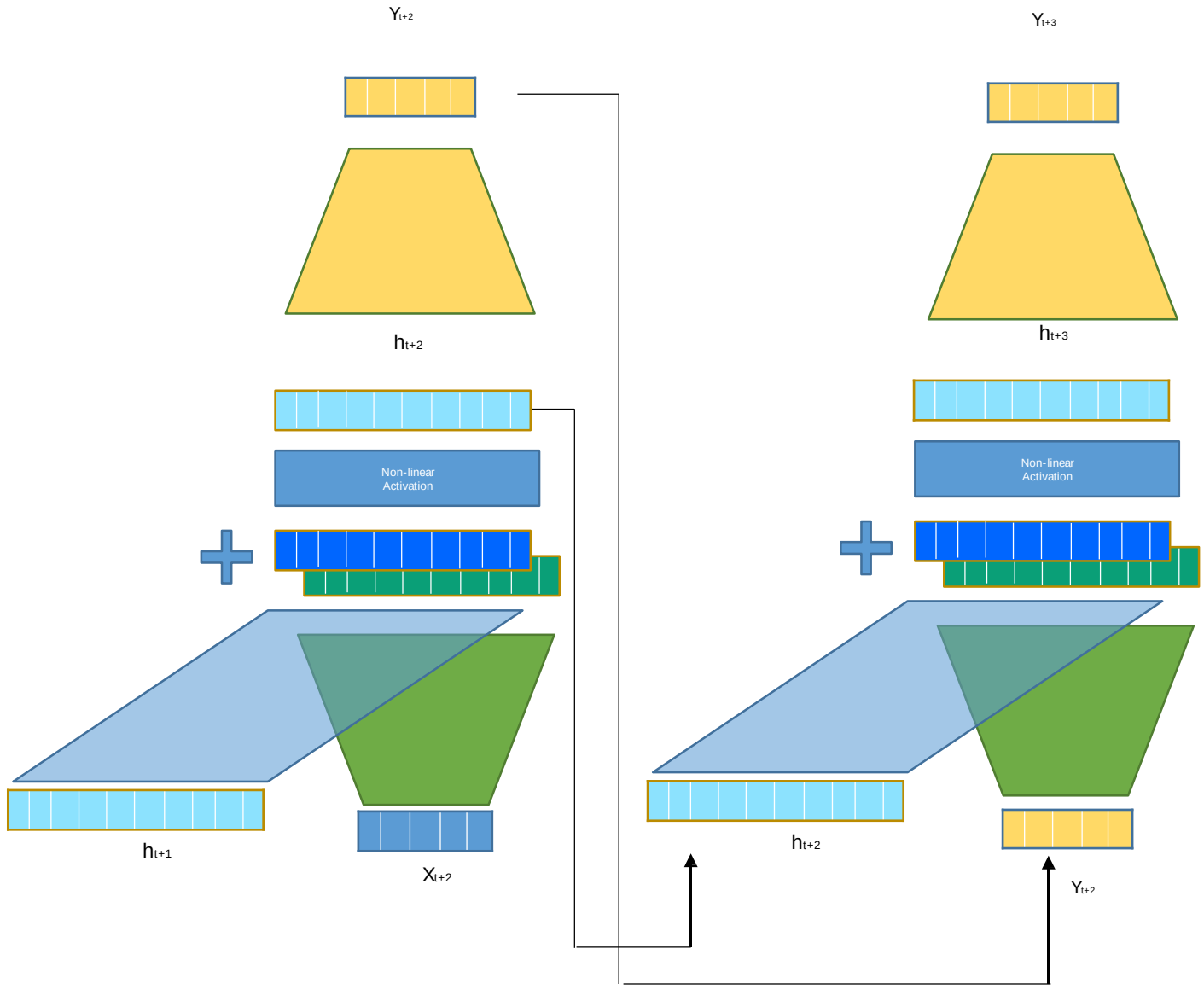
Recurrent Neural Network



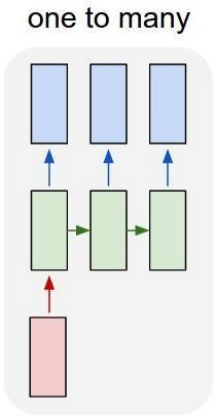


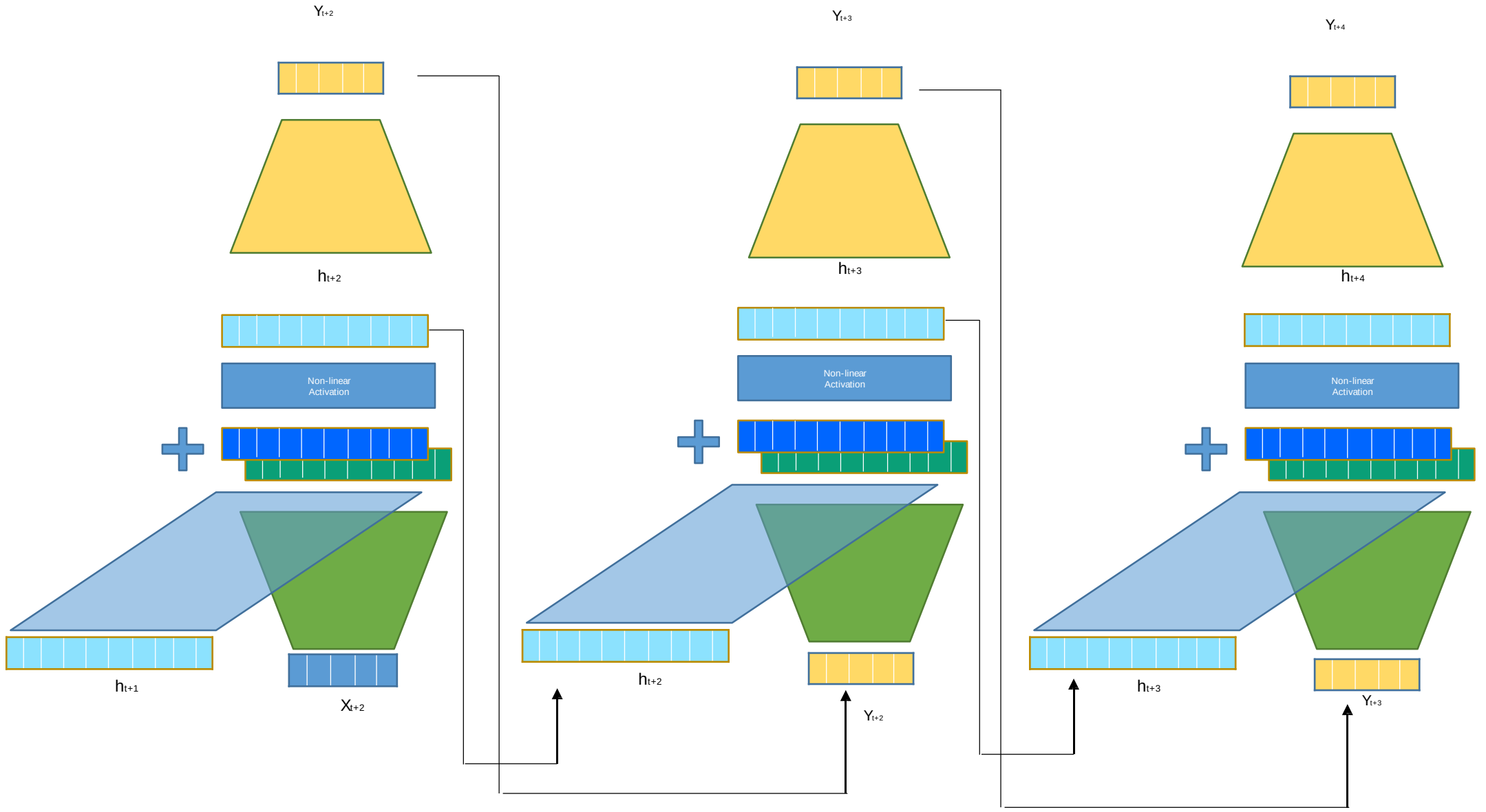
Recurrent Neural Network





Recurrent Neural Network

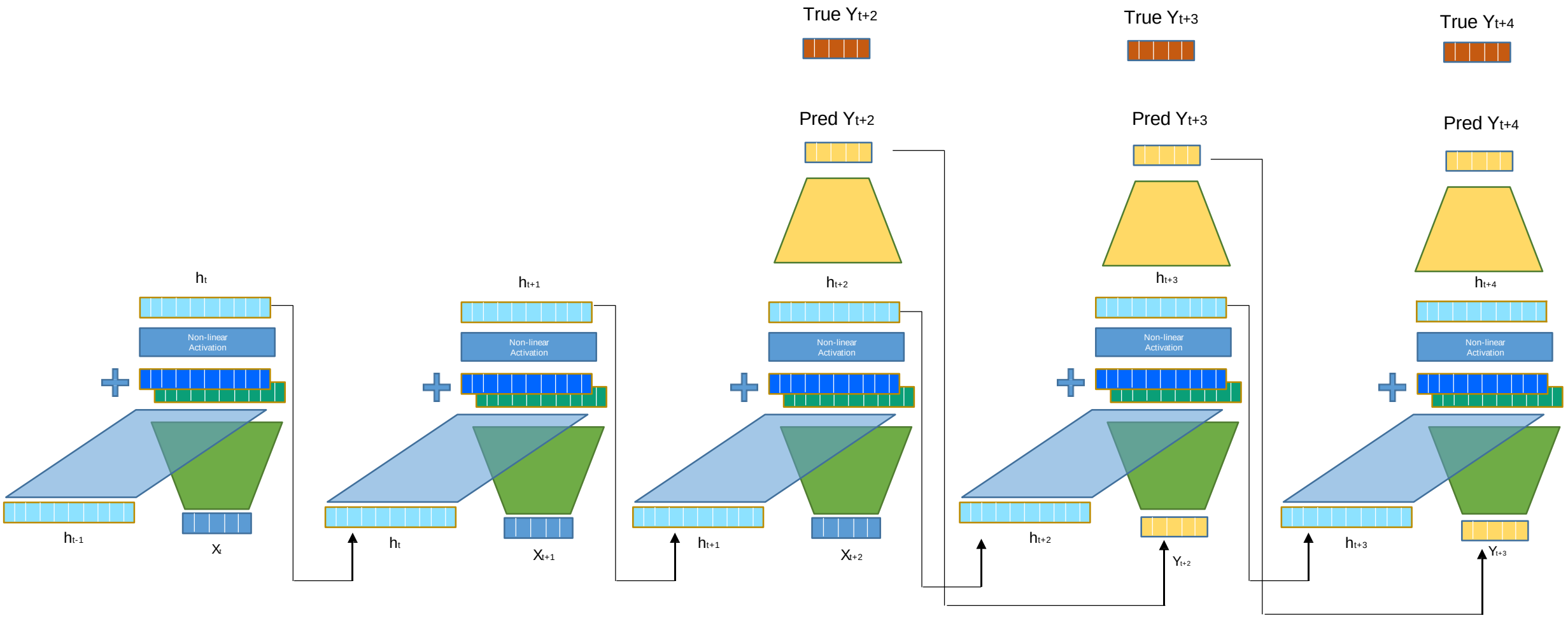




Okay, now we understand RNN model(hypothesis)

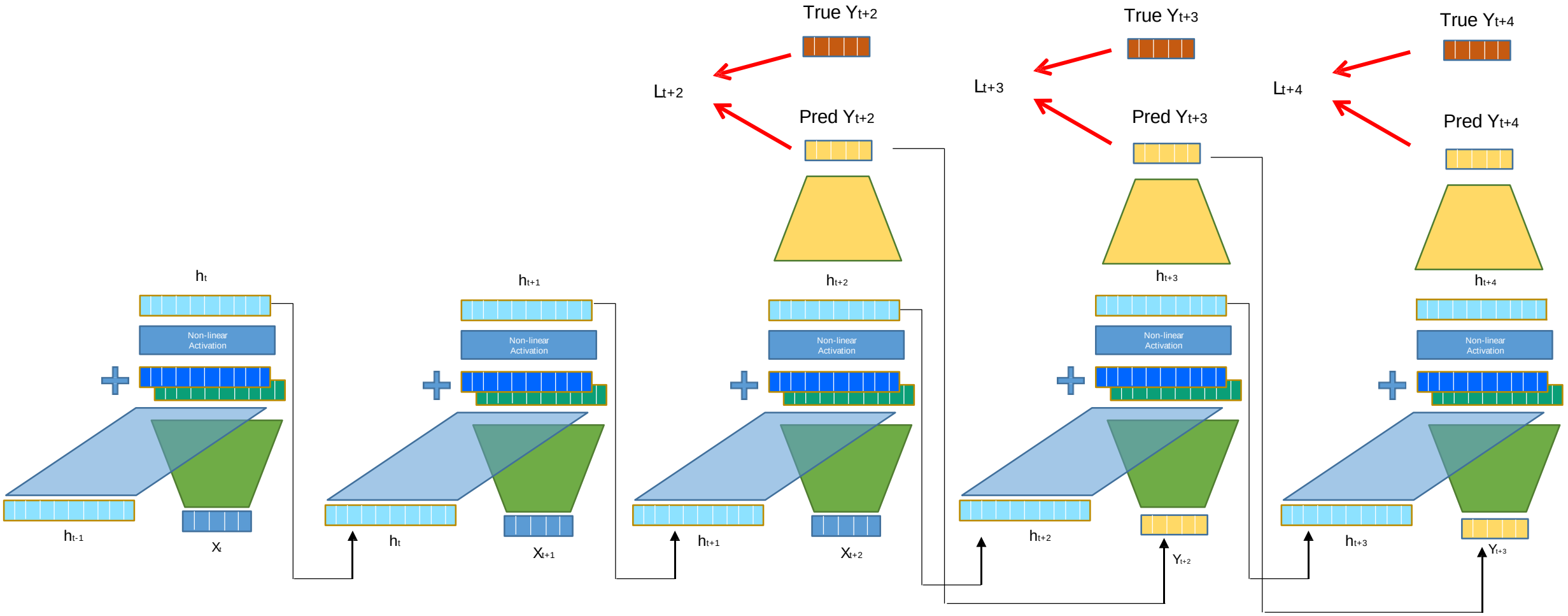
How can we evaluate it?

Calculate Loss of Recurrent Neural Network



Calculate Loss of Recurrent Neural Network

$$Loss(\theta) = \sum_{t} loss(y_{true,t}, y_{pred,t})$$



Calculate Loss of Recurrent Neural Network

$$Loss(\theta) = \sum_{t} loss(y_{true,t}, y_{pred,t})$$

Classification → CrossEntropy

Regression → MSE