Idea Factory Intensive Program #2

딥러닝 홀로서기

#25

이론강의/PyTorch실습/코드리뷰

딥러닝(Deep Learning)에 관심이 있는 학생 발굴을 통한
딥러닝의 이론적 배경 강의 및 오픈소스 딥러닝 라이브러리 PyTorch를 활용한 실습

Acknowledgement

Sung Kim's 모두를 위한 머신러닝/딥러닝 강의
- https://hunkim.github.io/ml/
- https://www.youtube.com/playlist?list=PLlMkM4tgfjnLSOjrEJN31gZATbcj_MpUm

Andrew Ng's and other ML tutorials
- https://class.coursera.org/ml-003/lecture
- http://www.holehouse.org/mlclass/ (note)
- Deep Learning Tutorial
- Andrej Karpathy's Youtube channel

WooYeon Kim & SeongOk Ryu's KAIST CH485 Artificial Intelligence and Chemistry
- https://github.com/SeongokRyu/CH485---Artificial-Intelligence-and-Chemistry

SungJu Hwang's KAIST CS492 Deep Learning Course Material

Many insightful articles, blog posts and Youtube channels

Facebook community
- Tensorflow KR (https://www.facebook.com/groups/TensorFlowKR/)
- Pytorch KR (https://www.facebook.com/groups/PyTorchKR/)

Medium Channel and Writers
- Toward Data Science (https://towardsdatascience.com/)

Today's Time Schedule

Assignment #5 Review	20 mins
Recurrent Neural Network	1 hour
Implement Basic RNN in Pytorch	1.5 hour

Dealing with Sequential Data

Imagine Your Boss Wants You to Solve a Problem Like...

Automatically generate caption with the given image

Predict whether a company would be bankrupted

Translate one sentence into another language

Classify whether the word is owns' name or not

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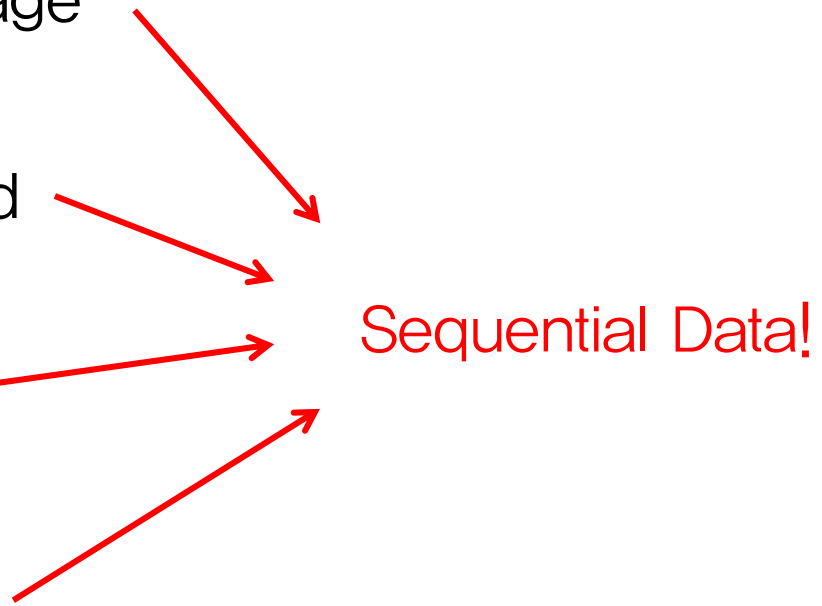

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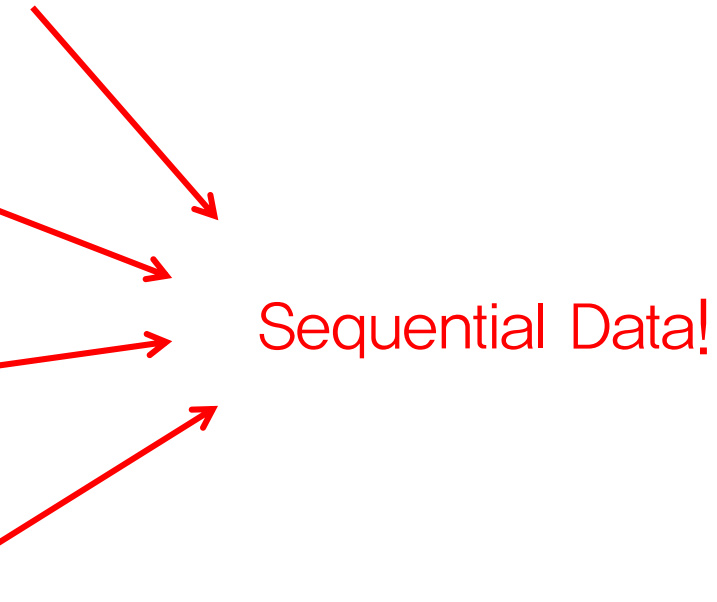

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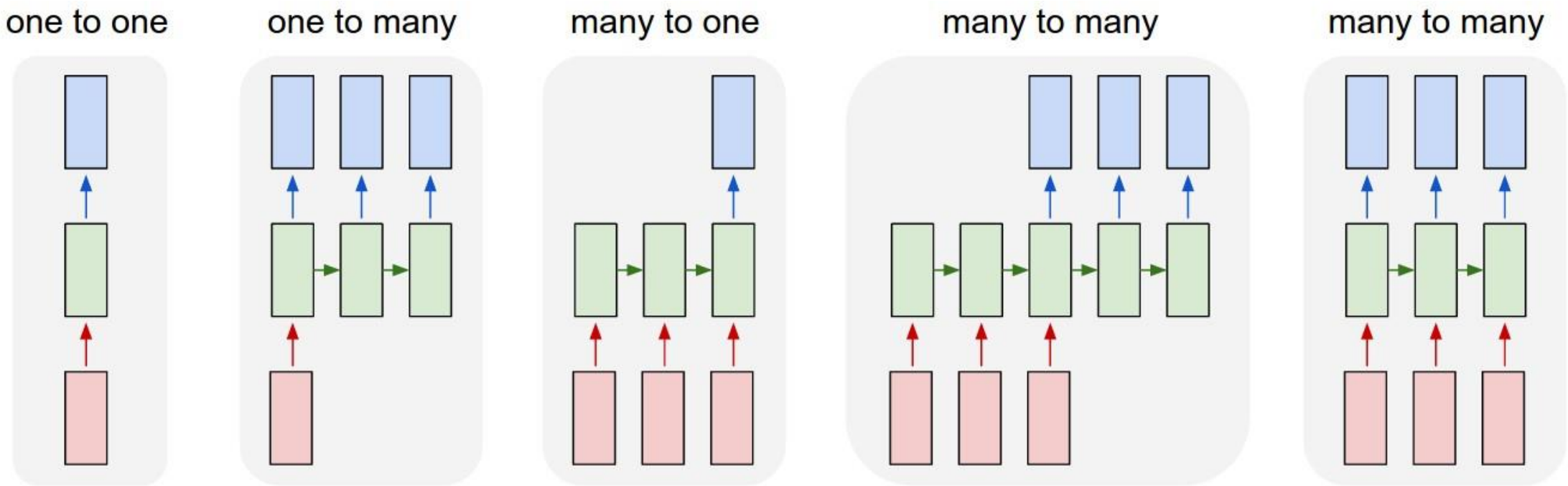

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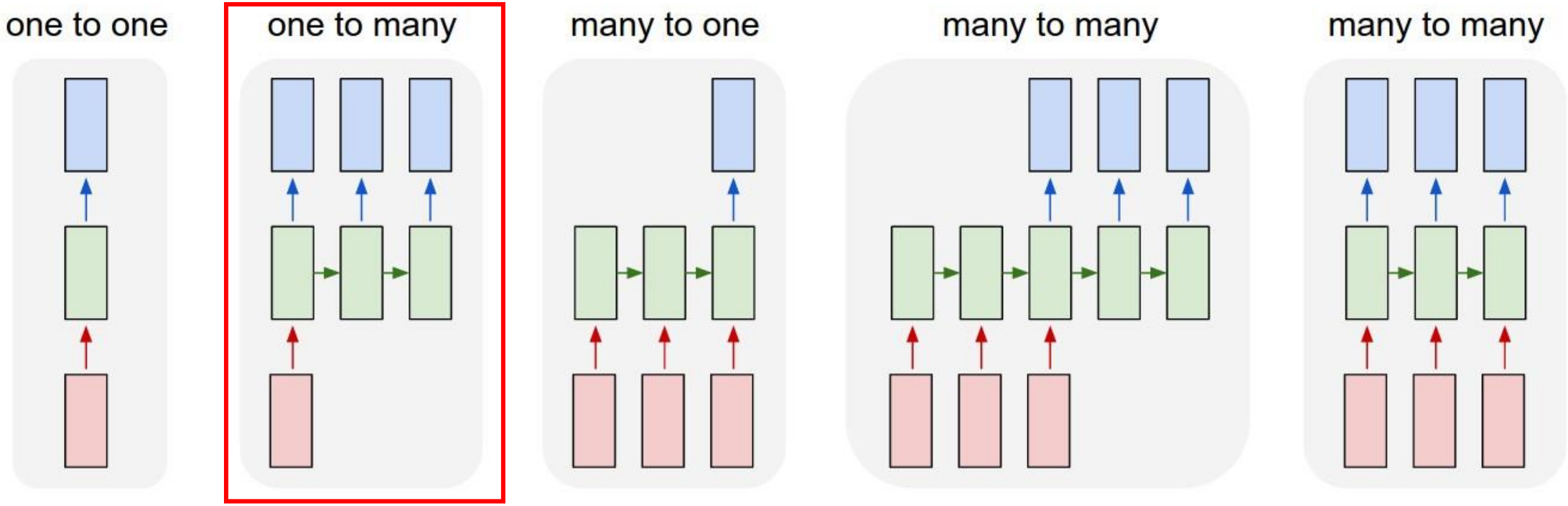

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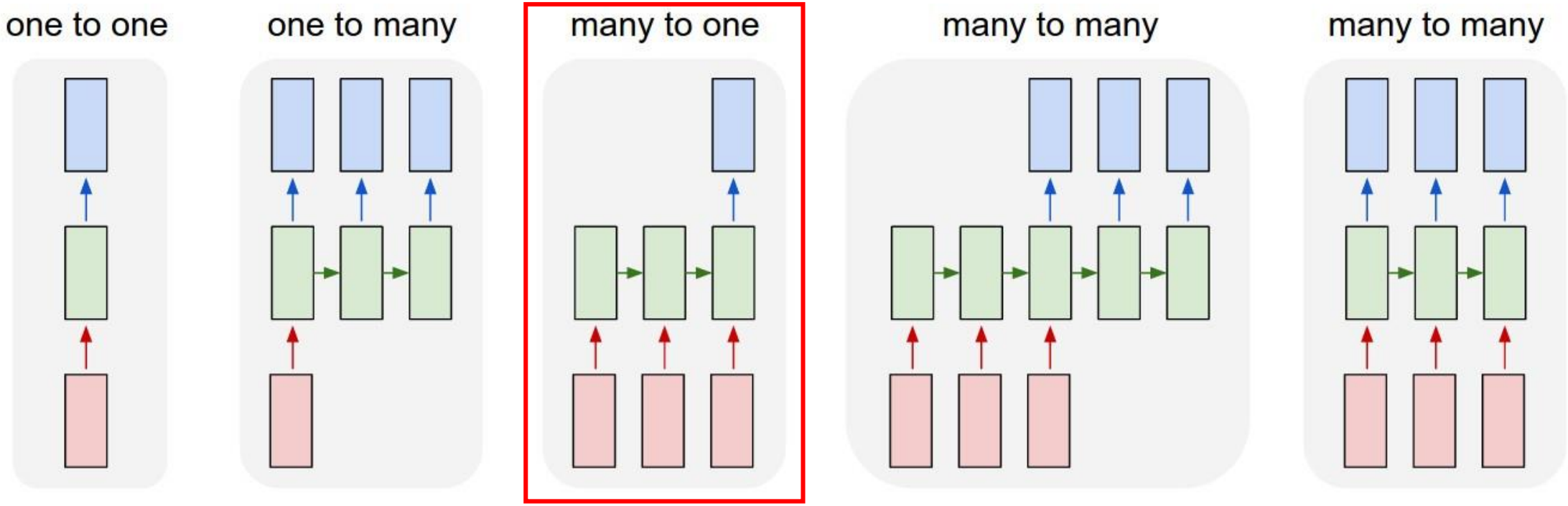

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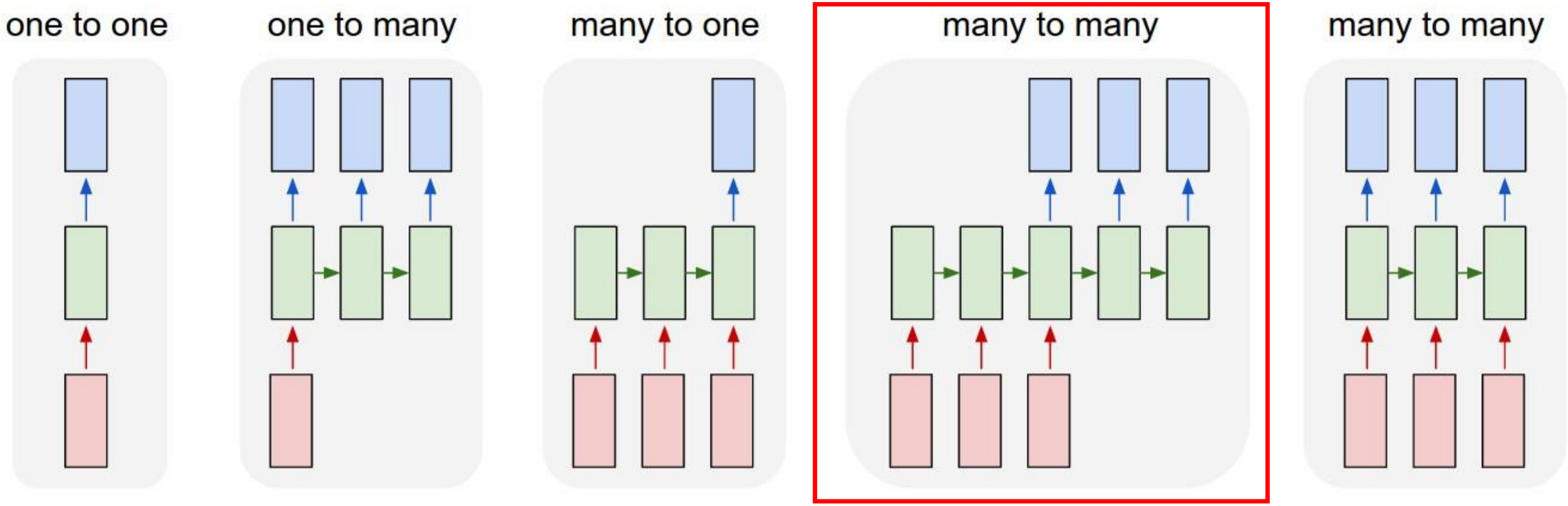

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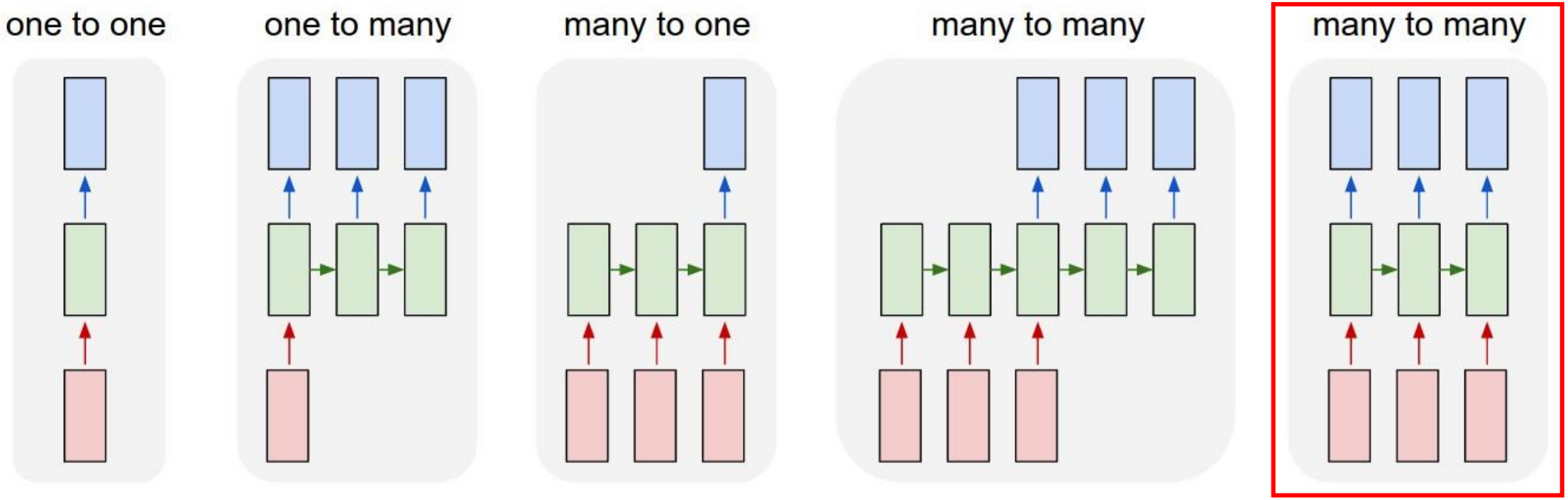

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Classical Approach for Time Series Analysis

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- 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

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

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Deep Learning Dealing with Sequential Data

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MLP? Stack of fully connected layers

CNN? Stack of (convolution + pooling + fully connected) layers

Deep Learning Dealing with Sequential Data

MLP? Stack of fully connected layers

Cannot handle a sequence with arbitrary length

For fixed length sequence, require lots of parameters

CNN? Stack of (convolution + pooling + fully connected) layers

Actually perform quite well on time series analysis

Recommend to read: https://machinelearningmastery.com/how-to-develop-convolutional-neural-networks-for-multi-step-time-series-forecasting/

Recurrent Neural Network

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Process both new inputs and model output of previous input!

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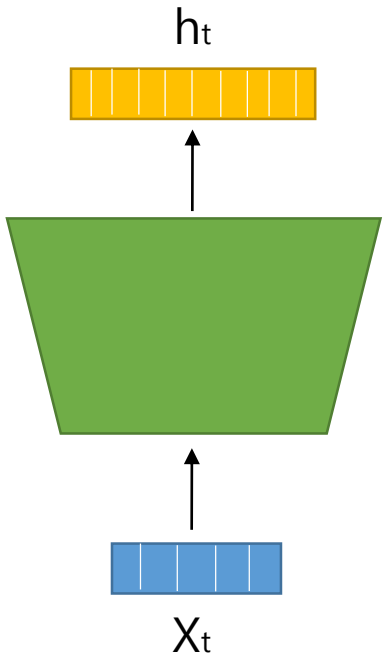

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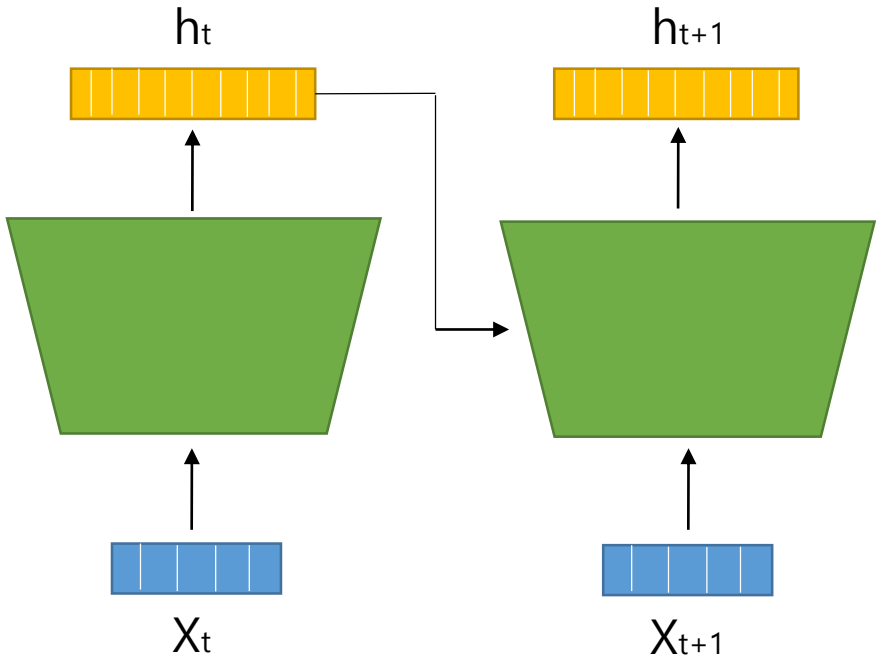

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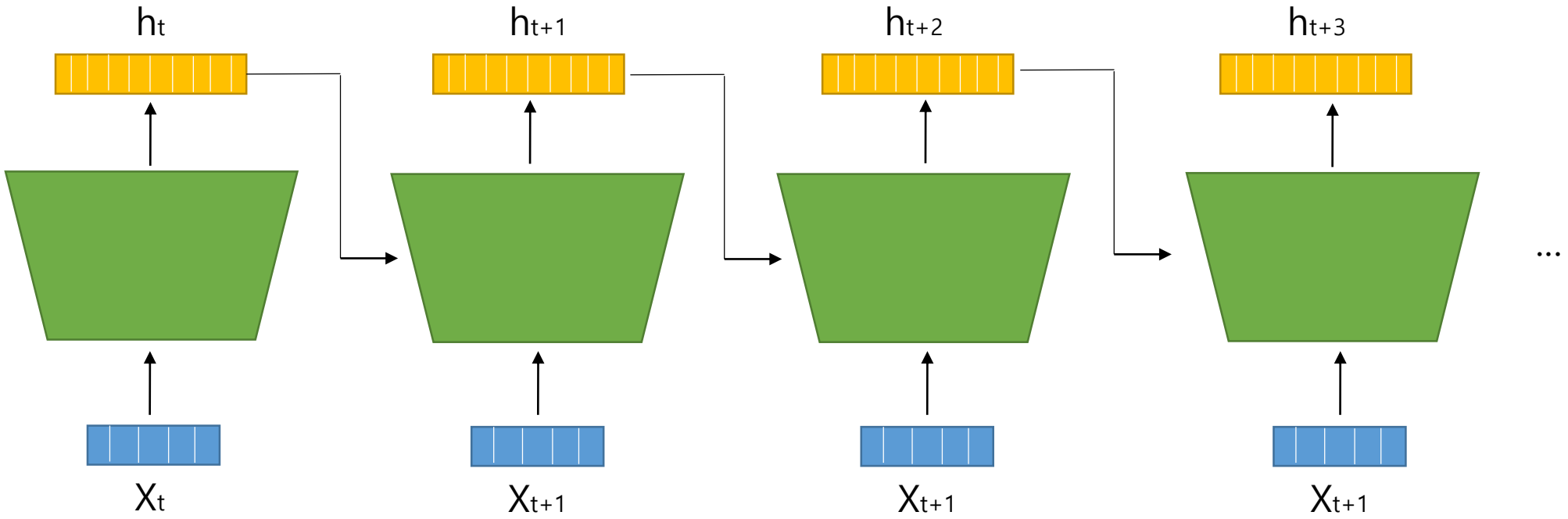

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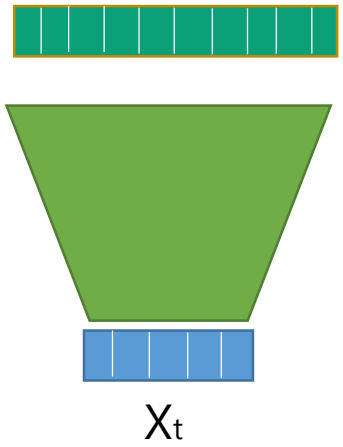
But exactly, how can we combine new input and previous output?



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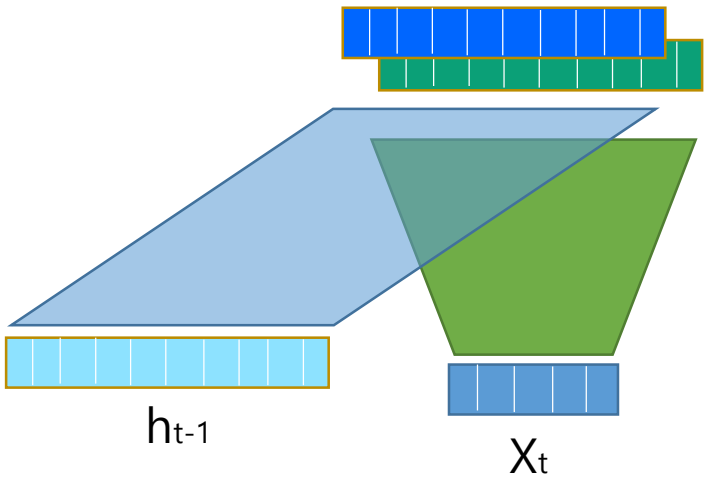

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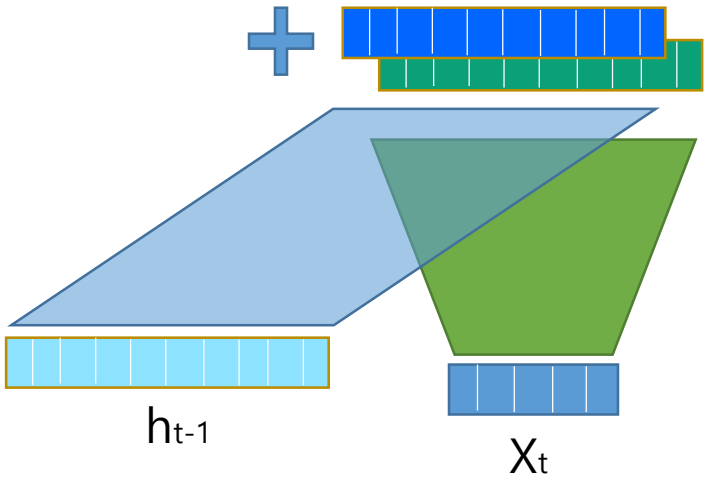

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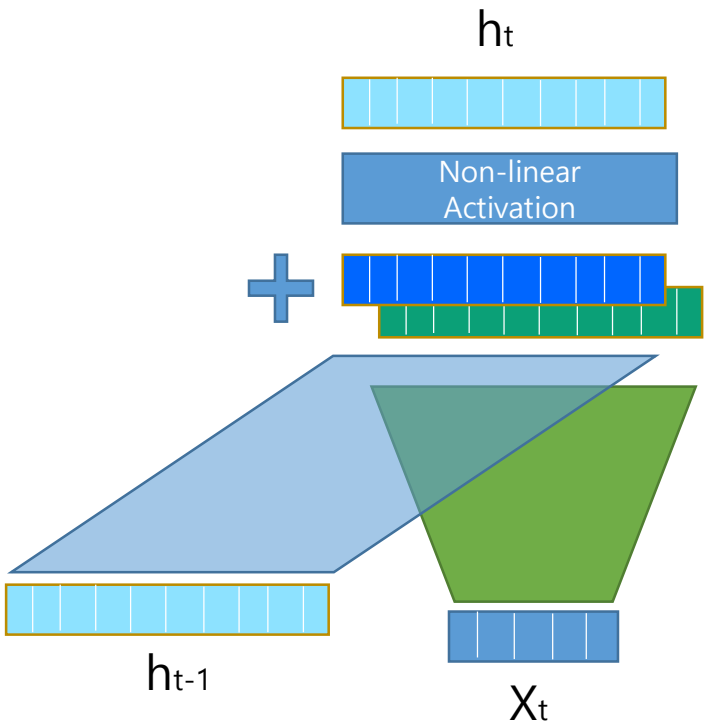

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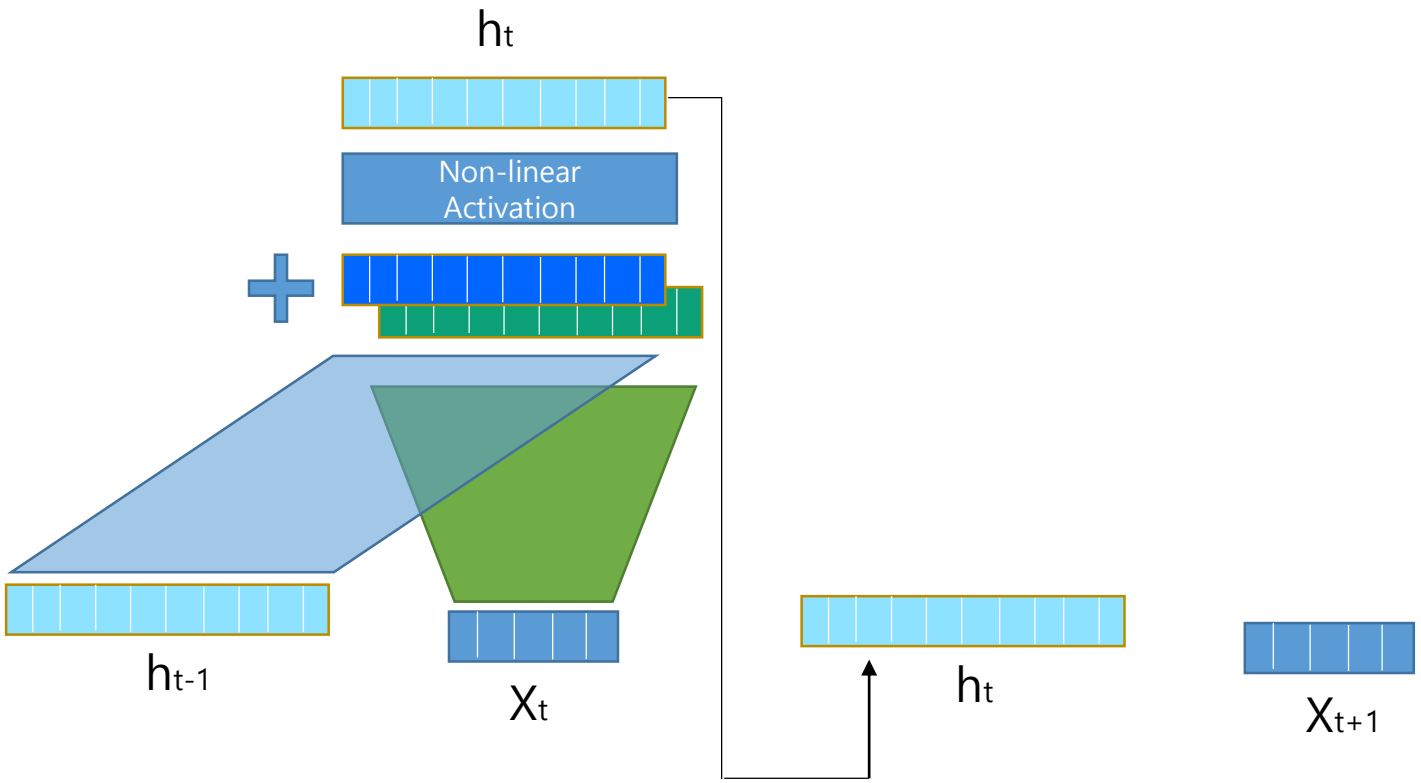

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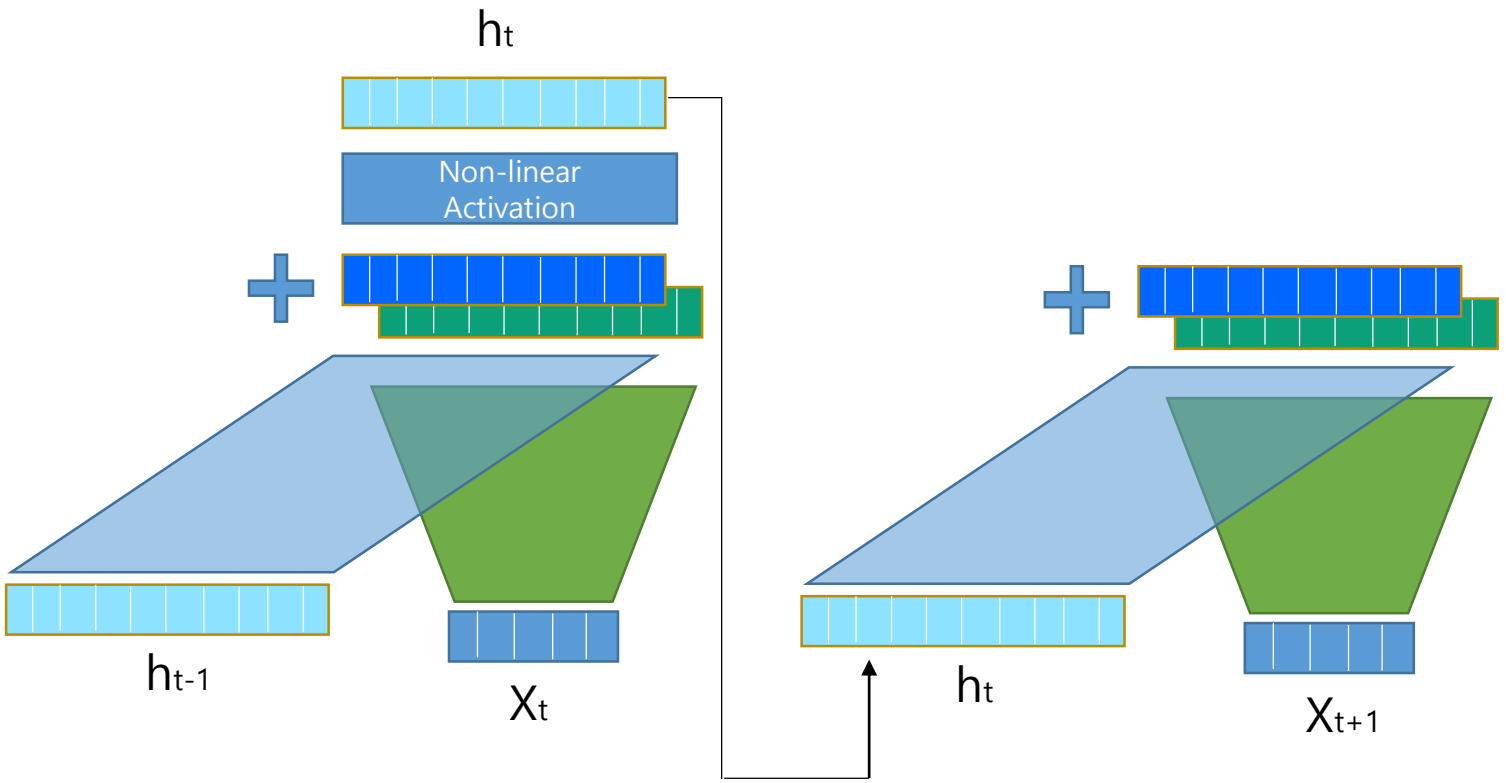

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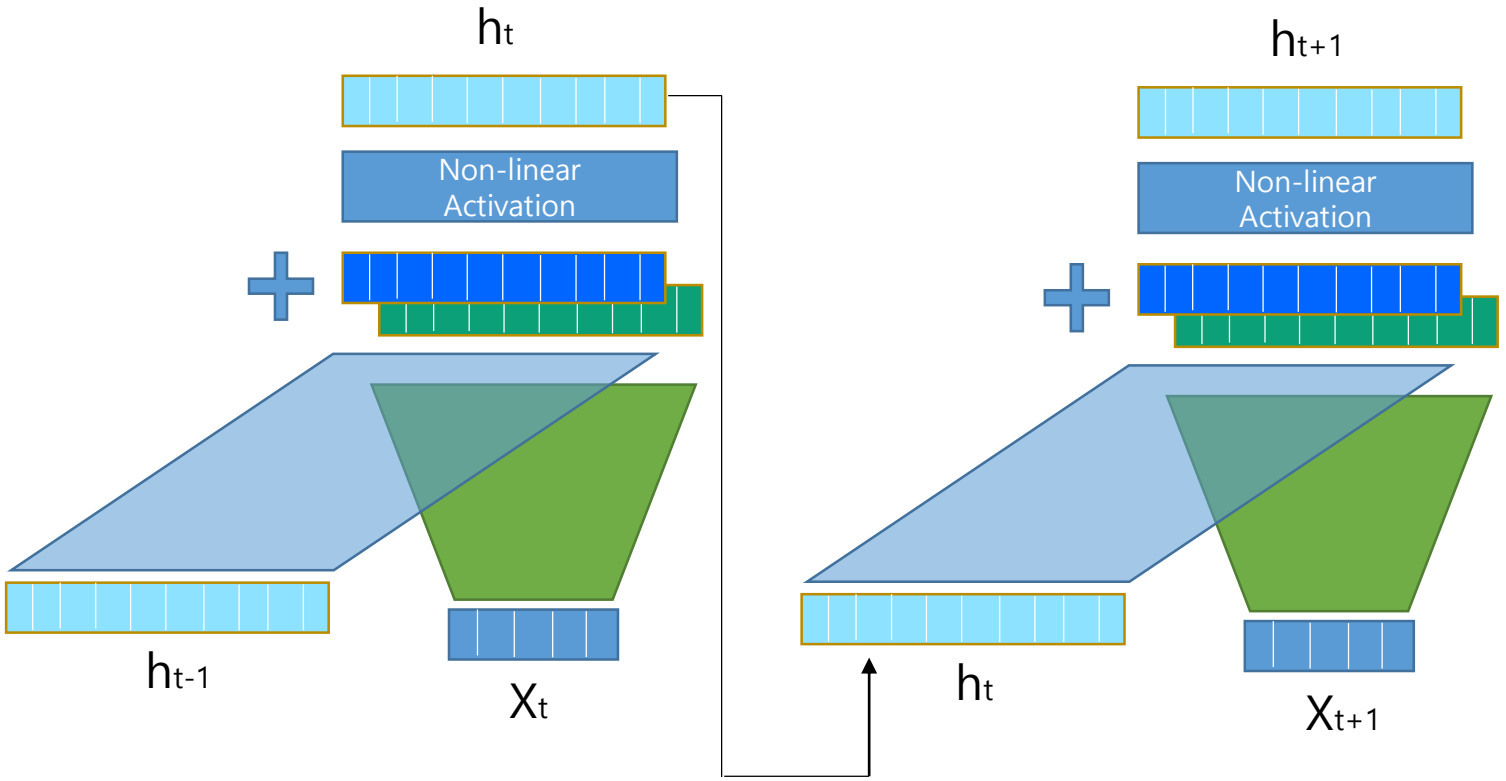

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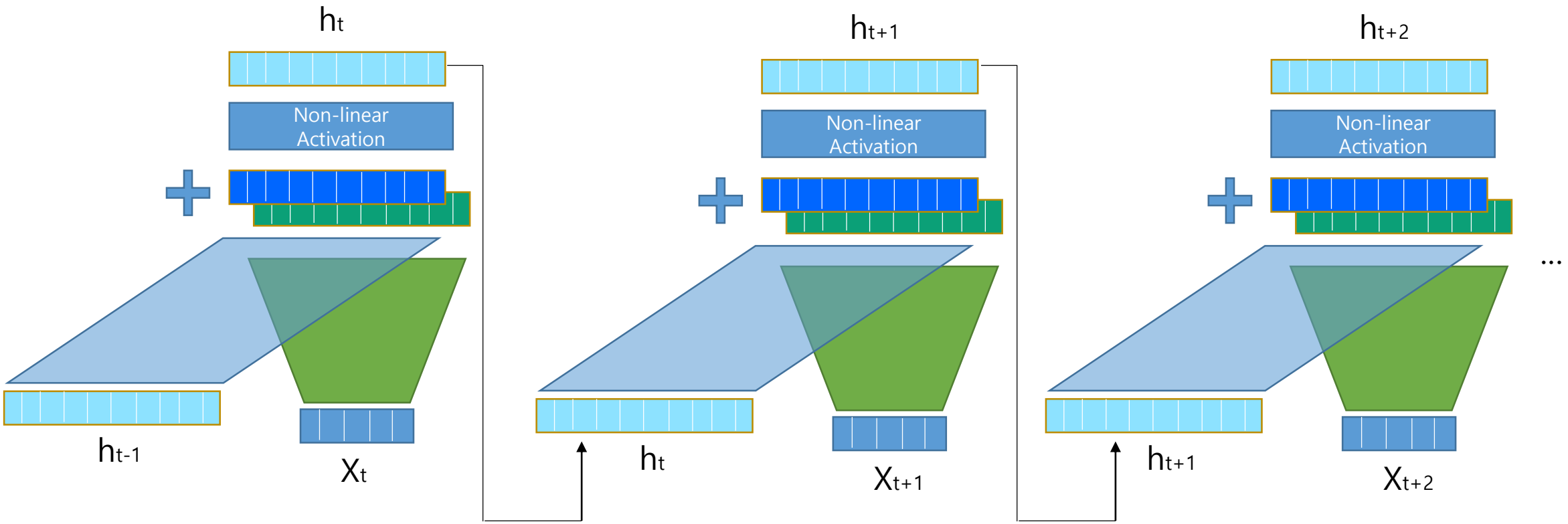

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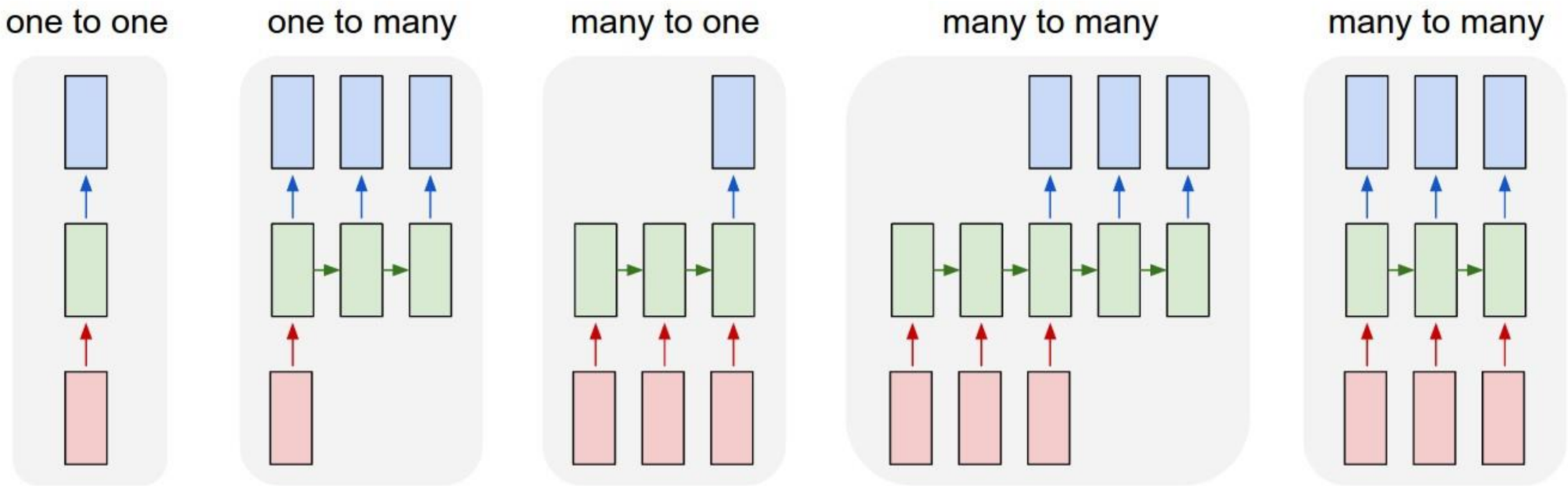

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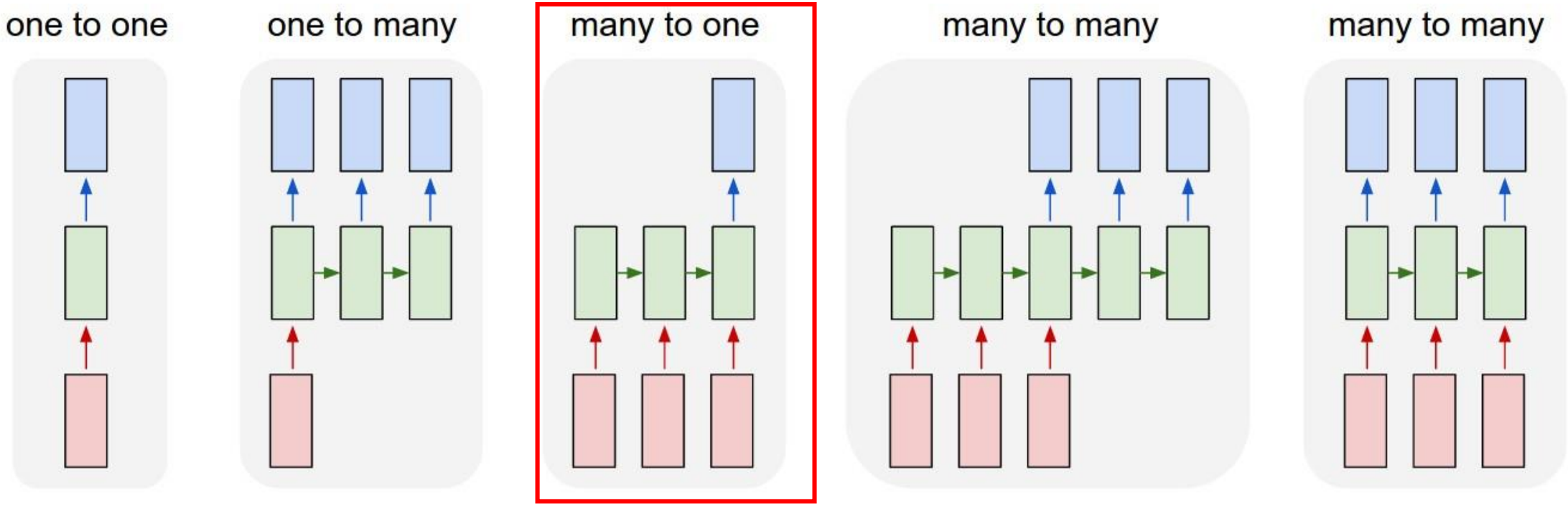

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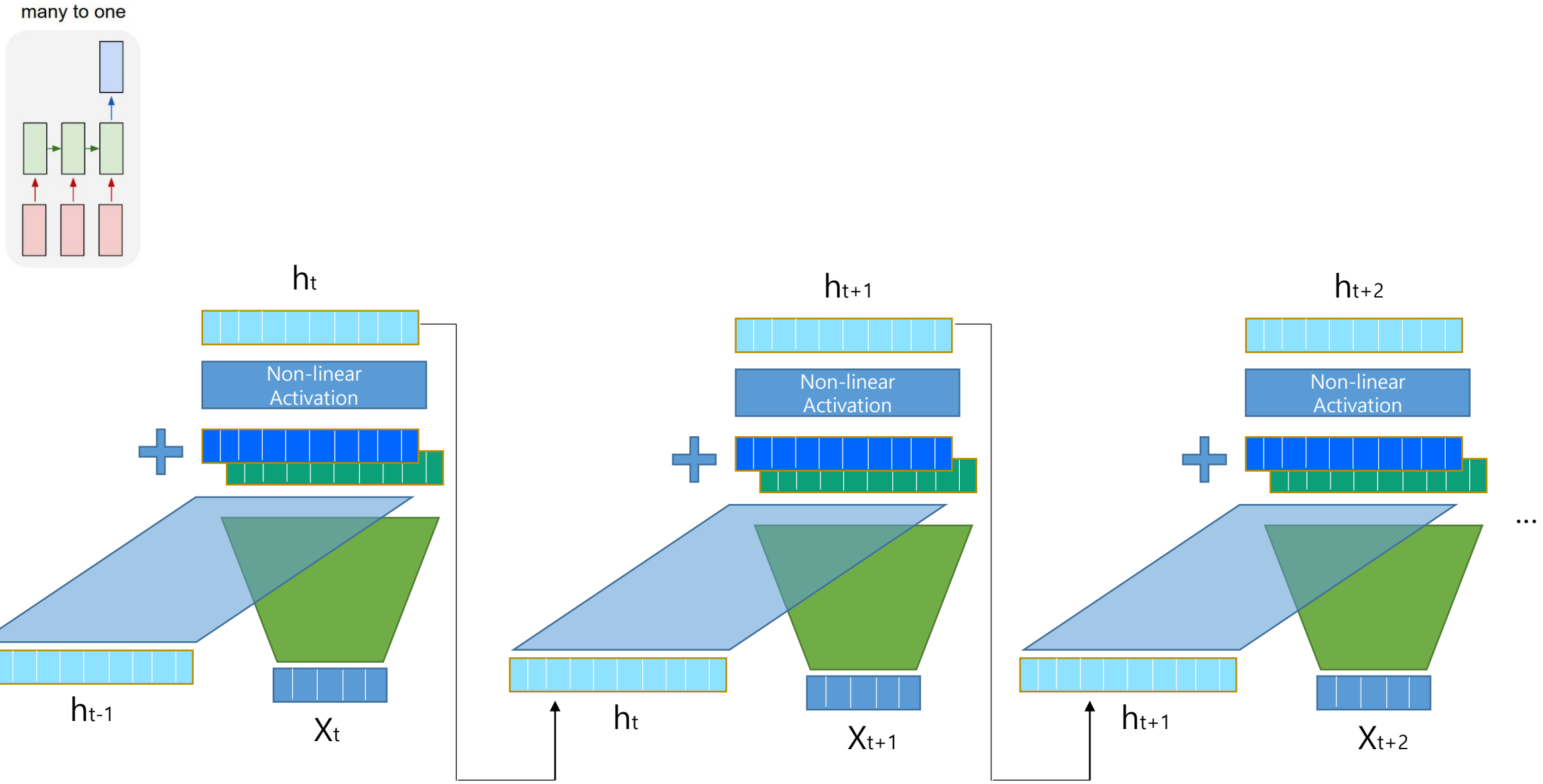

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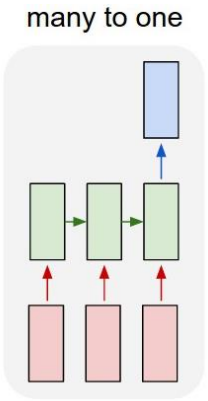

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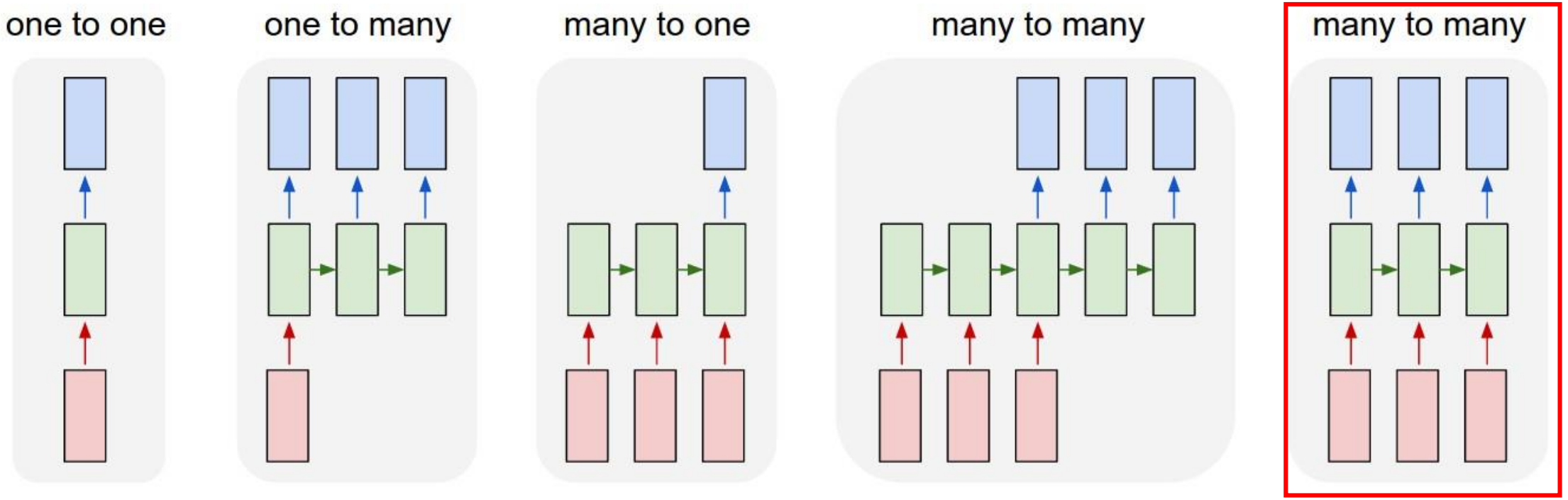

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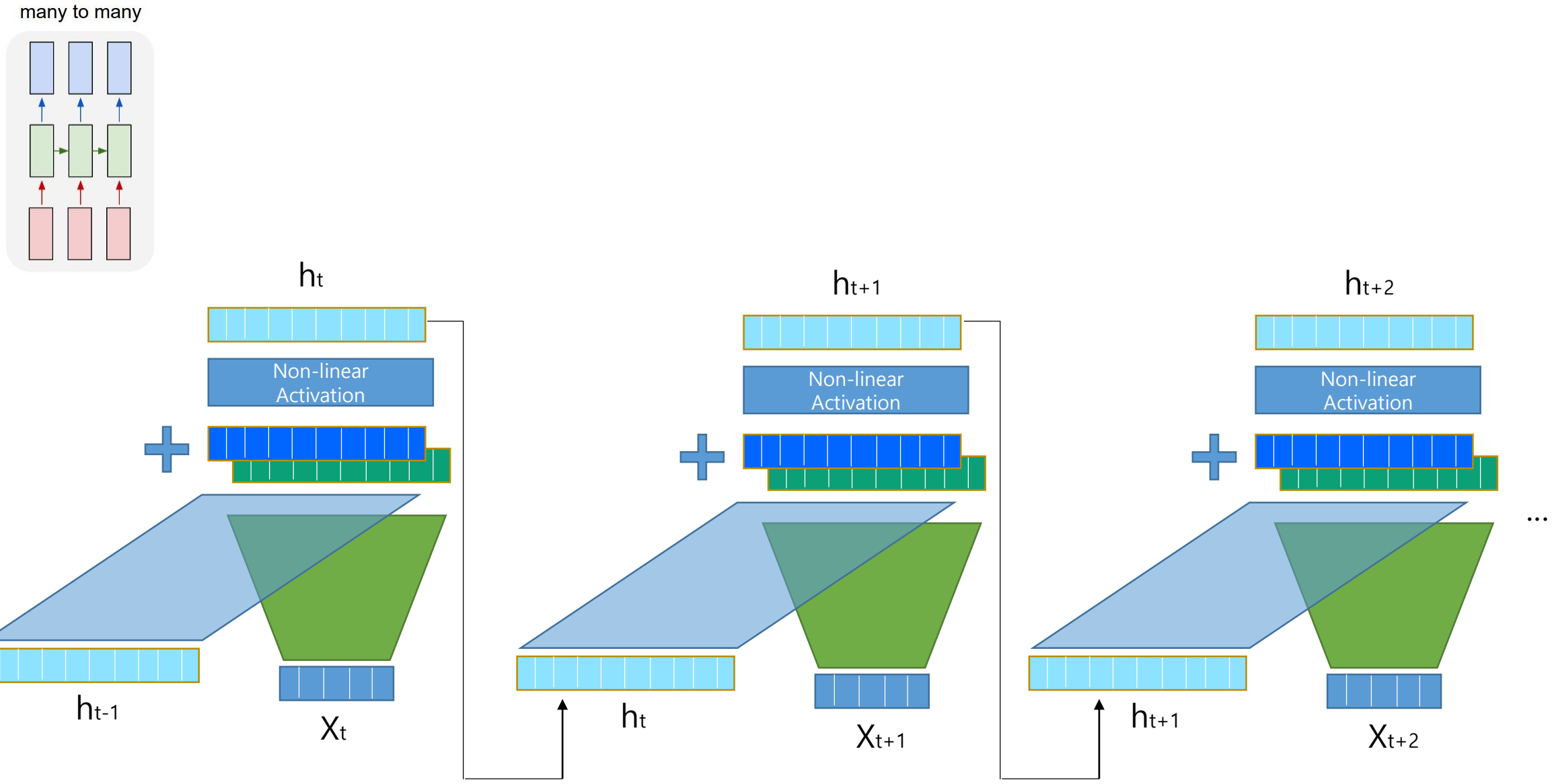

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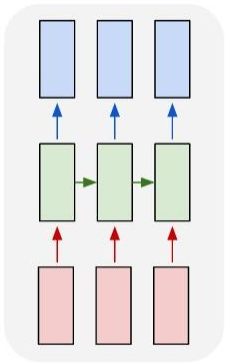

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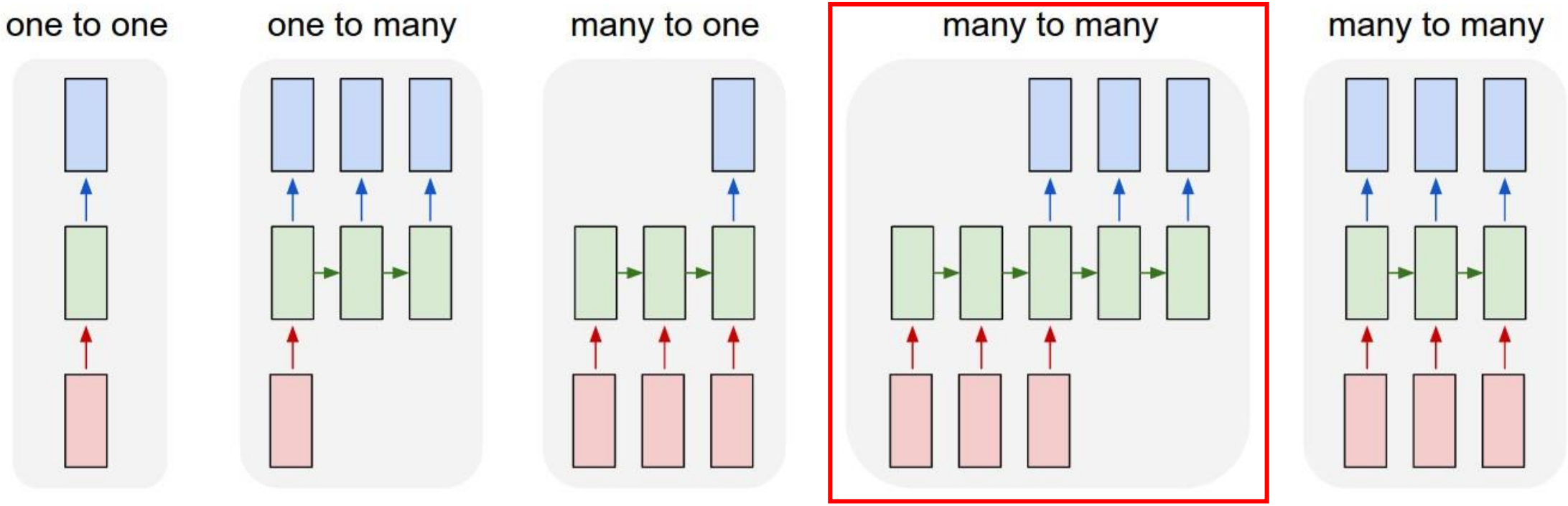

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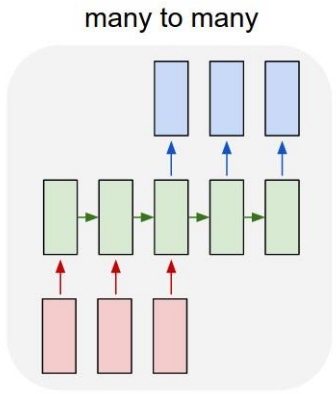

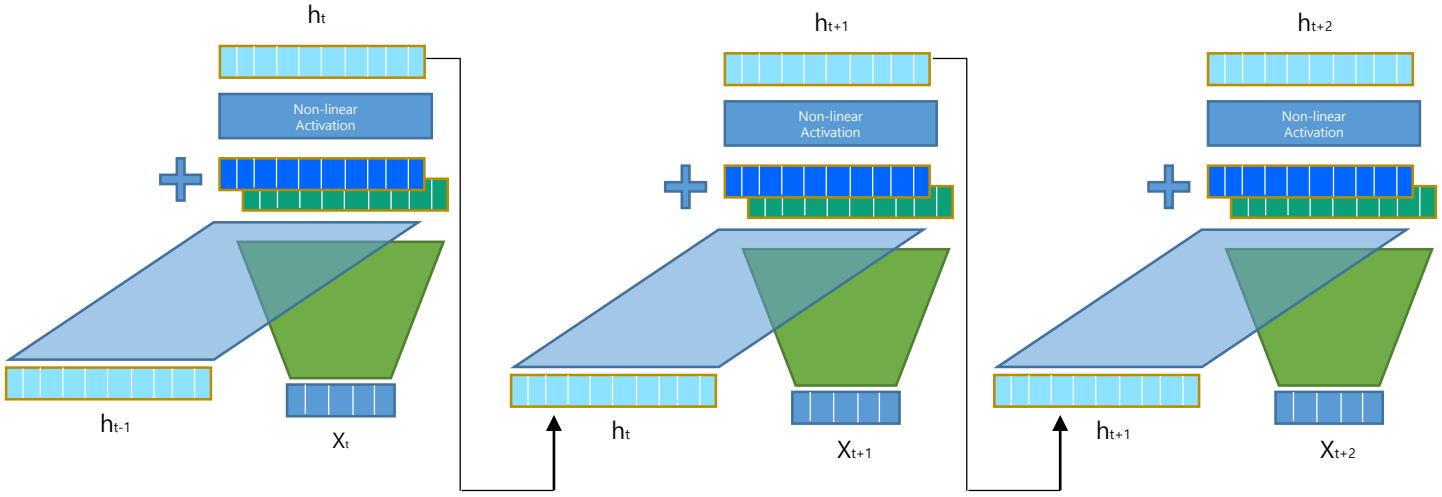

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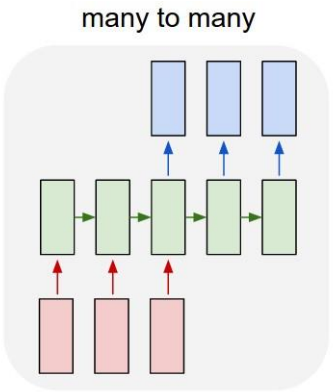

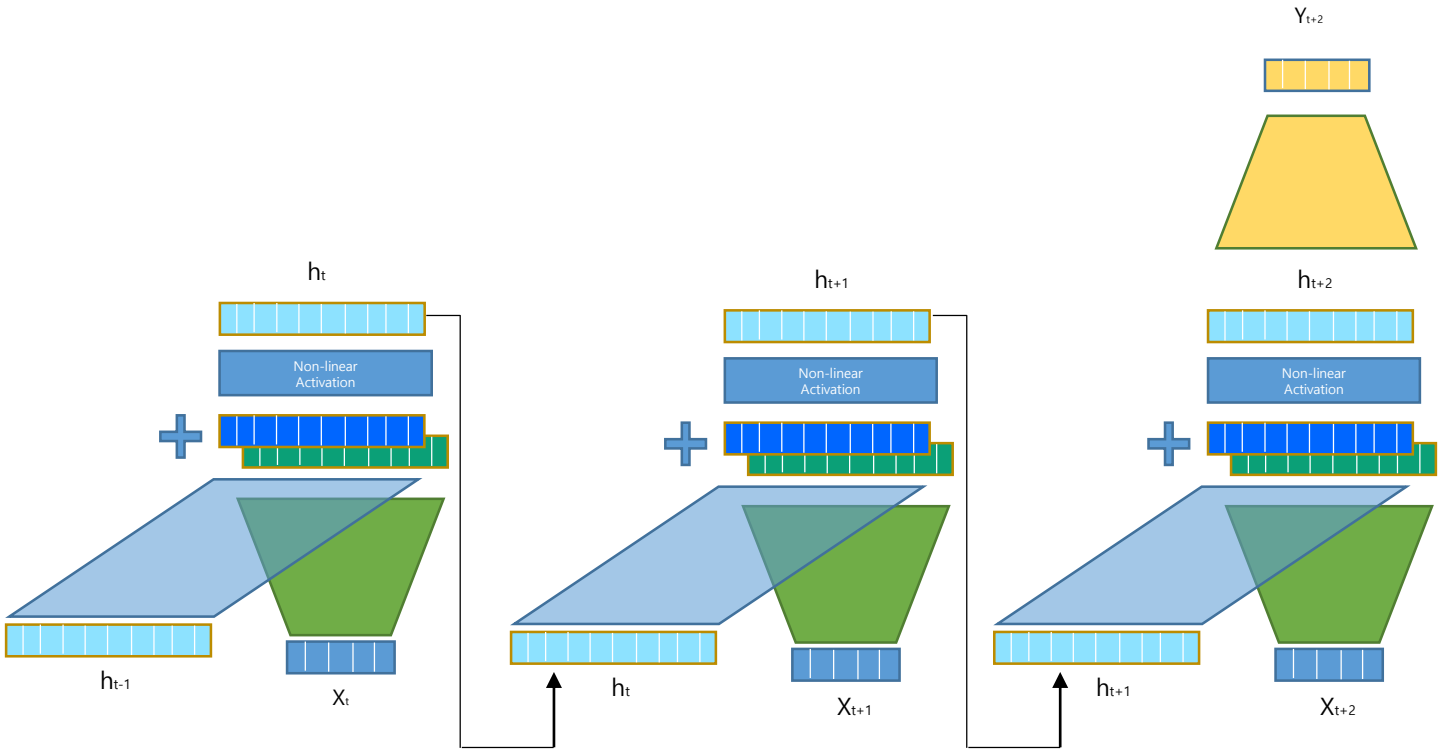

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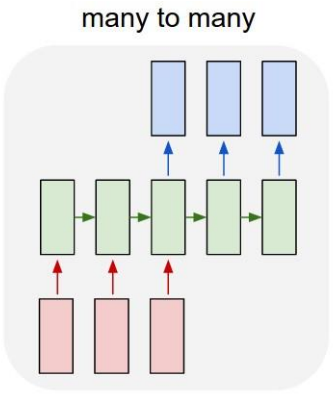

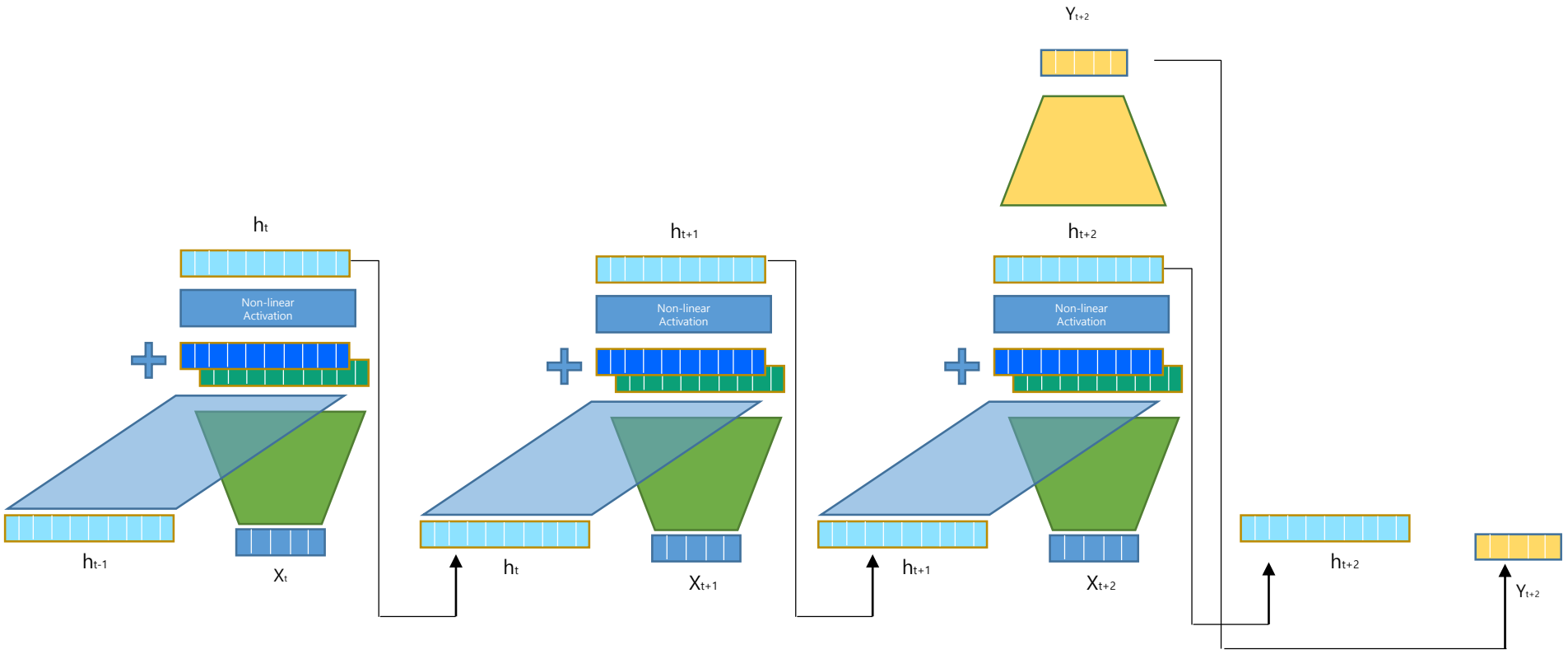

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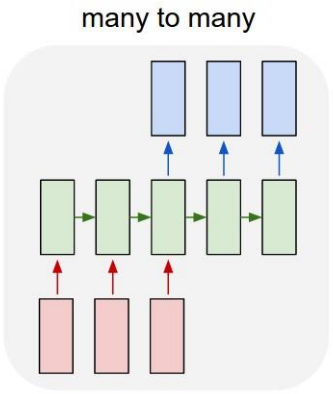

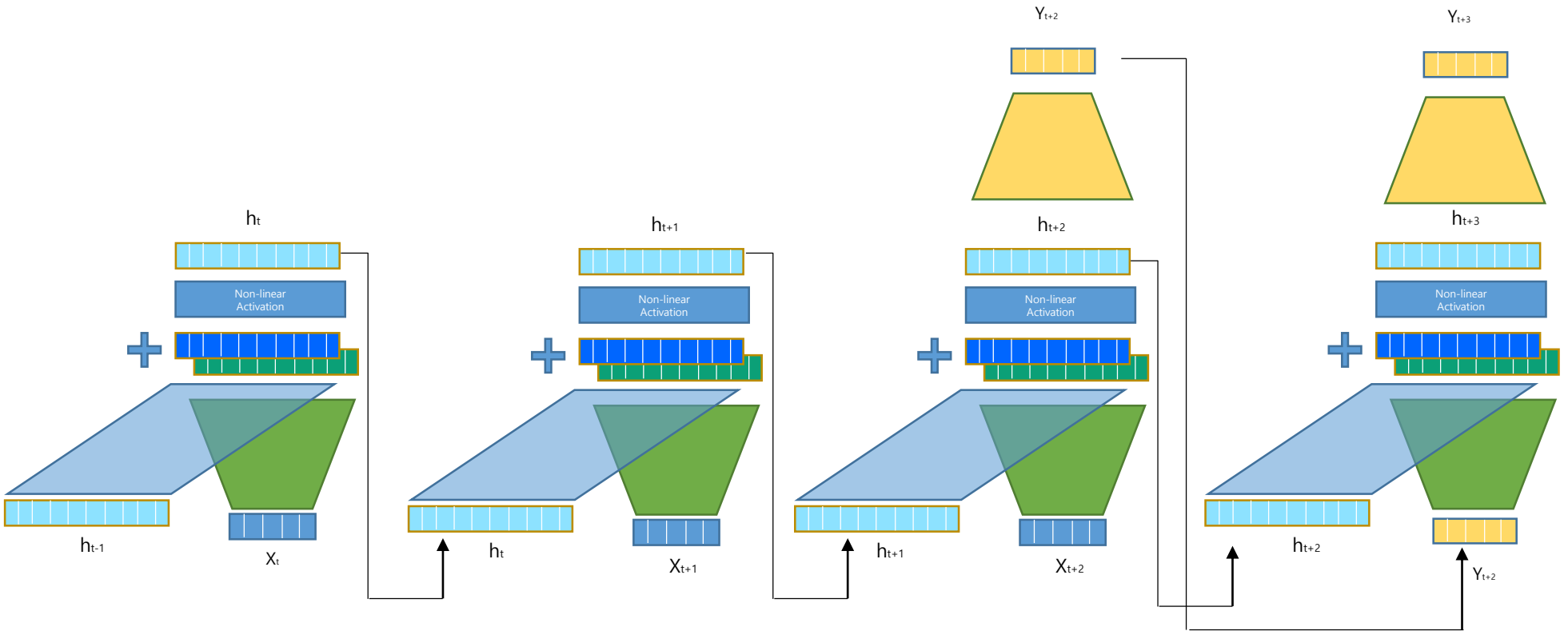

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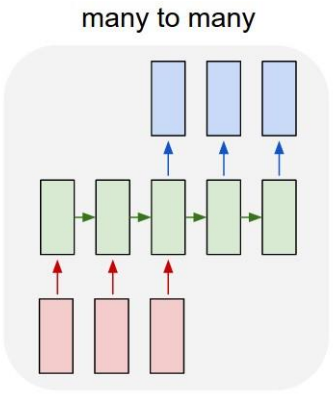

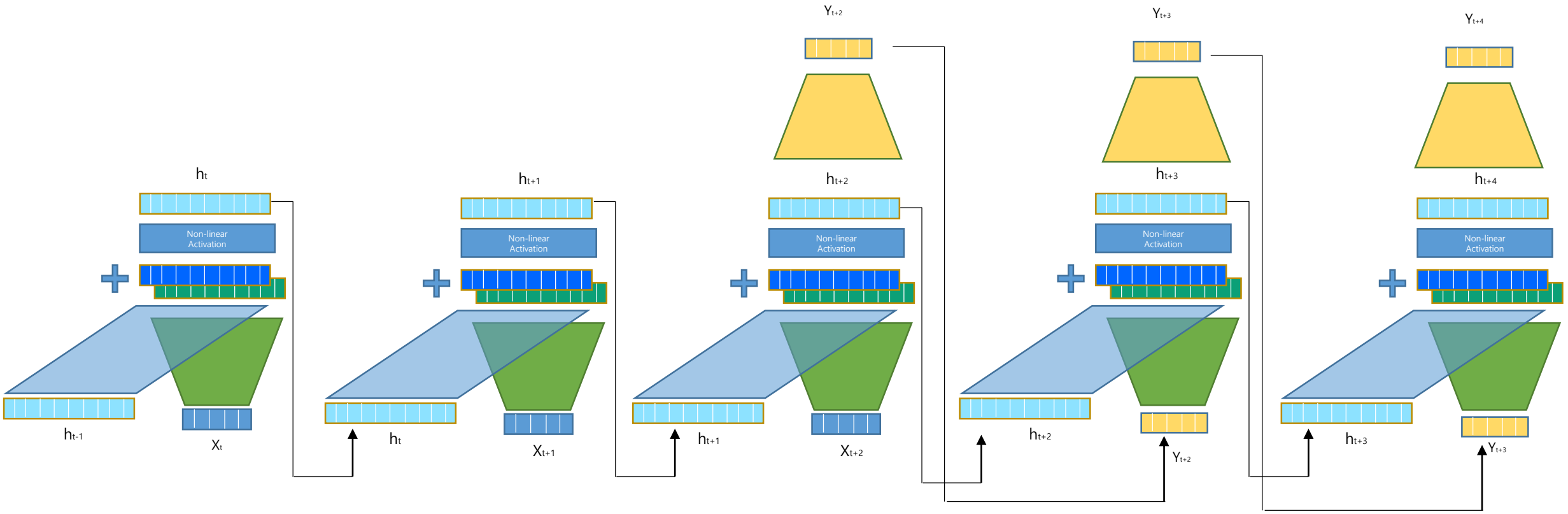

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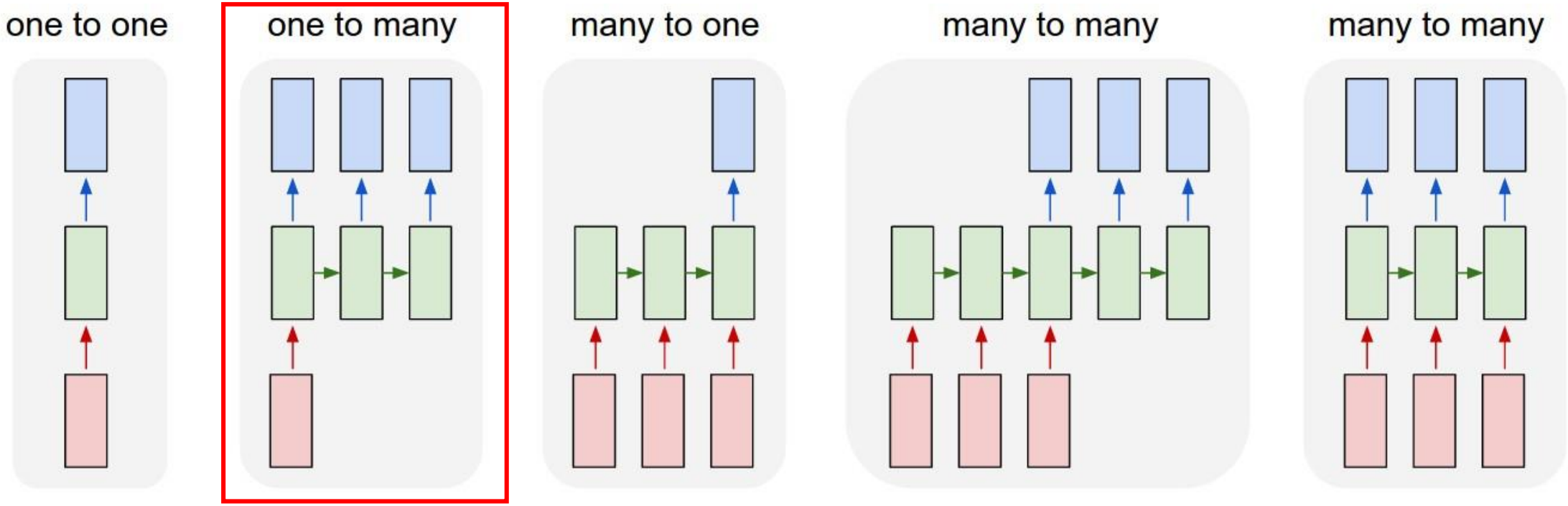

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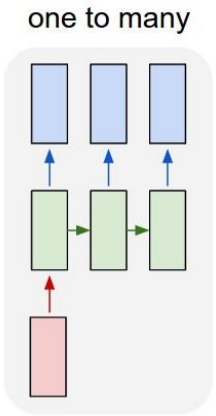
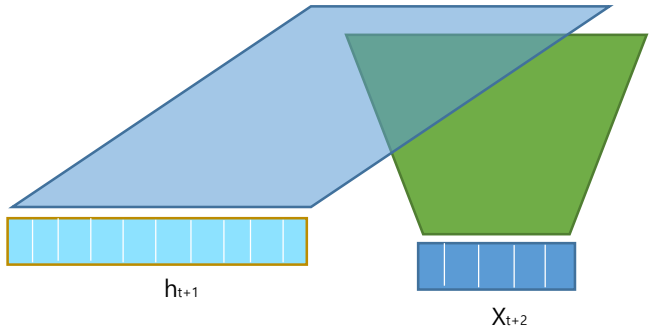
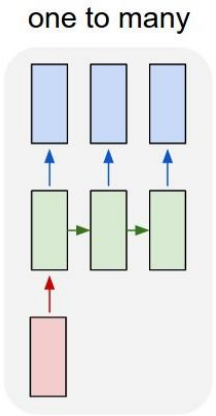
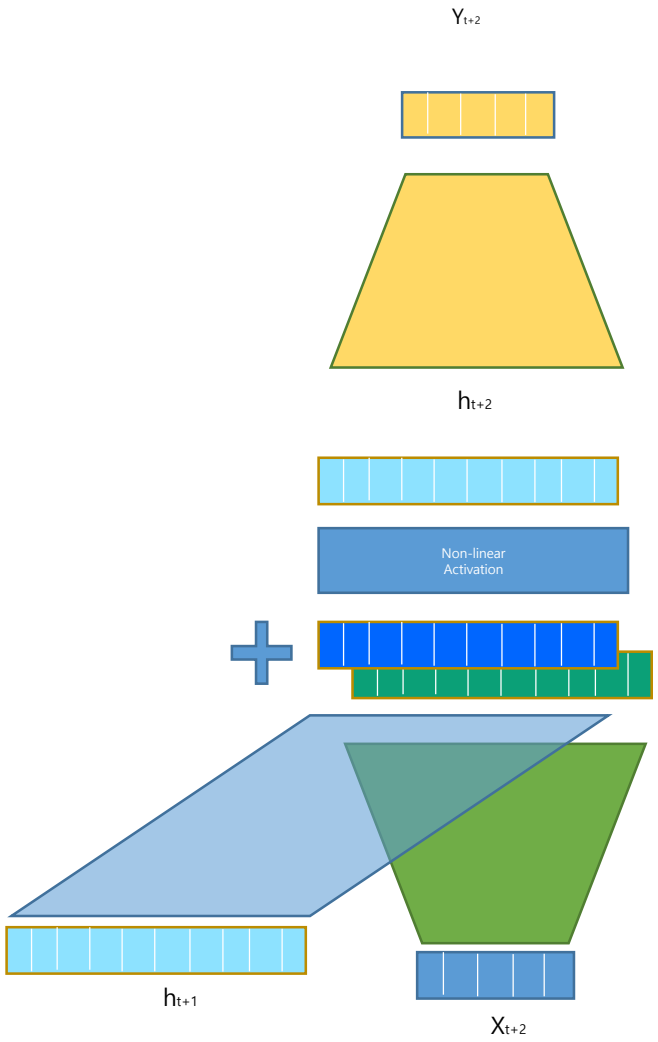
Recurrent Neural Network



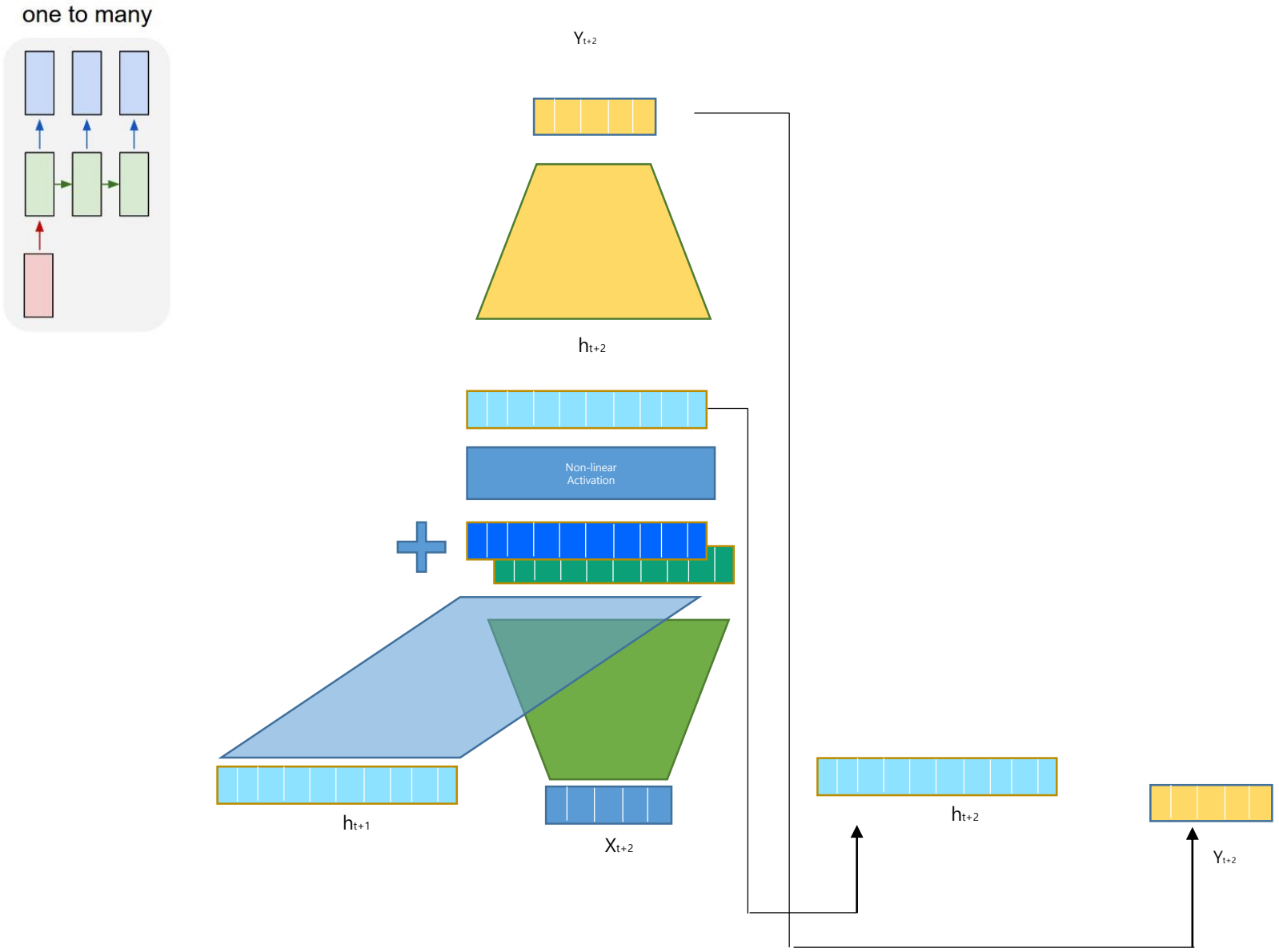


Recurrent Neural Network

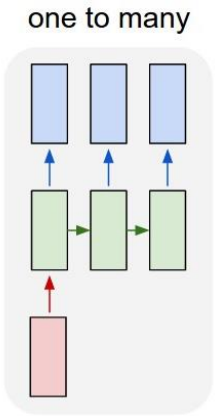


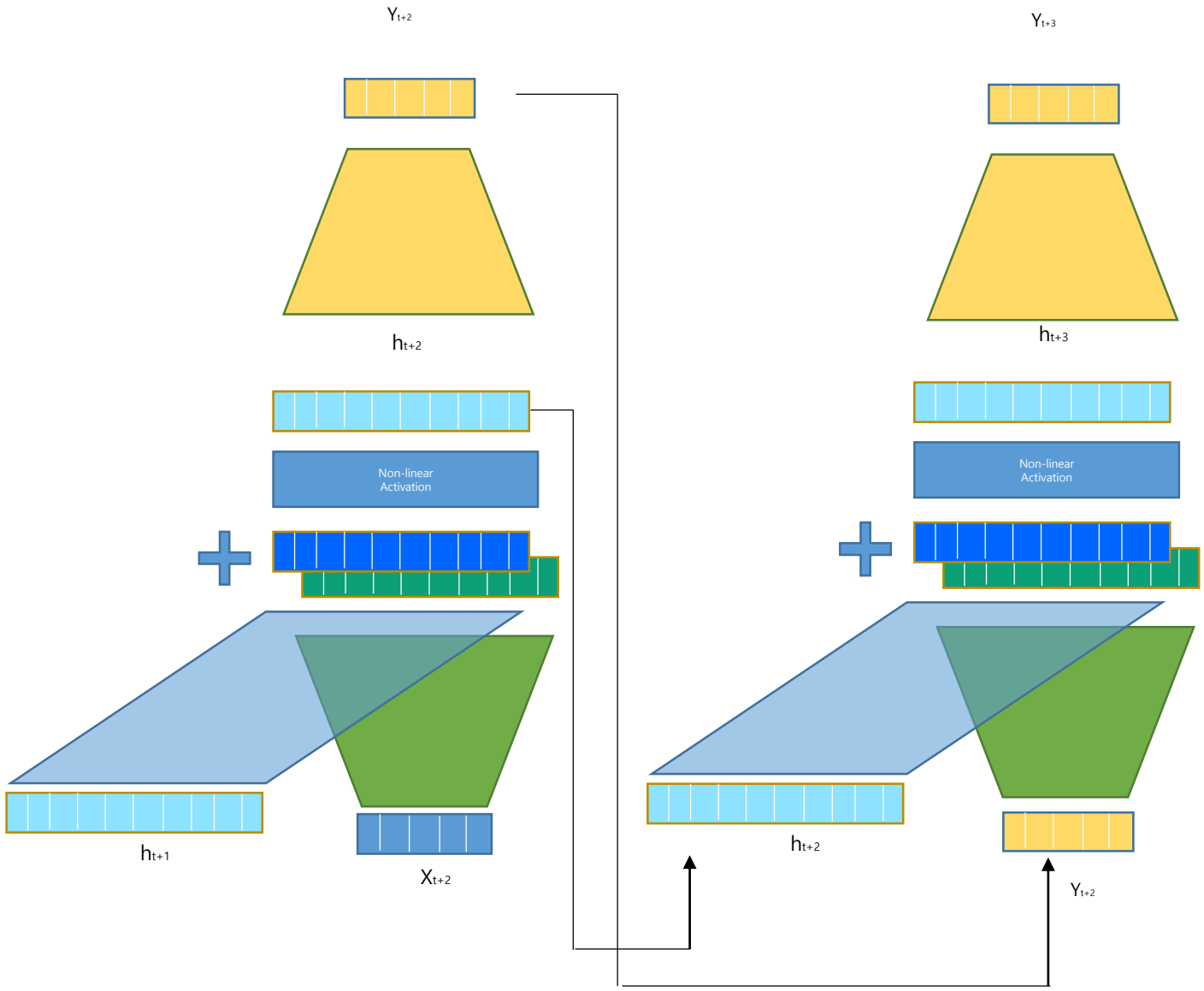


Recurrent Neural Network

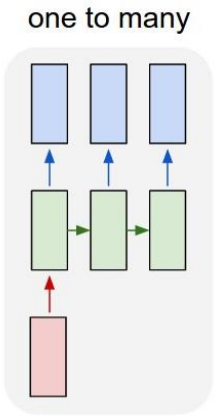


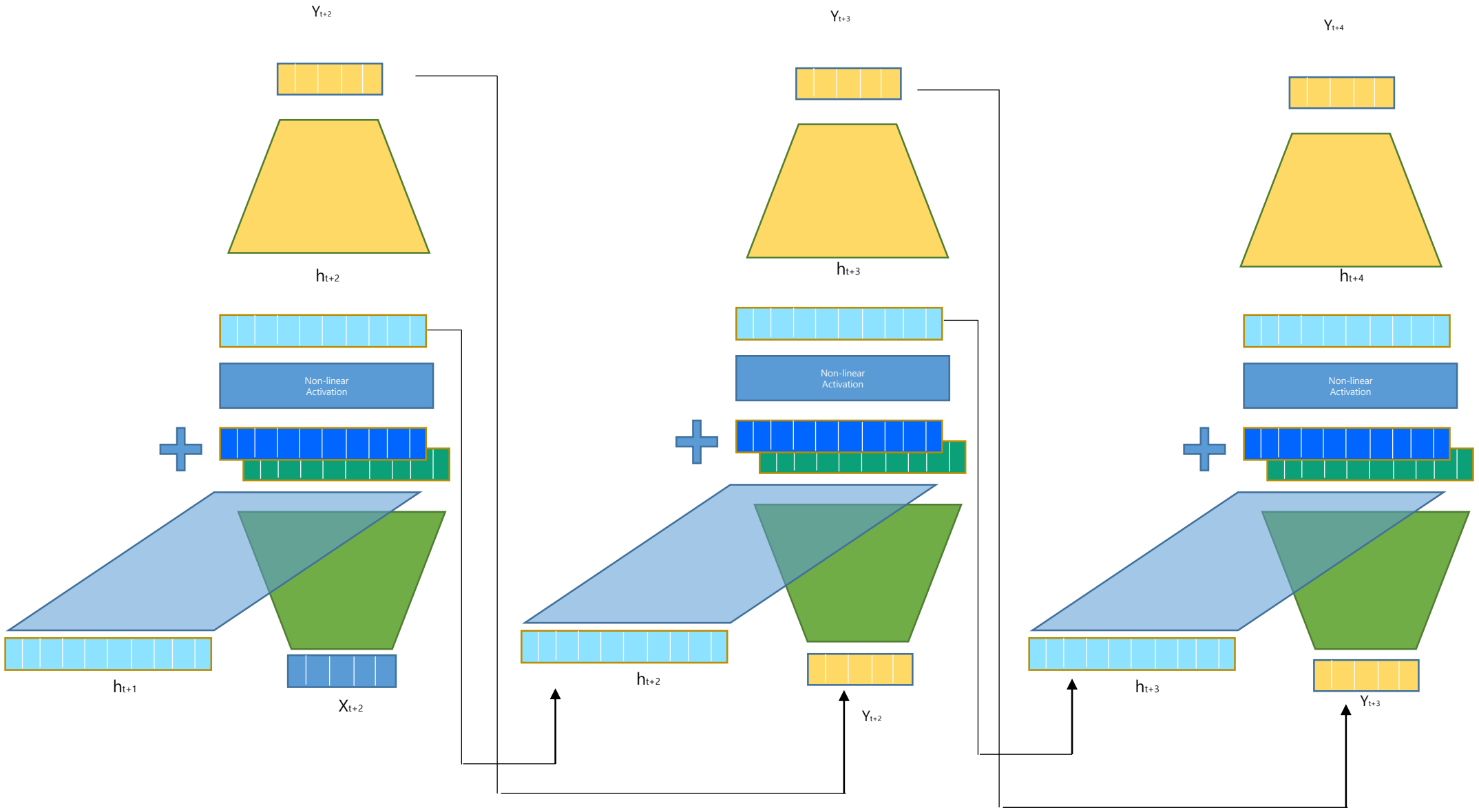
Recurrent Neural Network



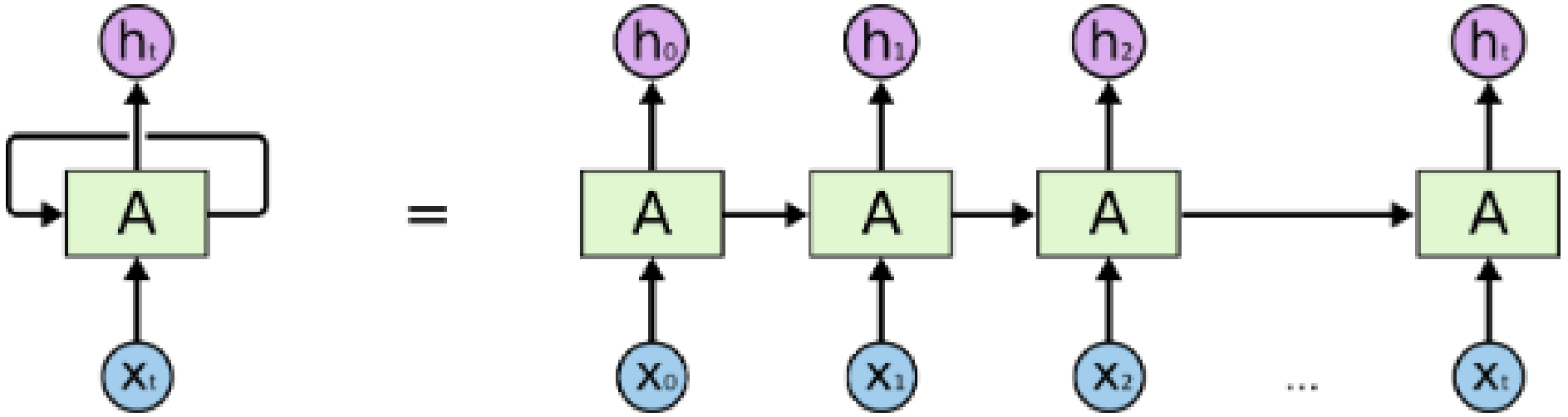


Recurrent Neural Network





Recurrent Neural Network

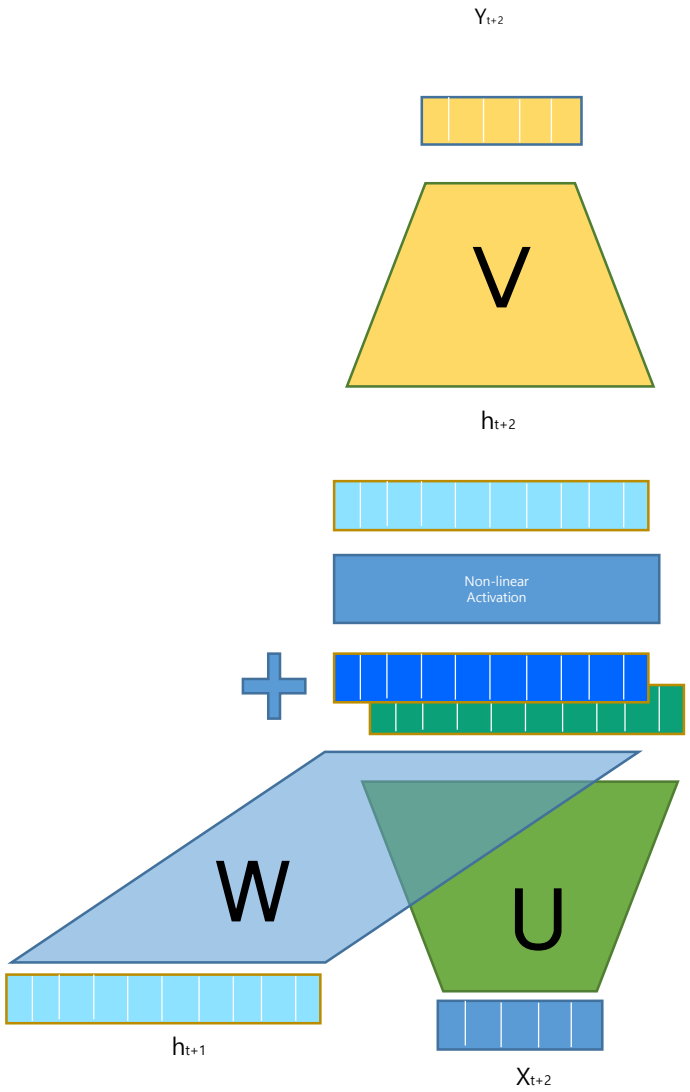


An unrolled recurrent neural network.

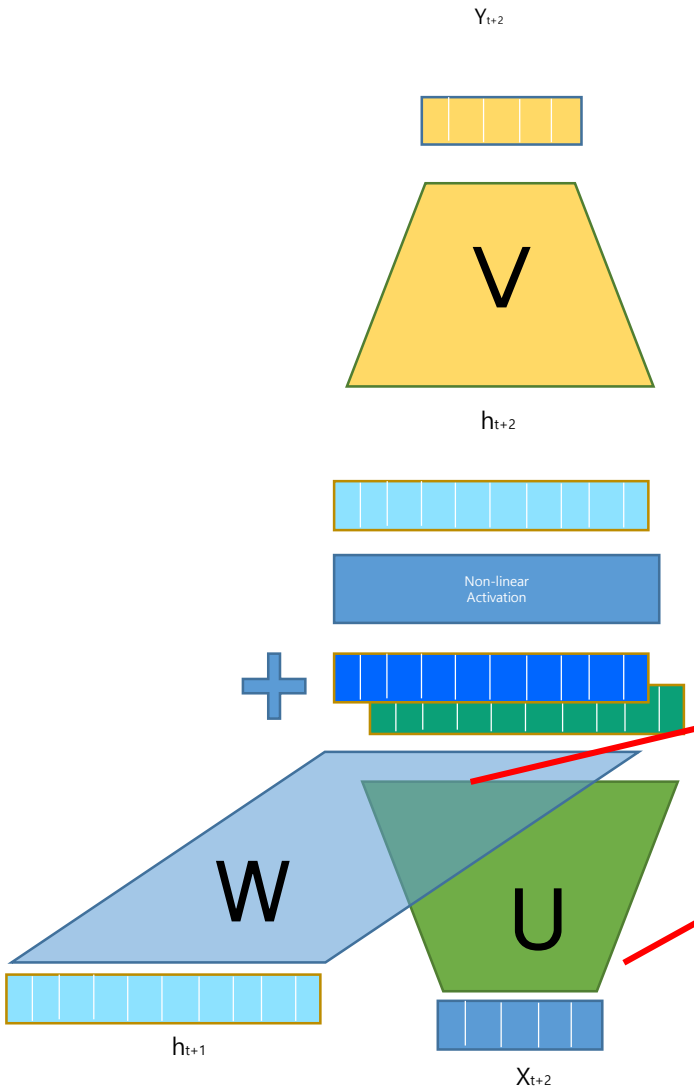
http://colah.github.io/posts/2015-08-Understanding-LSTMs/

Recurrent Neural Network with Math

Recurrent Neural Network with Math

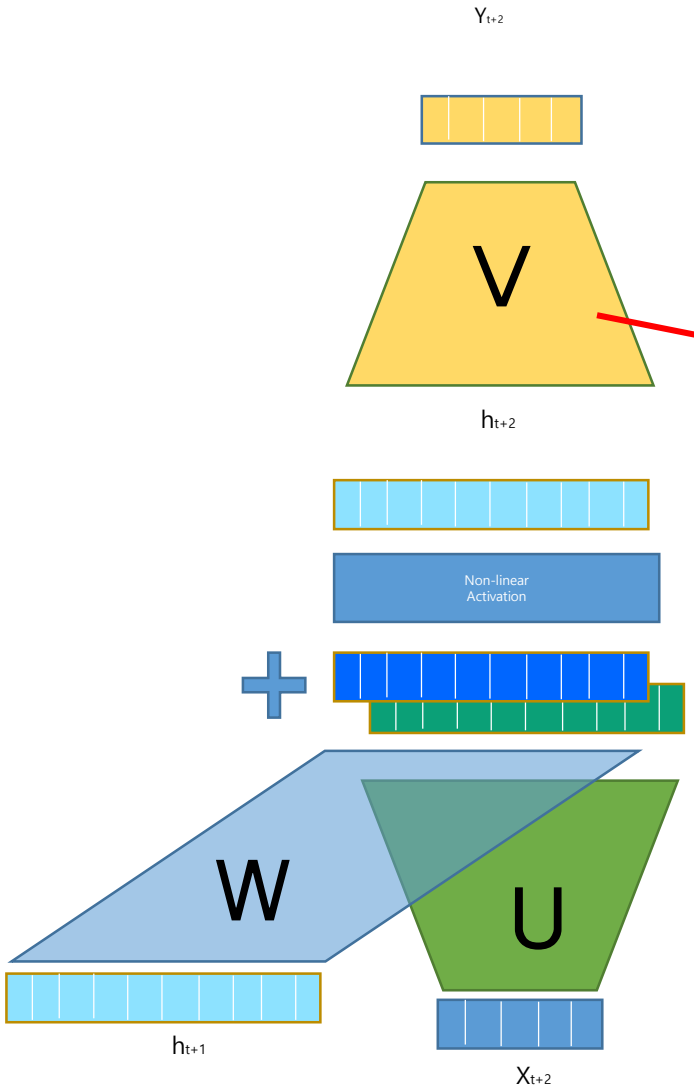


Recurrent Neural Network with Math



$$h_t = f(Ux_t + Wh_{t-1})$$

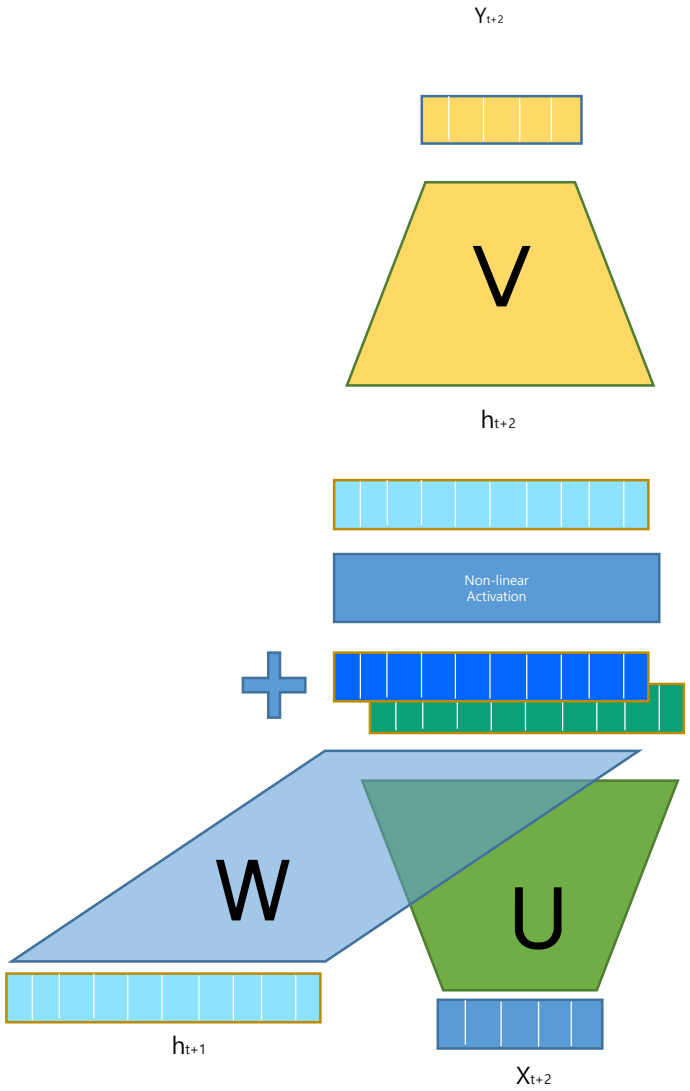
Recurrent Neural Network with Math



$$h_t = f(Ux_t + Wh_{t-1})$$

$$y_t = f(Vh_t)$$

Recurrent Neural Network with Math



f(x) = tanh(x)

$$h_t = f(Ux_t + Wh_{t-1})$$

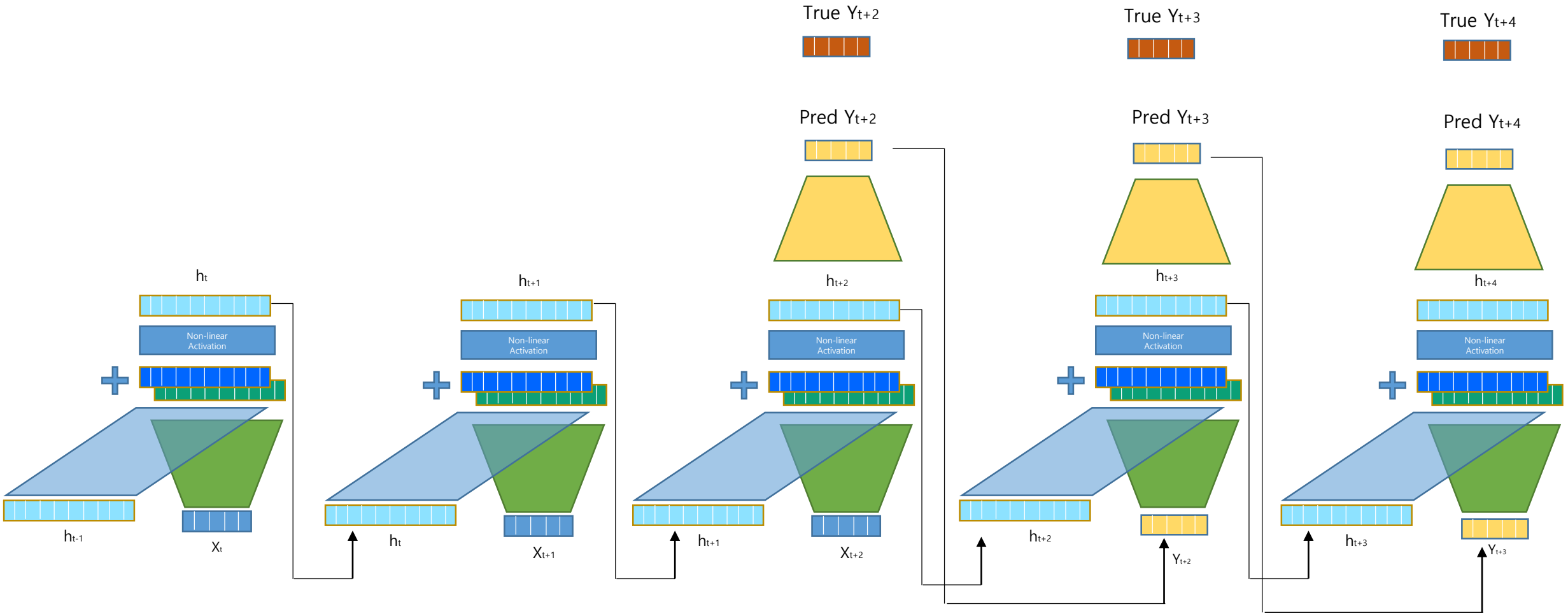
$$y_t = f(Vh_t)$$

f(x) = x

Okay, now we understand RNN model(hypothesis)

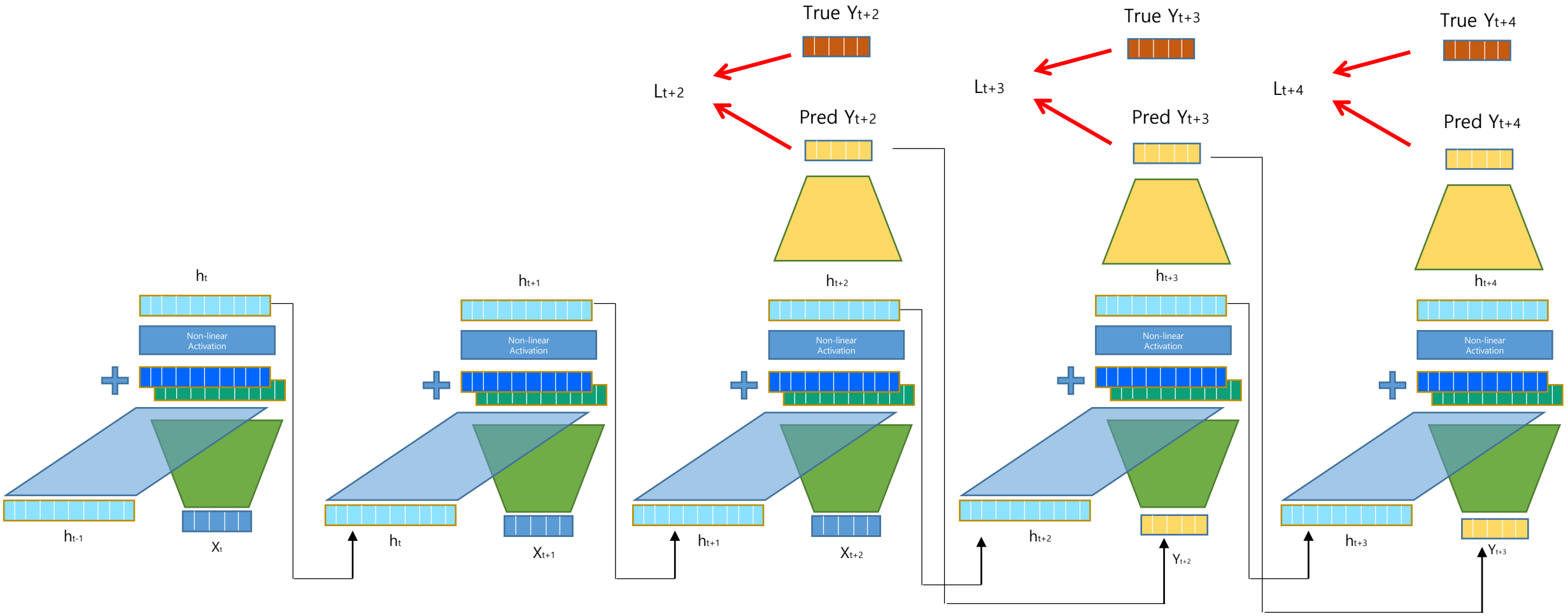
How can we evaluate it?

Calculate Loss of Recurrent Neural Network



Calculate Loss of Recurrent Neural Network

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

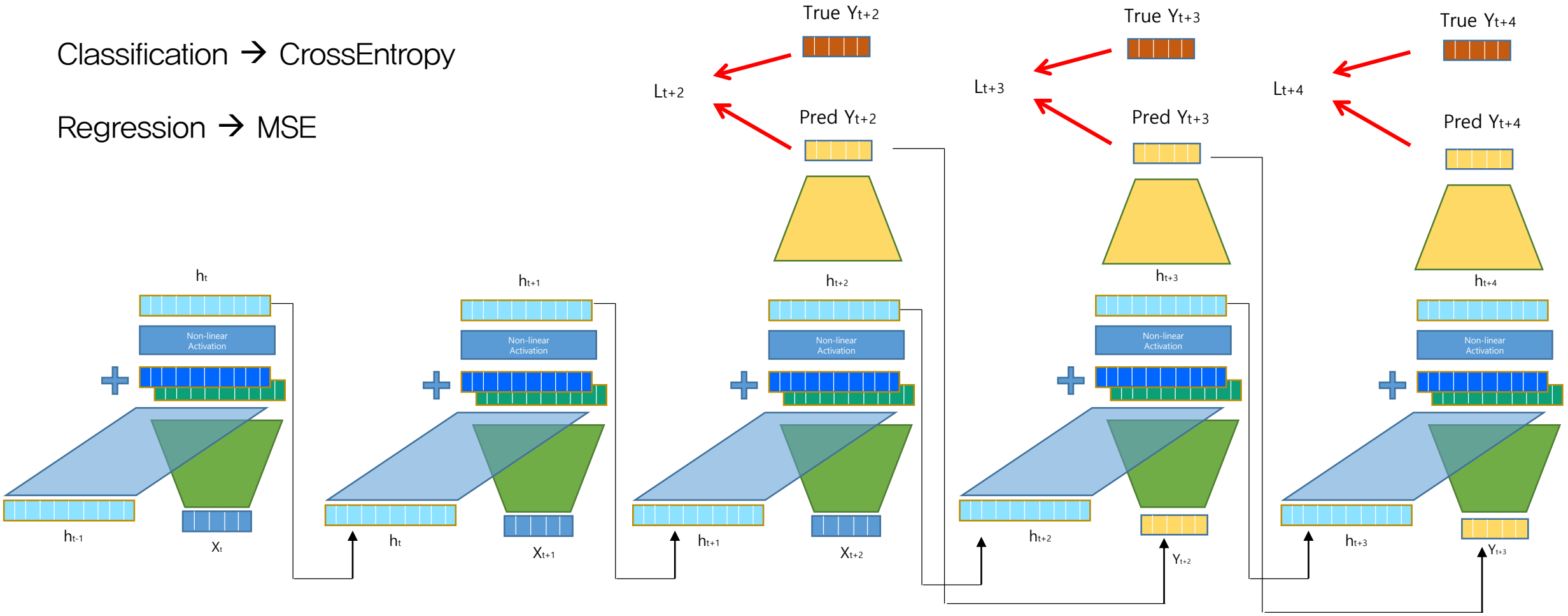


Calculate Loss of Recurrent Neural Network

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

Classification → CrossEntropy

Regression → MSE



Summary

- There are various tasks which have to deal with sequential data
- Recurrent Neural Network is suitable to handle it
- Basically RNN feeds new input and output from previous step together
- We can utilize RNN differently depends on the task

Today's Time Schedule

Assignment #5 Review — 20 mins

Recurrent Neural Network — 1 hour

Implement Basic RNN in Pytorch — 1.5 hour