RNN Review

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Computer Vision

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TRAIN AND TEST

Contents

- Recurrent Neural Network (RNN)
- Long Short Term Memory (LSTM)

What is RNN?

- RNN을 이야기하기 전에, 먼저 Sequential Data에 대해 생각해보자.

Sequential Data

- 순서가 중요한 데이터
- 자연어를 예로 들면, 문장 내의 단어를 맞바꾸면 의미가 달라지므로 Sequential Data.
- DNA 염기서열, 자연어와 시계열 데이터 등이 이에 해당된다.
- 순서를 바꾸어도 의미가 달라지지 않는 사진 등은 Non Sequential Data.
- RNN은 이러한 Sequential Data를 처리해줄 수 있음

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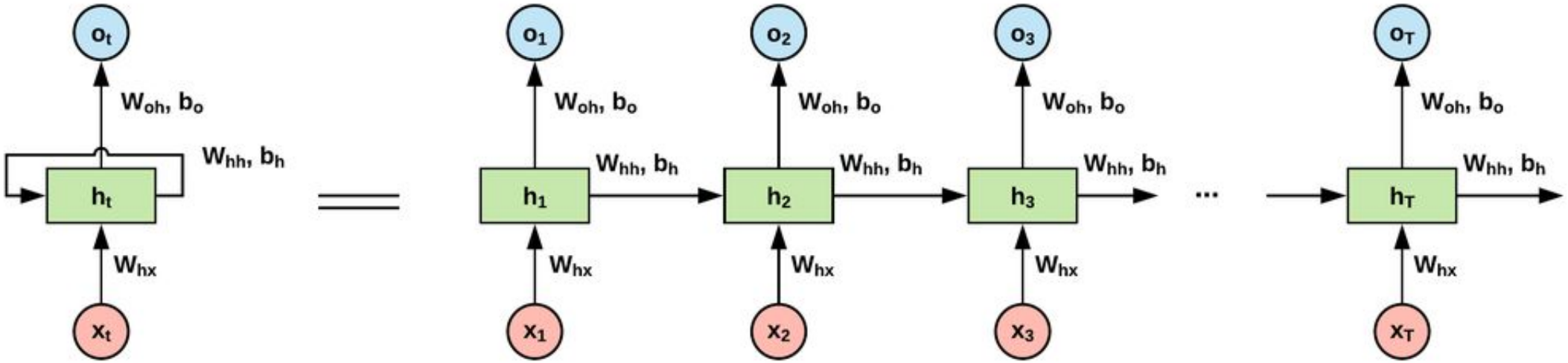
RNN



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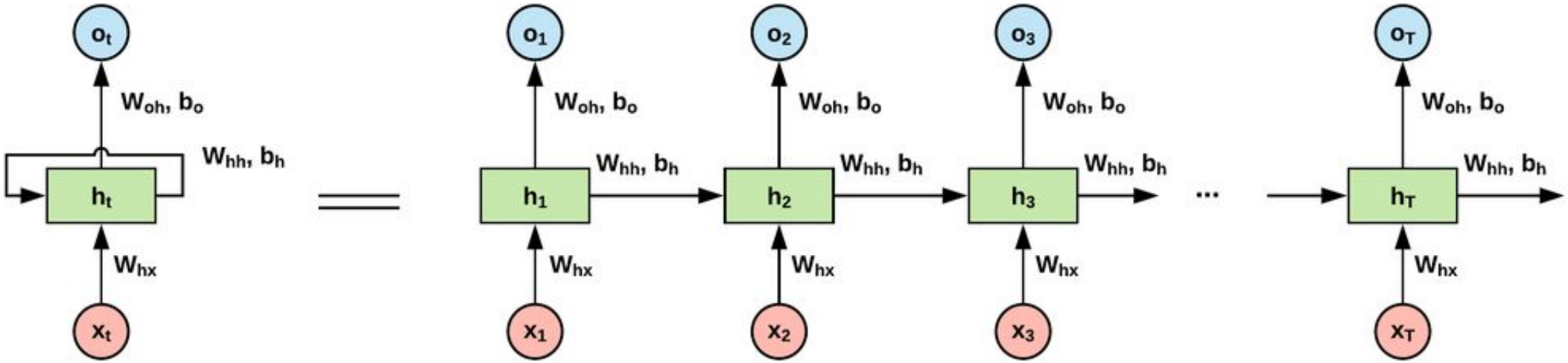
RNN



- 기존 신경망과 다르게, hidden state에서 다시 hidden state로 들어감
- Output Vector가 다시 Input Vector로.. = **Recurrent** Neural Network (RNN)

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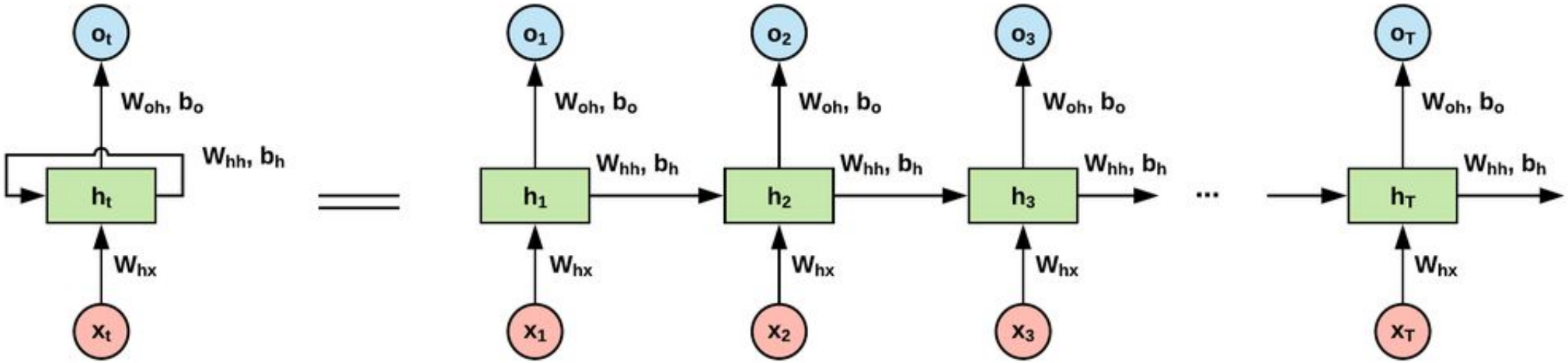
RNN



- t = 2 : x_2와 h_1가 Input -> o_2가 output
- t = 3 : x_3와 h_2가 input -> o_3가 output

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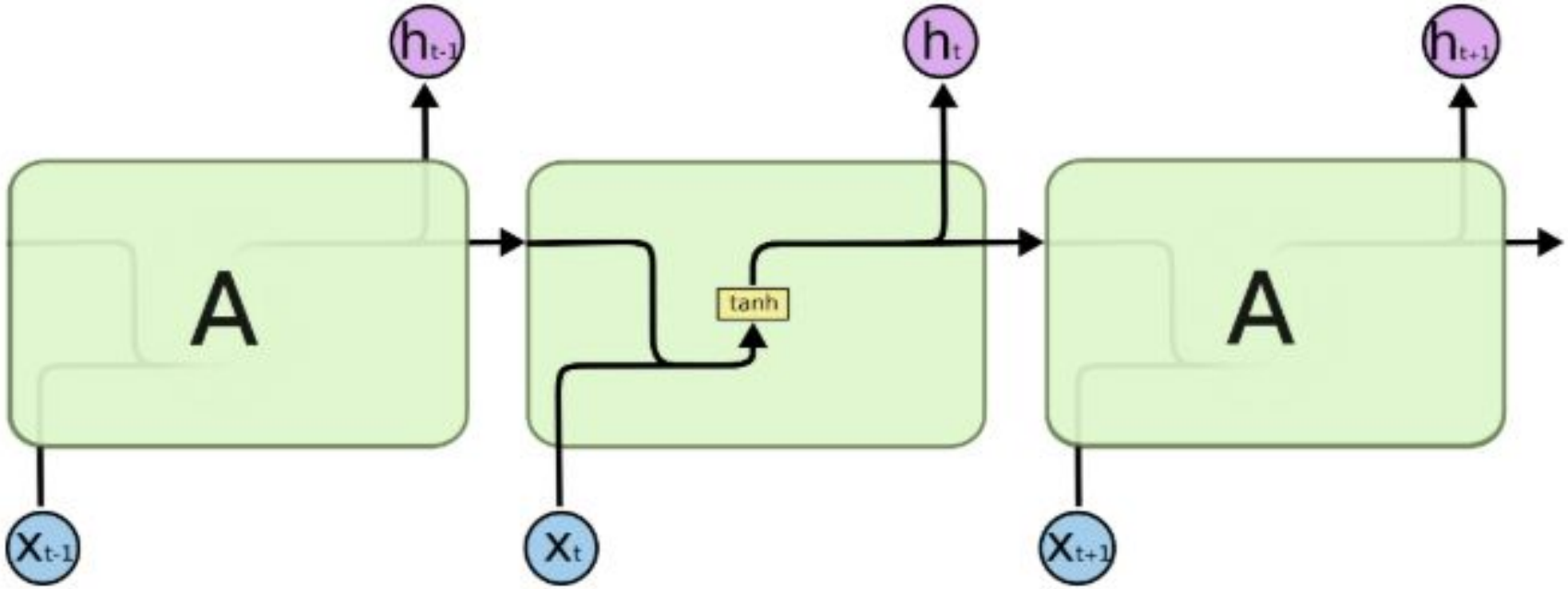
Hidden layers in RNN



$$h_t = \tanh(h_{t-1}W_h + x_tW_x + b)$$

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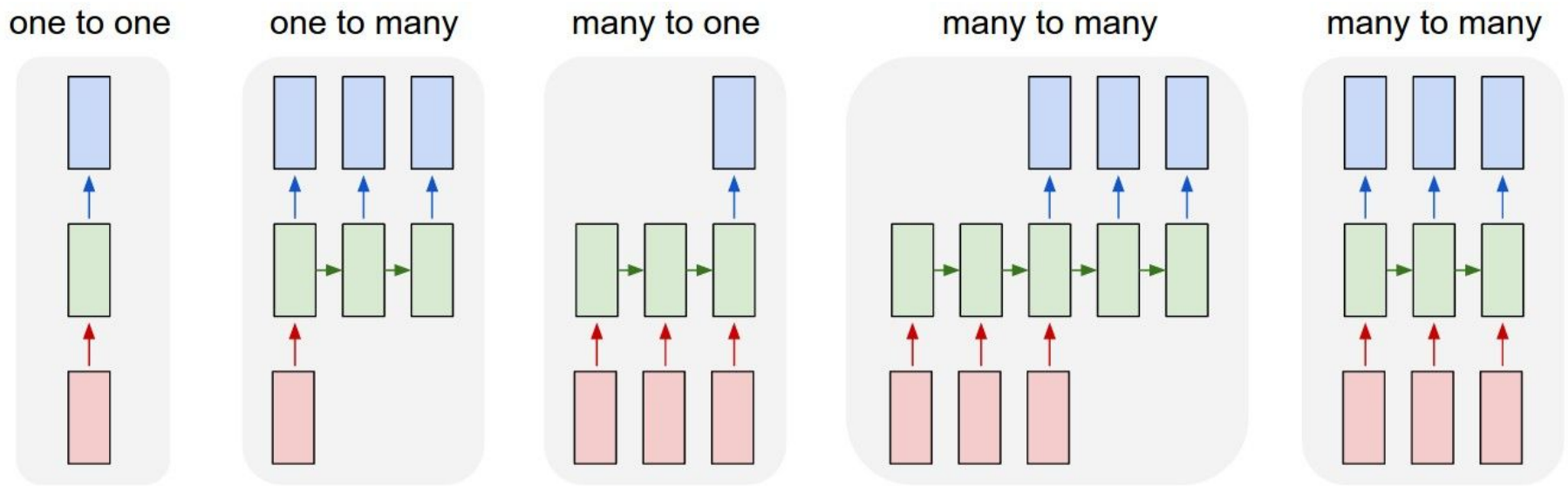
다양한 RNN 형태들



- many to many (Seq2Seq) : 문장 번역 (Machine Translation)
- many to many : Video Classification per frame

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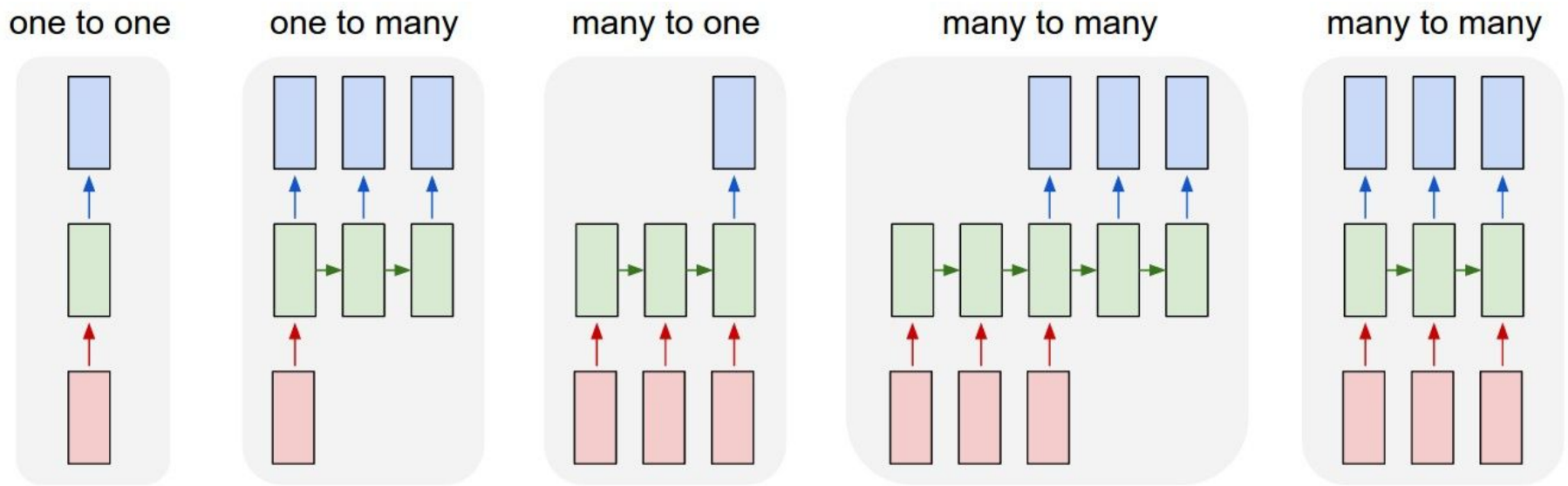
다양한 RNN 형태들



- one to many : Input으로 Image, Output으로 이에 대한 설명 (Image Captioning)
- many to one : Sentiment Analysis

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Pros and cons

- Pros : 임의의 Sequential Data를 처리 가능
- Cons
  - Hard to parallelize
  - Exploding / Vanishing Gradient (Long-term Dependency)

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So, how should we handle this problem?

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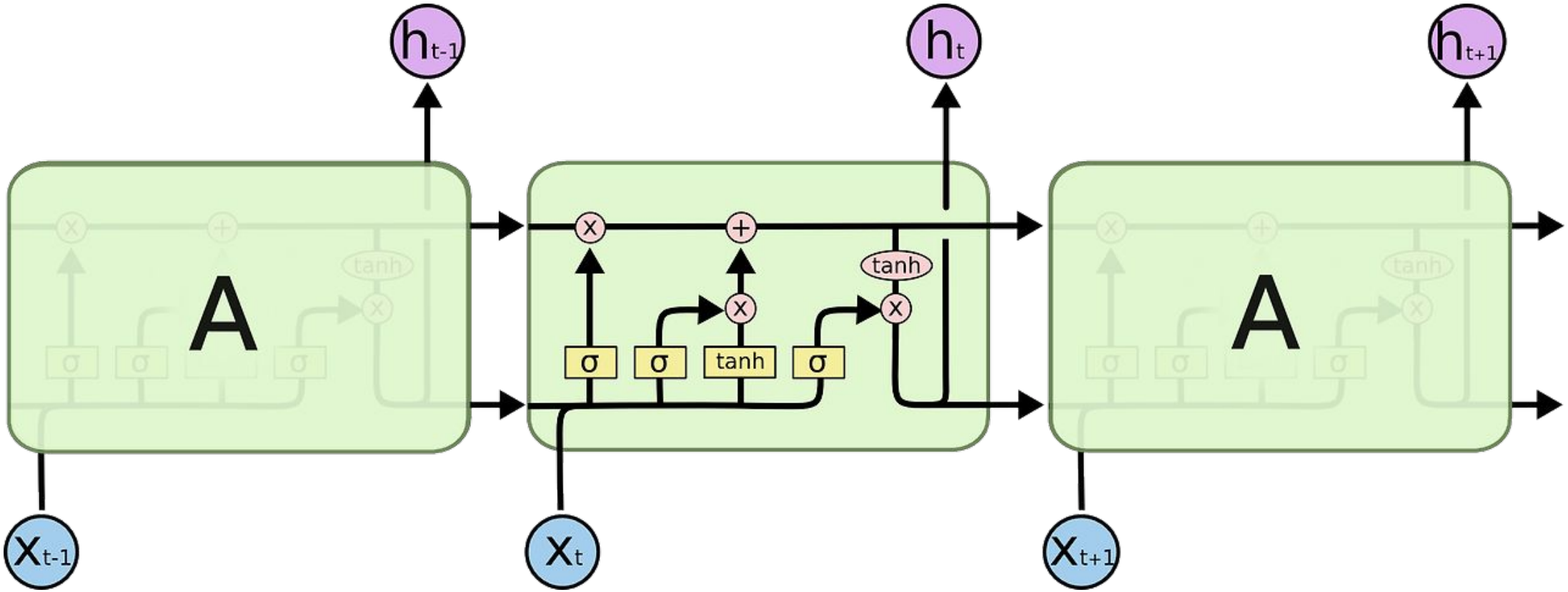
Long Short Term Memory (LSTM)



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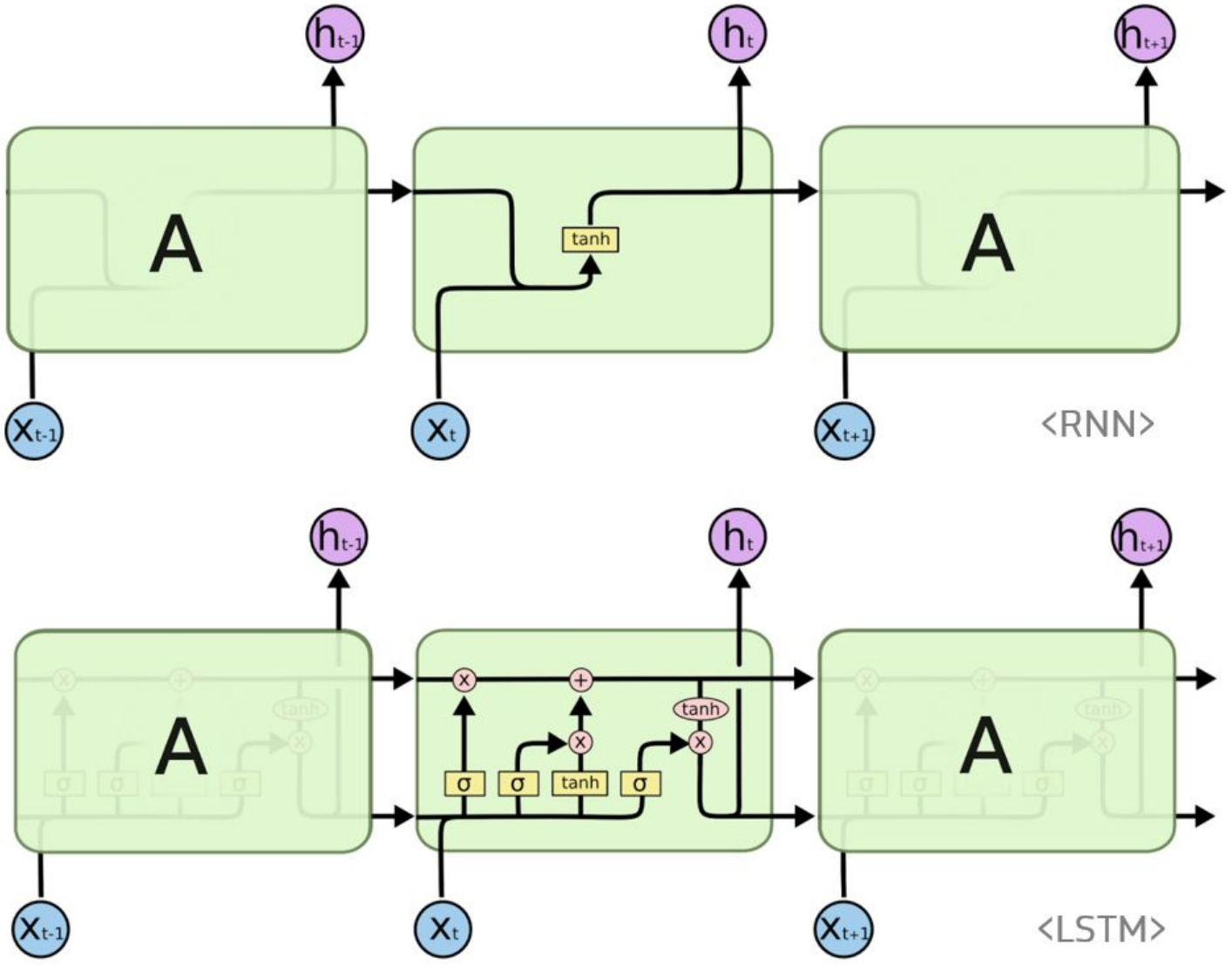
Long Short Term Memory (LSTM)



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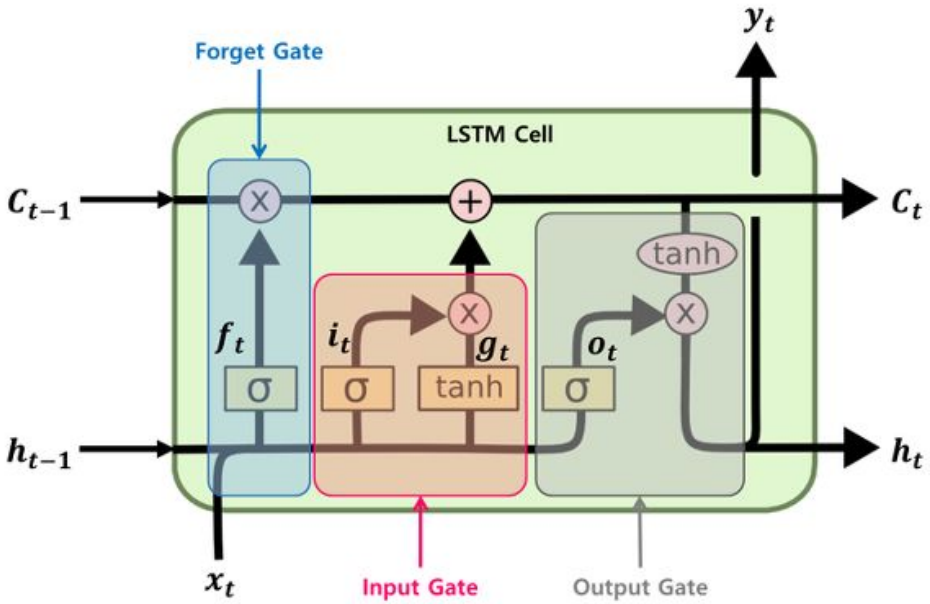
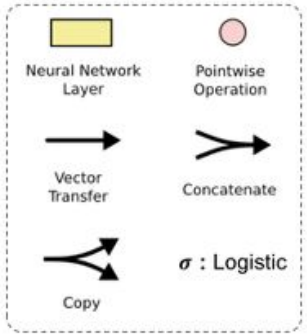
Hidden layers in LSTM





$$f_t = \sigma(W_{xh\_f}x_t + W_{hh\_f}h_{t-1} + b_{h\_f})$$
$$i_t = \sigma(W_{xh\_i}x_t + W_{hh\_i}h_{t-1} + b_{h\_i})$$
$$o_t = \sigma(W_{xh\_o}x_t + W_{hh\_o}h_{t-1} + b_{h\_o})$$
$$g_t = \tanh(W_{xh\_g}x_t + W_{hh\_g}h_{t-1} + b_{h\_g})$$
$$c_t = f_t \odot c_{t-1} + i_t \odot g_t$$
$$h_t = o_t \odot \tanh(c_t)$$

Forget gate (f_t) : 과거 정보를 얼마나 유지할 것인가?

Input gate (i_t) : 새로 입력된 정보는 얼마나 활용하는가?

Output gate (o_t) : 두 정보를 계산하여 나온 출력 정보를 얼마나 반영할 것인가?

https://dgkim5360.tistory.com/entry/understanding-long-short-term-memory-lstm-kr

TRAIN AND TEST

LSTM

- 앞선 문제 중 Vanishing / Exploding Gradient 해결

- 긴 문장에 대한 분류 / 생성 / 번역 등의 Task에서 Vanilla RNN 대비 우수한 성능

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