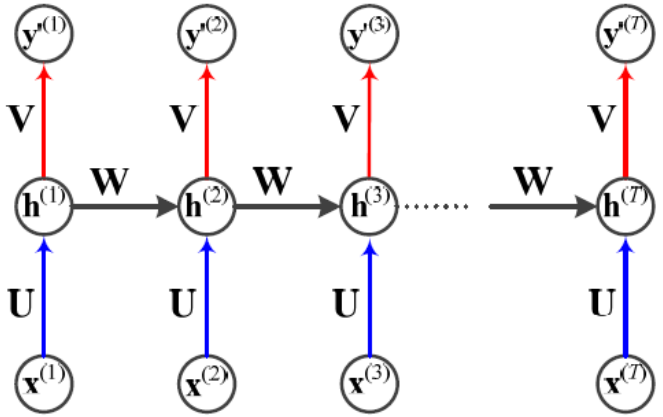
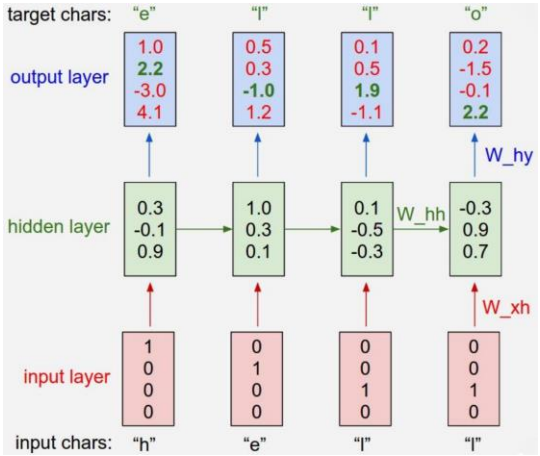
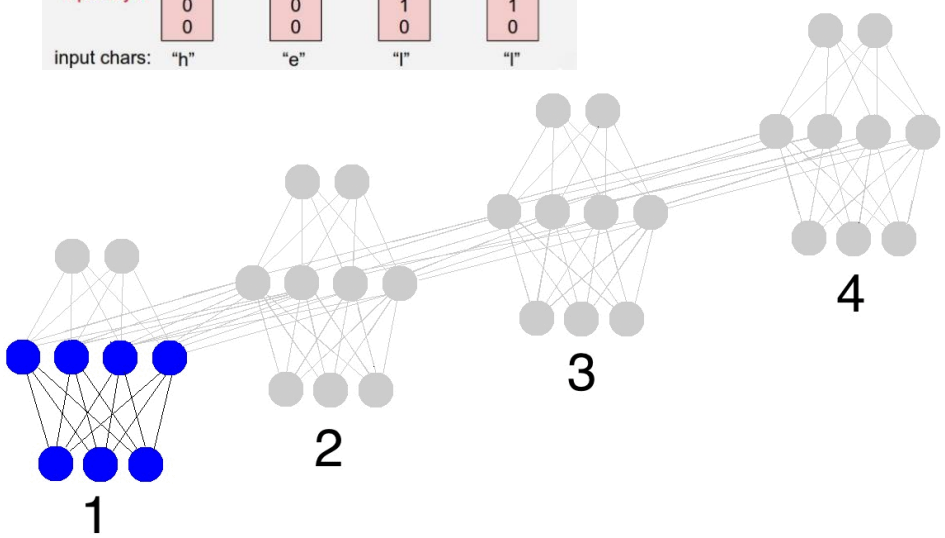
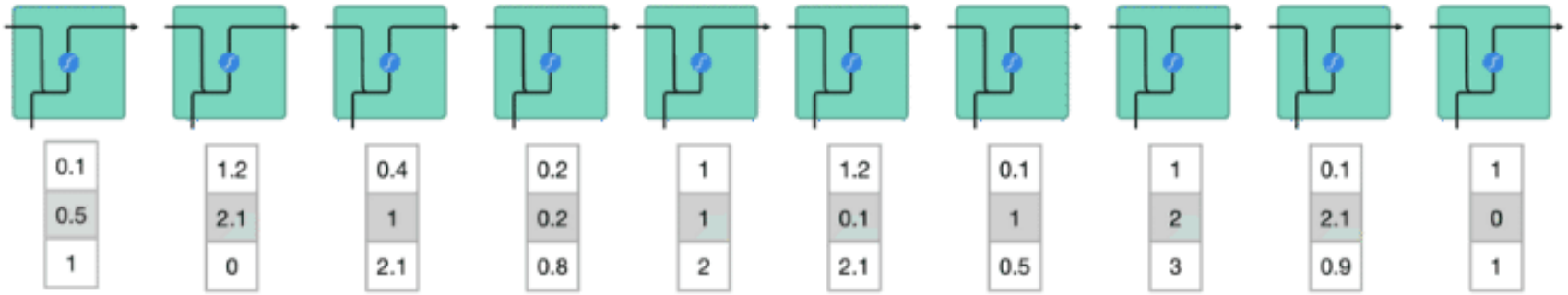


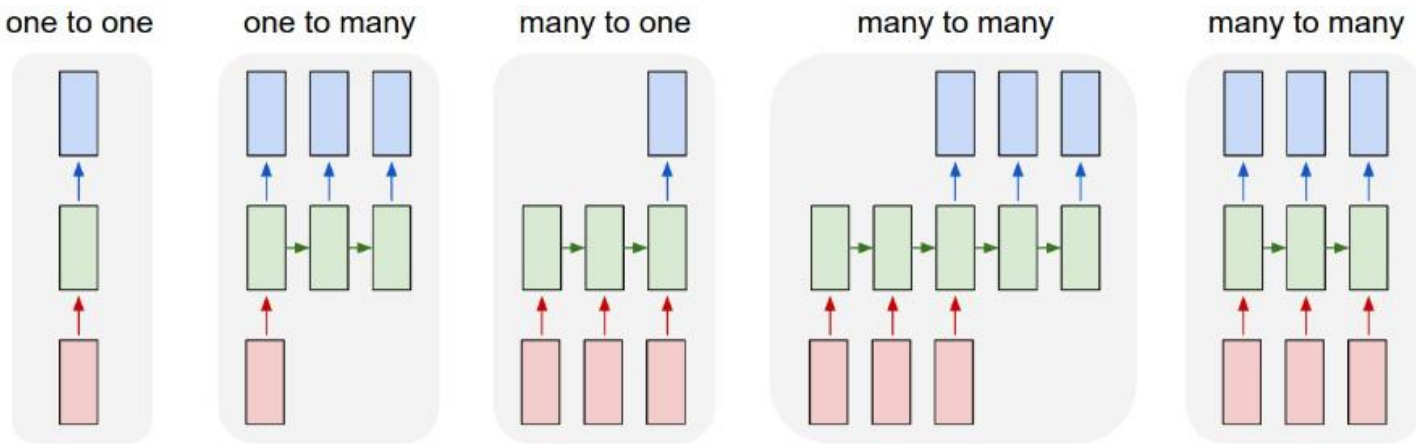
(c) 펄침

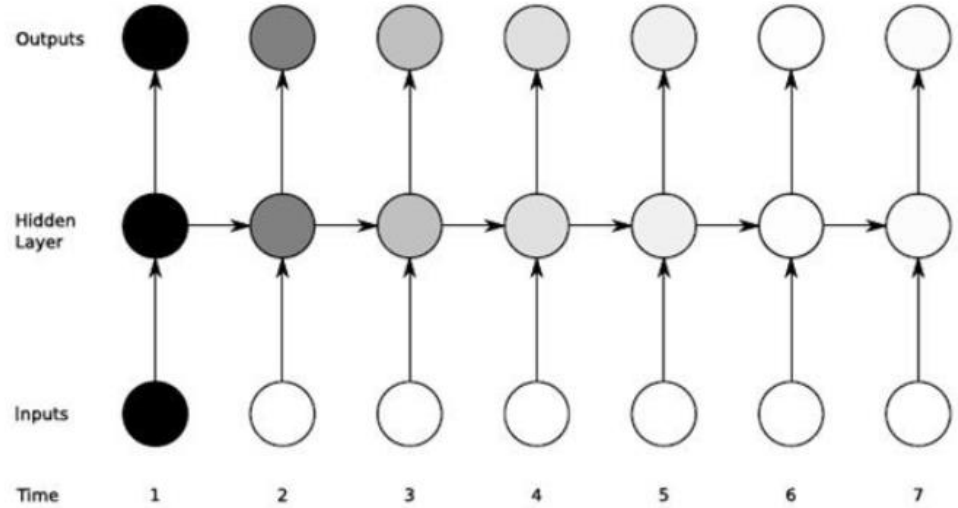


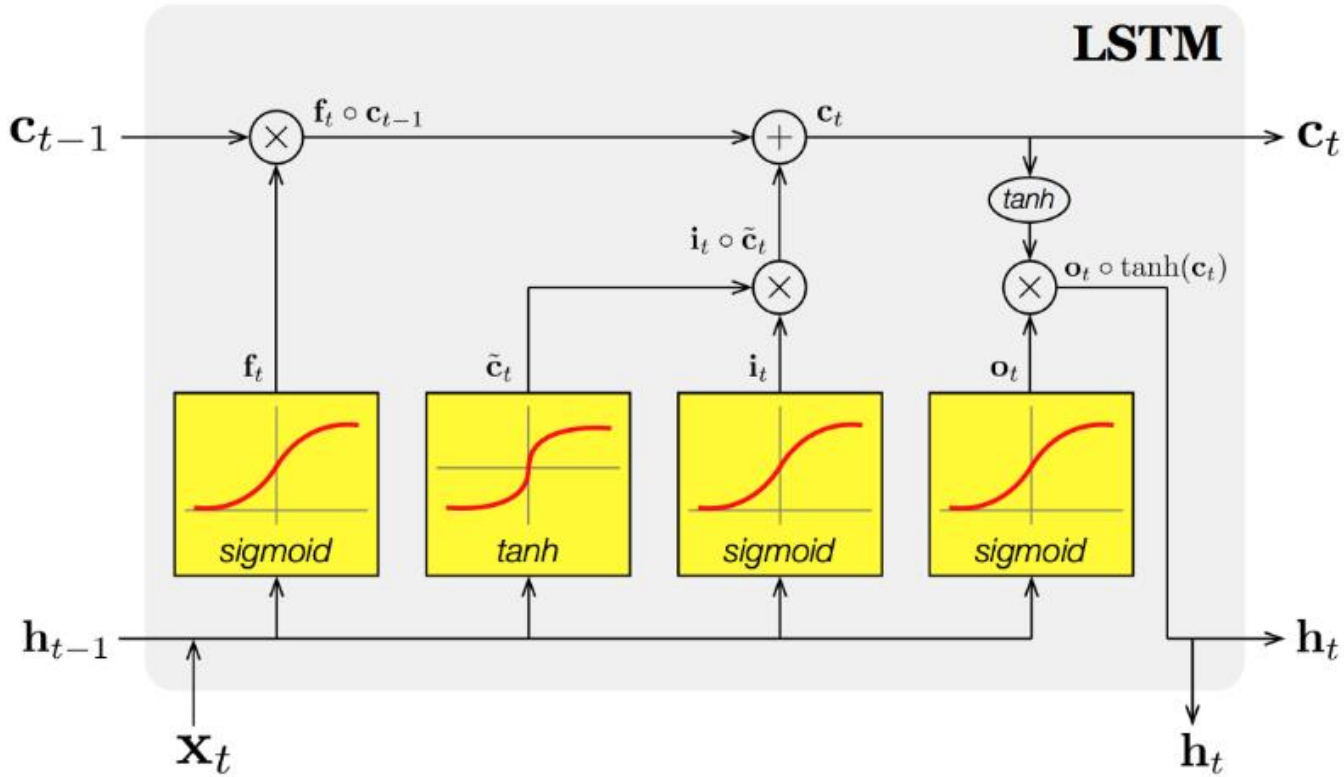


$$\mathbf{h}^{(t)} = f\left(\mathbf{h}^{(t-1)}, \mathbf{x}^{(t)}; \Theta\right)$$









Gating variables

$$\mathbf{f}_t = \sigma\left(\mathbf{W}_f[\mathbf{h}_{t-1}, \mathbf{x}_t] + \mathbf{b}_t\right)$$
$$\mathbf{i}_t = \sigma\left(\mathbf{W}_i[\mathbf{h}_{t-1}, \mathbf{x}_t] + \mathbf{b}_i\right)$$
$$\mathbf{o}_t = \sigma\left(\mathbf{W}_o[\mathbf{h}_{t-1}, \mathbf{x}_t] + \mathbf{b}_o\right)$$

Candidate (memory) cell state

$$\tilde{\mathbf{c}}_t = \tanh\left(\mathbf{W}_c[\mathbf{h}_{t-1}, \mathbf{x}_t] + \mathbf{b}_c\right)$$

Cell & Hidden state

$$\mathbf{c}_t = \mathbf{f}_t \circ \mathbf{c}_{t-1} + \mathbf{i}_t \circ \tilde{\mathbf{c}}_t$$
$$\mathbf{h}_t = \mathbf{o}_t \circ \tanh(\mathbf{c}_t)$$

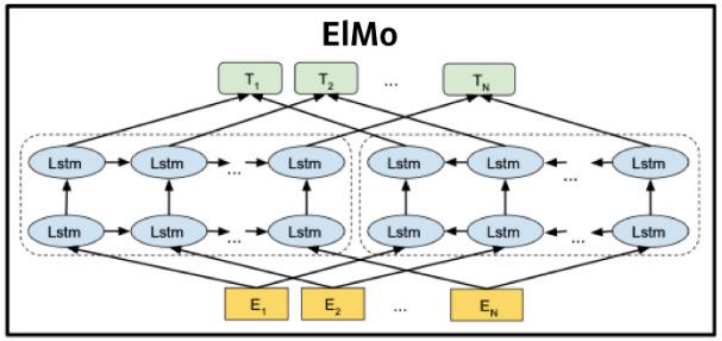
순방향 언어 모델(예시: OpenAI GPT, ELMo)

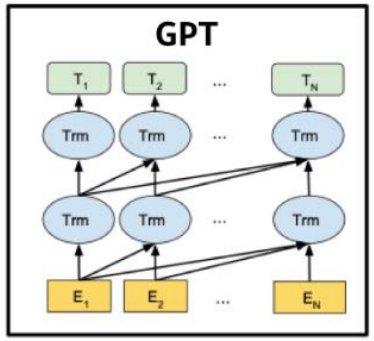
역방향 언어 모델(예시: ELMo)

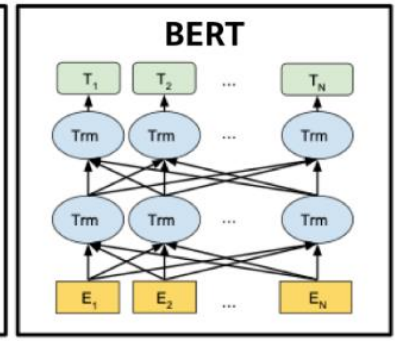
Jamie walks into a _____ and orders a cocktail.

CBOW 언어 모델(예시: word2vec, fastText)

완전 양방향 언어 모델(예시: BERT, XLNet)







Semi-supervised Sequence Learning
context2Vec
Pre-trained seq2seq

ULMFiT — **ELMo**

Multi-lingual

MultiFiT

Transformer

Bidirectional LM

GPT

Larger model
More data

GPT-2

Defense

Grover

GPT-3

Cross-lingual

Multi-task

+ Generation

XLM
UDify

MT-DNN

MASS
UniLM

Knowledge distillation

MT-DNN$_{KD}$

Span prediction
Remove NSP

Longer time
Remove NSP
More data

SpanBERT

RoBERTa

Permutation LM
Transformer-XL
More data

XLNet

+Knowledge Graph

ERNIE
(Tsinghua)

Neural entity linker

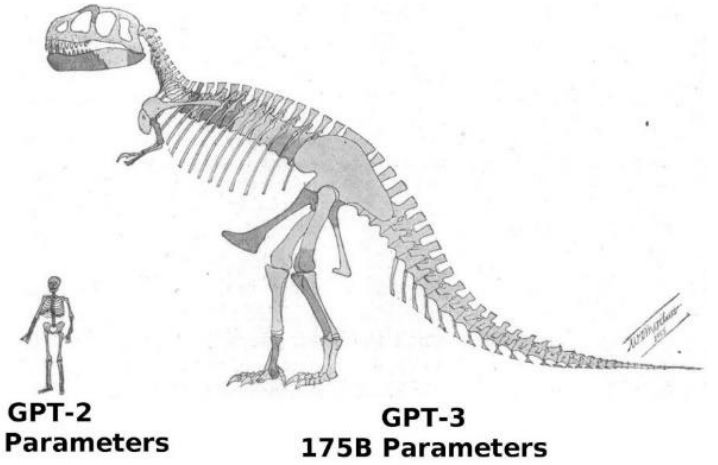
KnowBert

Cross-modal

VideoBERT
CBT
ViLBERT
VisualBERT
B2T2
Unicoder-VL
LXMERT
VL-BERT
UNITER

Whole Word Masking

ERNIE (Baidu)
BERT-wwm



GPT-2
1.5B Parameters

GPT-3
175B Parameters

GPT-3로 할 수 있는 일들

소설 쓰기	"난 괜찮아요" 입력하면 뒤 이야기를 알아서 씀	"그녀는 화를 낼 생각은 아니었지만, 목소리가 갈라졌다. 그녀는 '짝사랑' 앞에서 울고 싶진 않았지만, 그 상황의 감정적 스트레스가 그녀를 짓누르는 듯했다…."
이메일 답장	"제안 고맙지만 거절한다." 이메일 핵심 키워드 입력	"귀하가 보내주신 이메일은 감사히 잘 받았습니다. 그러나 안타깝게도 저희로선 귀하의 제안을 받을 수가 없습니다." 인사말 등 격식 차려진 이메일 자동완성
가계부 완성	"2달 월세로 150만원 사전 지불" 입력	엑셀표로 가계부 작성. 현재 현금보유량, 지불 총액, 잔금 등 알아서 정리

By Xiaozhi Wang & Zhengyan Zhang @THUNLP