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AI2E : Workshop 10

Recurrent Neural Networks !

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01

Sequence models

An exciting area in DL

02

Why RNNs

Can’t we just use standard NNs?

03

What is Recurrent Neural Networks

Definitions, types and time traveling!

04

Solution for Vanishing gradient

NN Architectures as a solution

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01. Sequence models

An exciting area in DL

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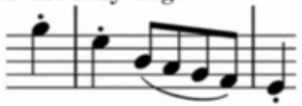
Sequence Data Examples

Speech recognition		→	"The quick brown fox jumped over the lazy dog."
Music generation	∅	→	
Sentiment classification	"There is nothing to like in this movie."	→	★☆☆☆☆
DNA sequence analysis	AGCCCCTGTGAGGAACTAG	→	AGCCCCTGTGAGGAACTAG
Machine translation	Voulez-vous chanter avec moi?	→	Do you want to sing with me?
Video activity recognition		→	Running
Name entity recognition	Yesterday, Harry Potter met Hermione Granger.	→	Yesterday, Harry Potter met Hermione Granger.

Andrew Ng

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02. Why RNNs

can’t we just use standard NNs?

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Two Main Reasons To Use RNN

1

Input layer size can change

2

Pass the feature learned

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03. What is Recurrent Neural Networks

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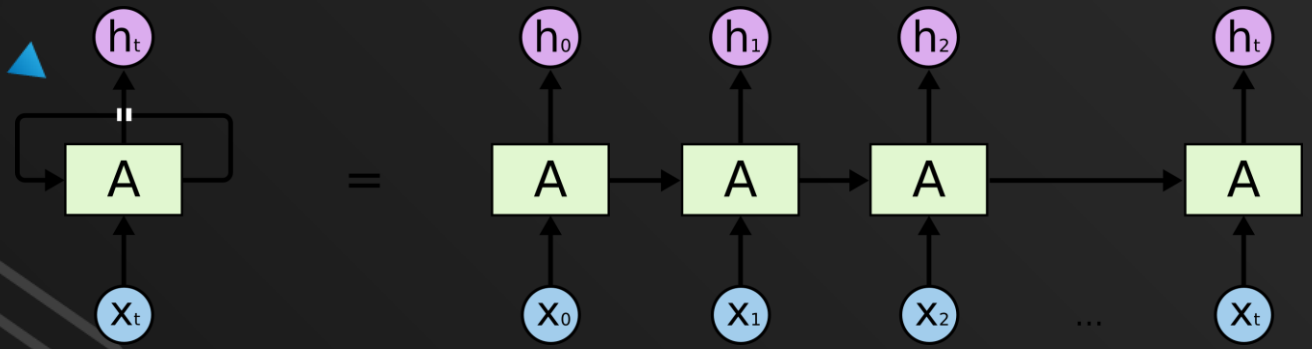

RNN is a type of neural networks, a feed-forward architecture used for sequential data with a variable length such as sentences or chronological series.

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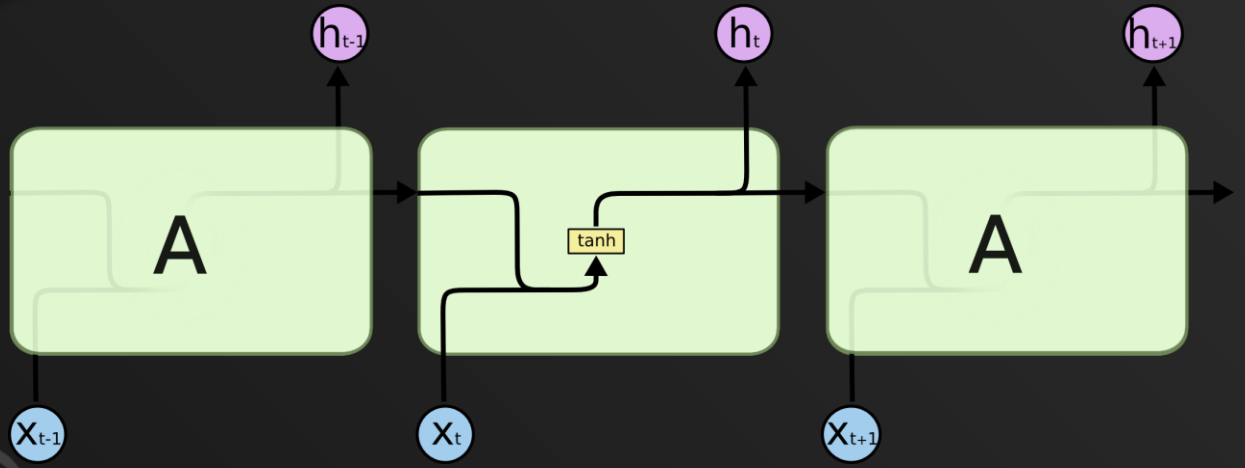

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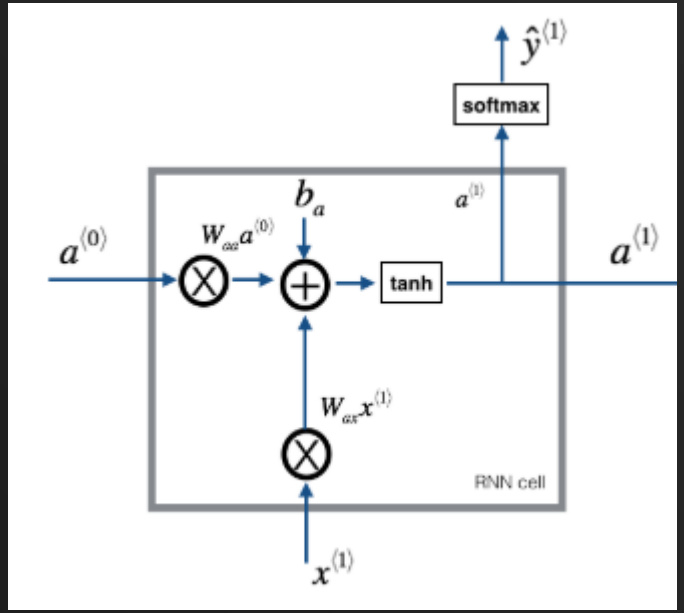
$$a^{\langle t+1 \rangle} = \tanh(W_{ax} x^{\langle t+1 \rangle} + W_{aa} a^{\langle t \rangle} + b)$$

$$z^{\langle t+1 \rangle} = W_{ya} a^{\langle t+1 \rangle} + b_y$$

$$\hat{y}^{\langle t+1 \rangle} = softmax(z^{\langle t+1 \rangle})$$



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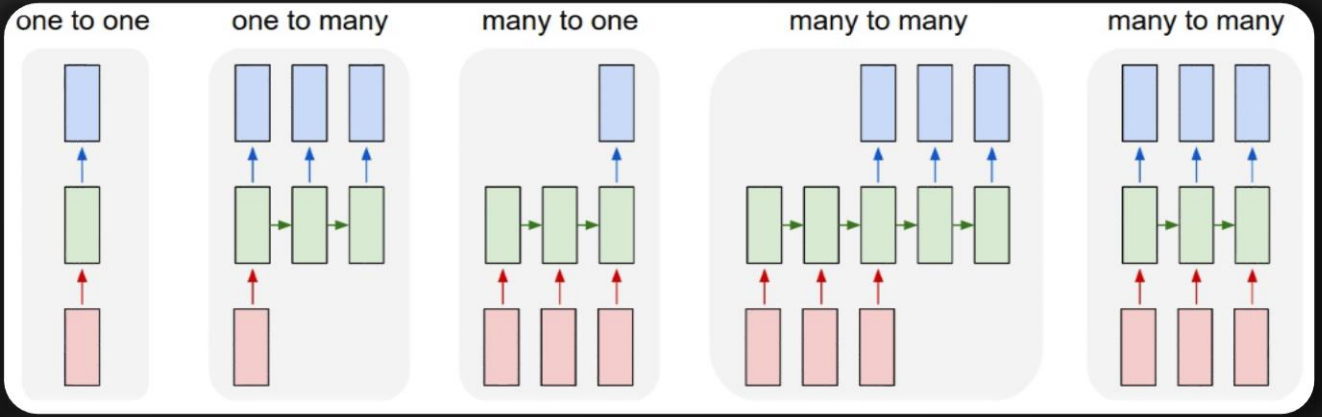
RNN Types



The Unreasonable Effectiveness of Recurrent Neural Networks

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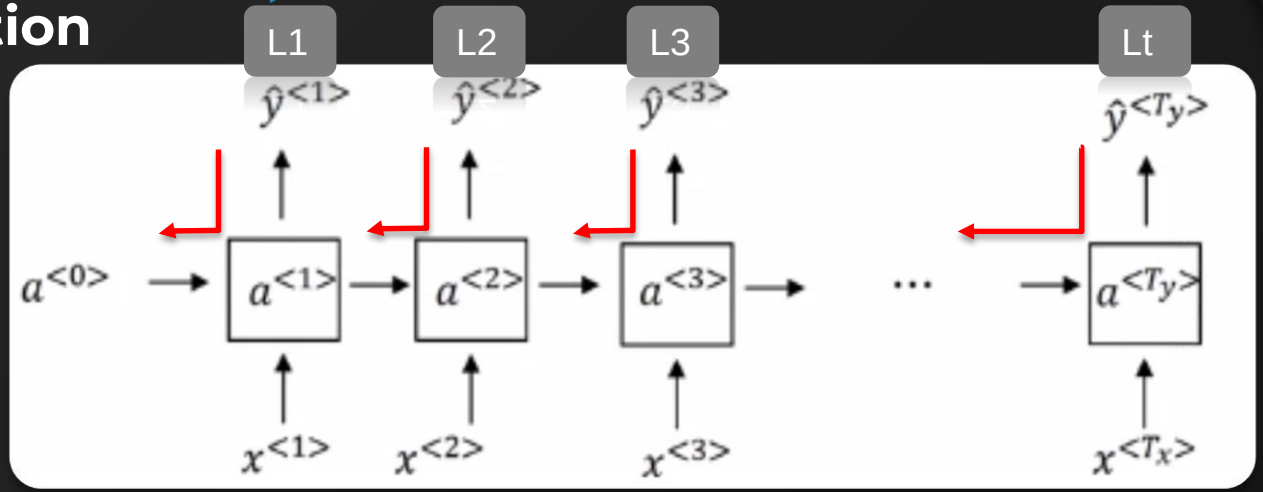
Bring your time machines... Backpropagation through time!



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04. Solution for Vanishing gradient

NN Architectures as a solution

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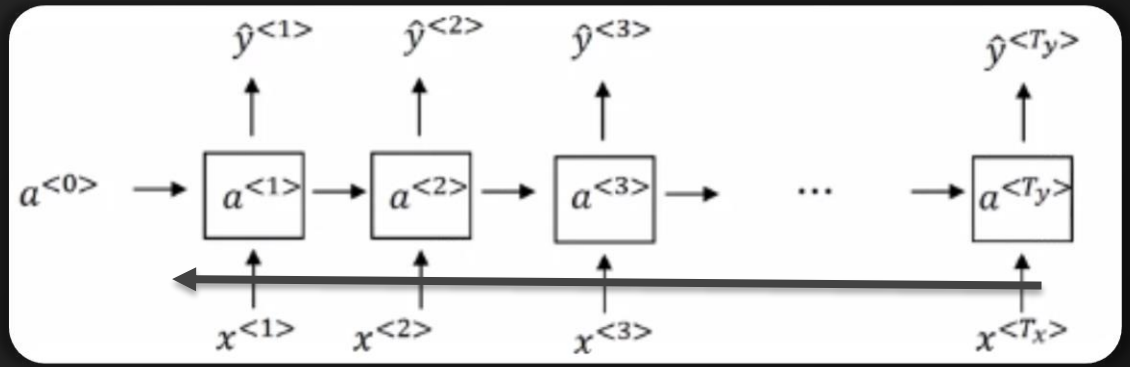
What is the Vanishing Gradient Problem

The dinosaurs which lived millions of years ago and..., were not able to survive.



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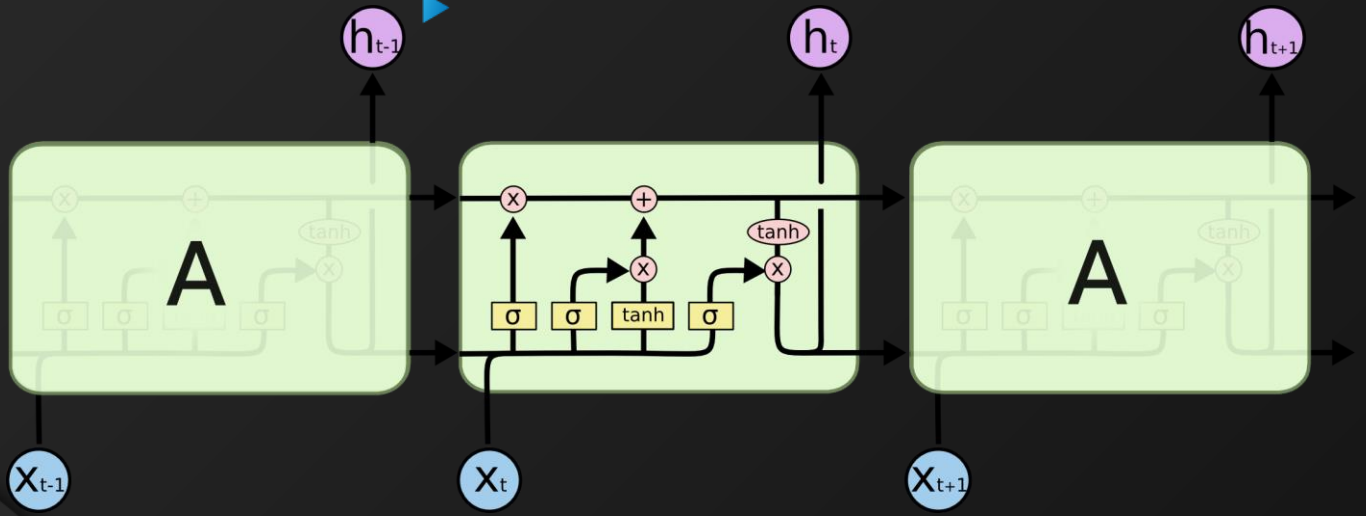
LSTM



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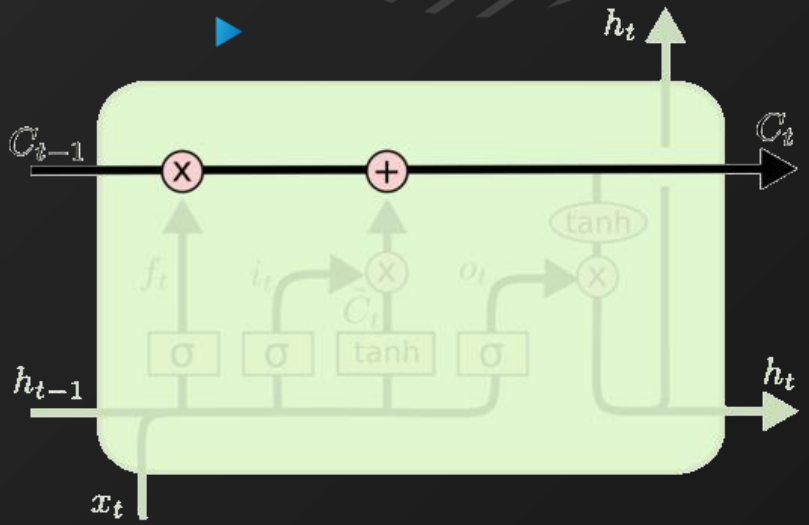
Cell state



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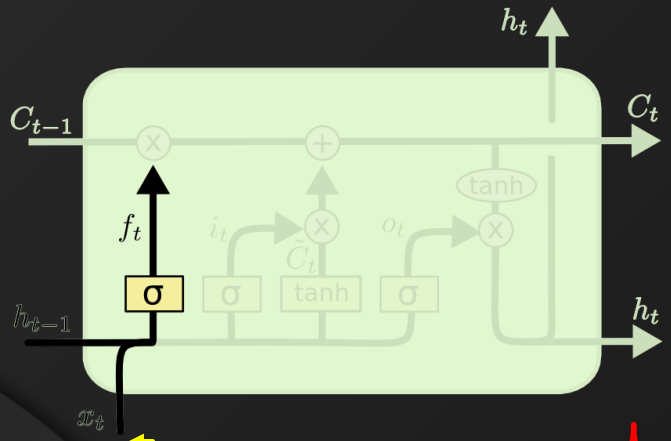
Forget gate



$$f_t = \sigma\left(W_f \cdot [h_{t-1}, x_t] \; + \; b_f\right)$$

Harry approaches and then she takes out her wand…

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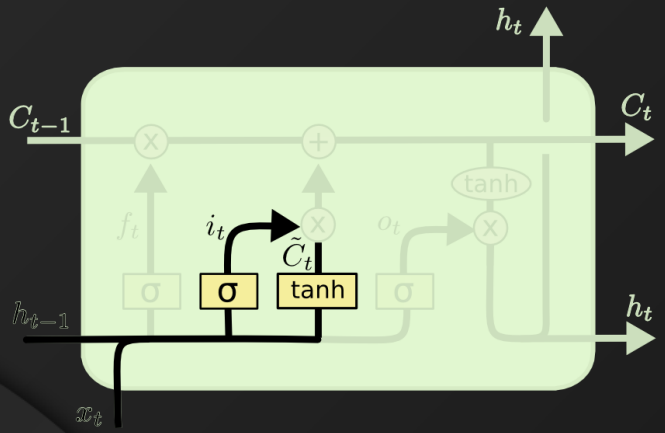
Input gate



$$i_t = \sigma\left(W_i \cdot [h_{t-1}, x_t] \; + \; b_i\right)$$

$$\tilde{C}_t = \tanh(W_C \cdot [h_{t-1}, x_t] \; + \; b_C)$$

Harry approaches and then she takes out her wand…

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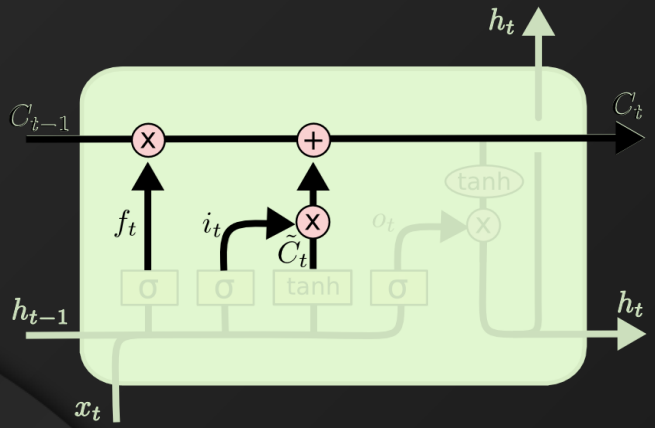
Update gate



$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t$$

Harry approaches and then she takes out her wand…

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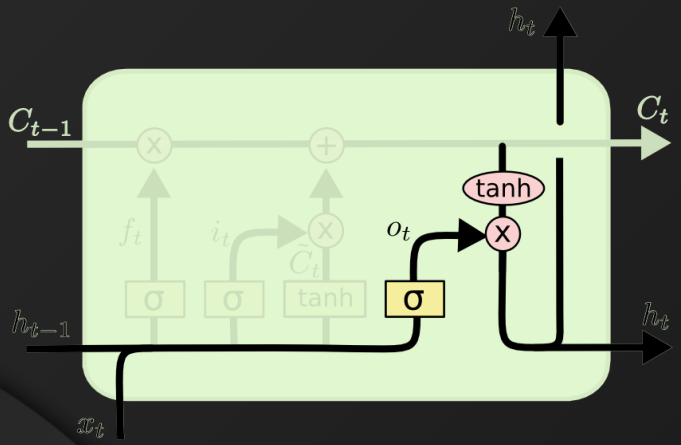
Filtering the cell state



$$o_t = \sigma\left(W_o\left[h_{t-1}, x_t\right] + b_o\right)$$

$$h_t = o_t * \tanh\left(C_t\right)$$

Harry approaches and then she takes out her wand…

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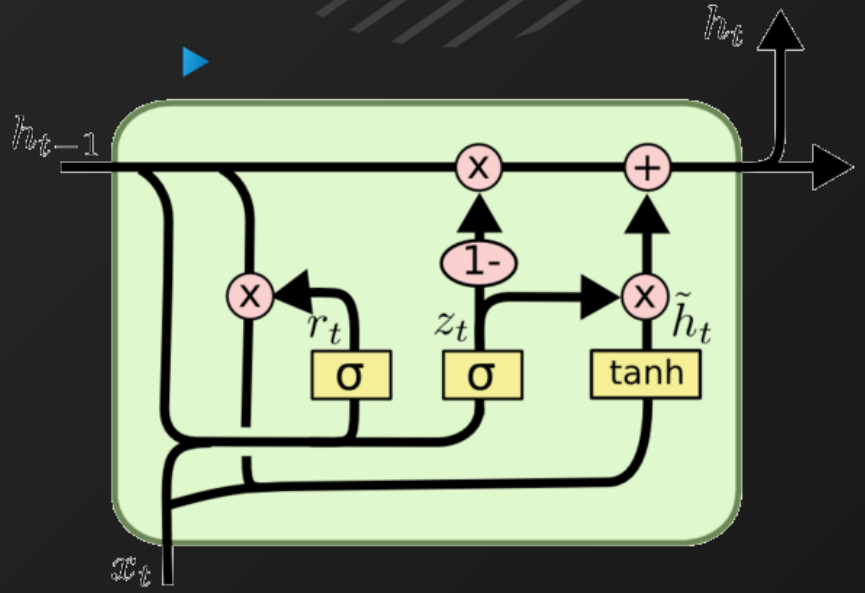
GRU



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More to explore!

Deep RNNs

Word embeddings

Language models

Word2vec

Attention mechanism

Auto-Encoder

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Let’s practice!

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