



Recurrent Neural Networks

English

Spanish

I want to drink beer.

English

Spanish

I want to drink beer.  Quiero tomar cerveza.



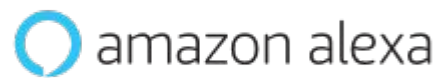


Two kittens sit inside
coffee mugs.

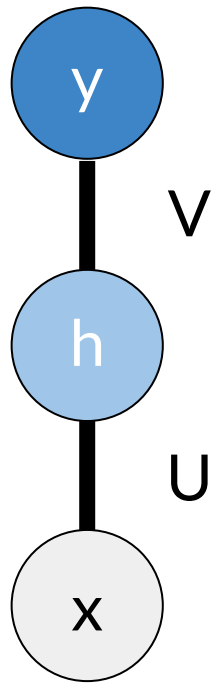
...an 'internal' memory.



Hey Siri



How do they work?



$$y = \text{softmax}(V * h)$$

$$h = \sigma(U * x)$$

σ = activation function

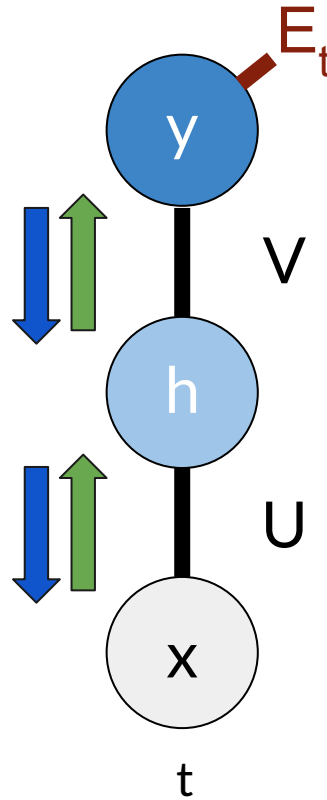
Feed-Forward Network

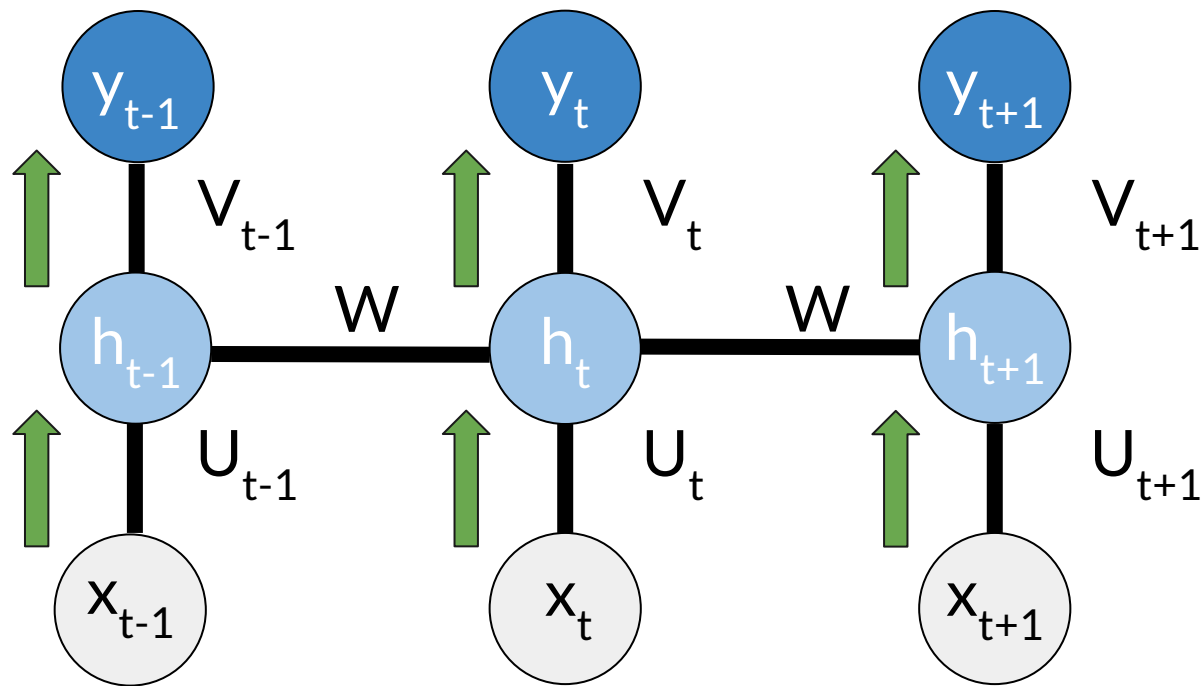
$$y = \text{softmax}(V * h)$$

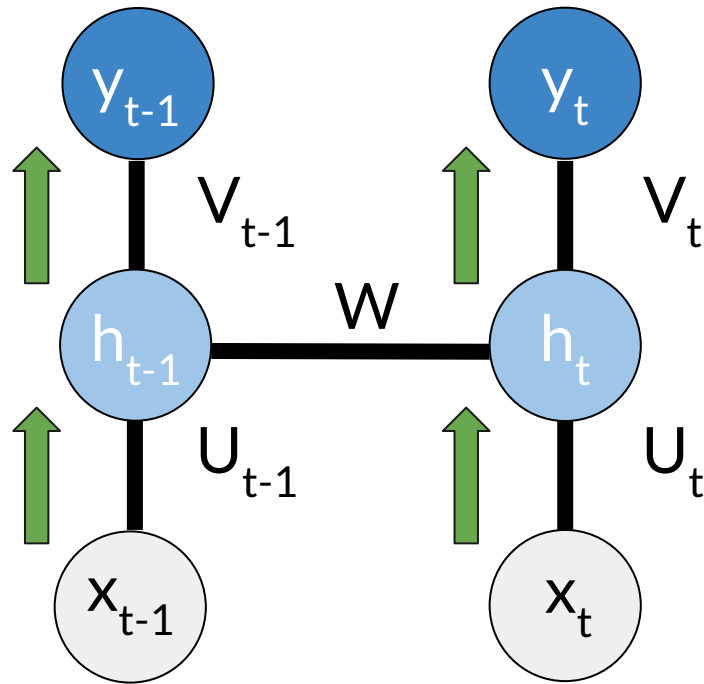
$$h = \sigma(U * x)$$

σ = activation function

Gradient Descent



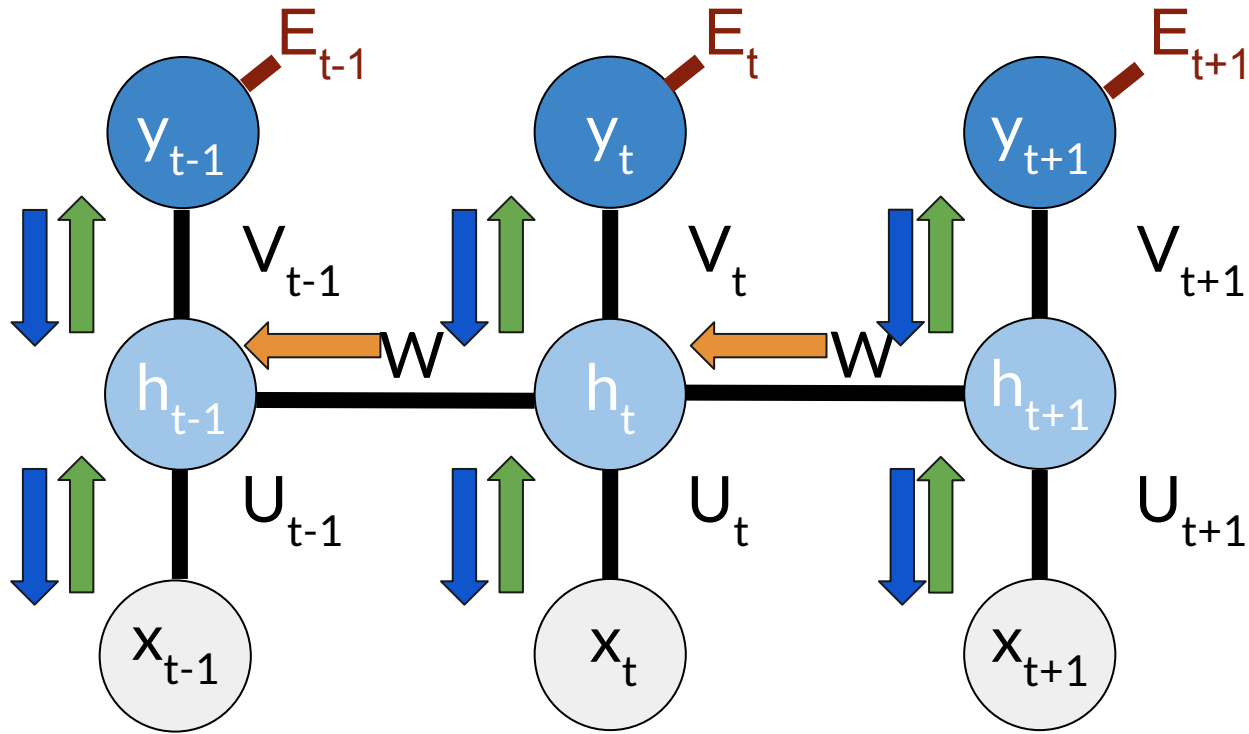




$$y_t = \text{softmax}(V_t * h_t)$$

$$h_t = \sigma(U_t * x_t + W * h_{t-1})$$

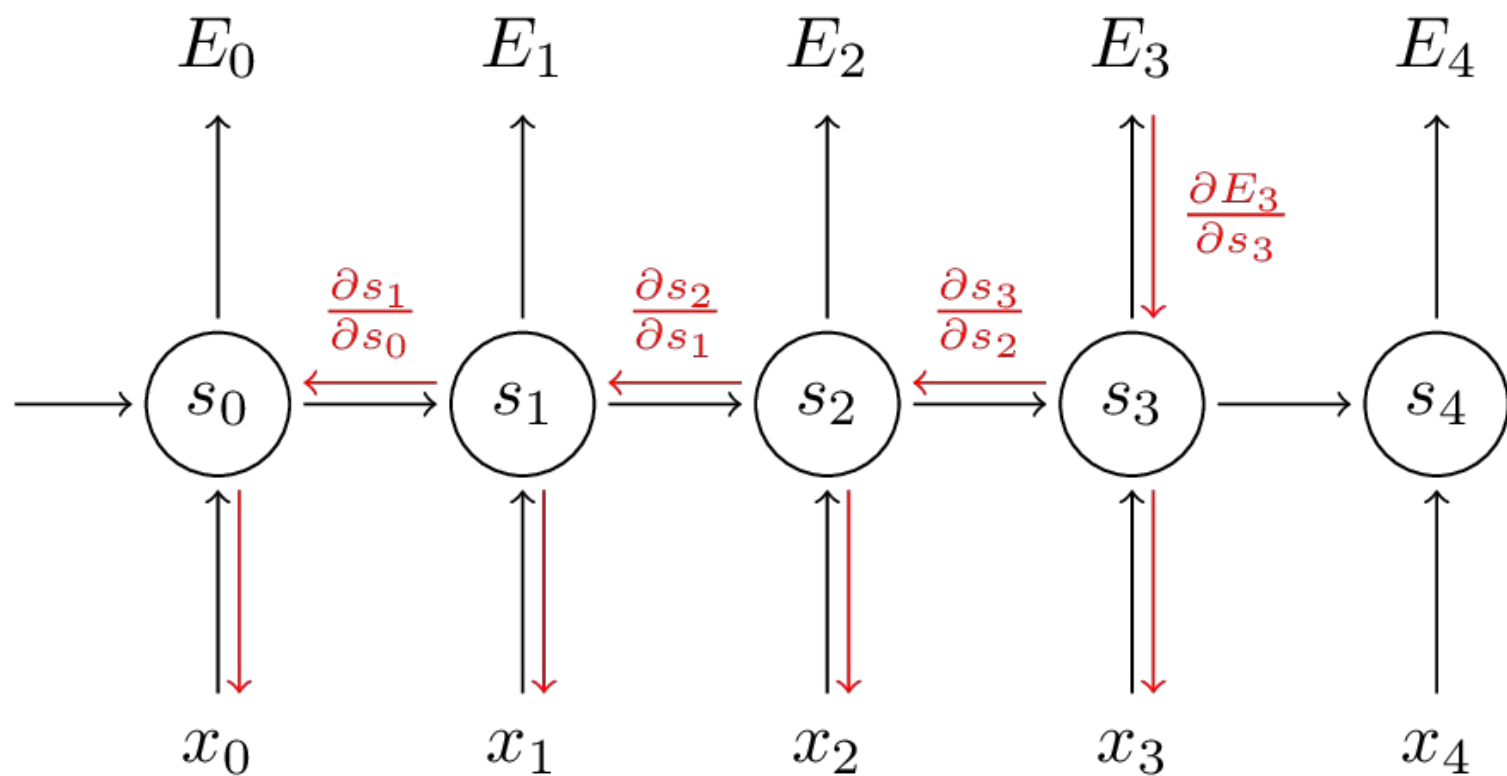
σ = activation function



Feed-Forward Network

Backpropagation

Backpropagation through time



$$\frac{\partial E_3}{\partial W} = \sum_{k=0}^3 \frac{\partial E_3}{\partial \hat{y}_3} \frac{\partial \hat{y}_3}{\partial s_3} \frac{\partial s_3}{\partial s_k} \frac{\partial s_k}{\partial W}$$

Disadvantages/Considerations

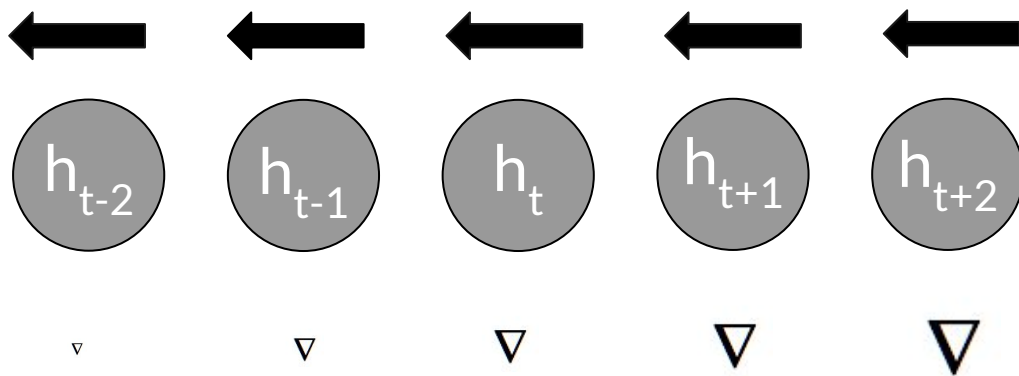
h_{t-2}

h_{t-1}

h_t

h_{t+1}

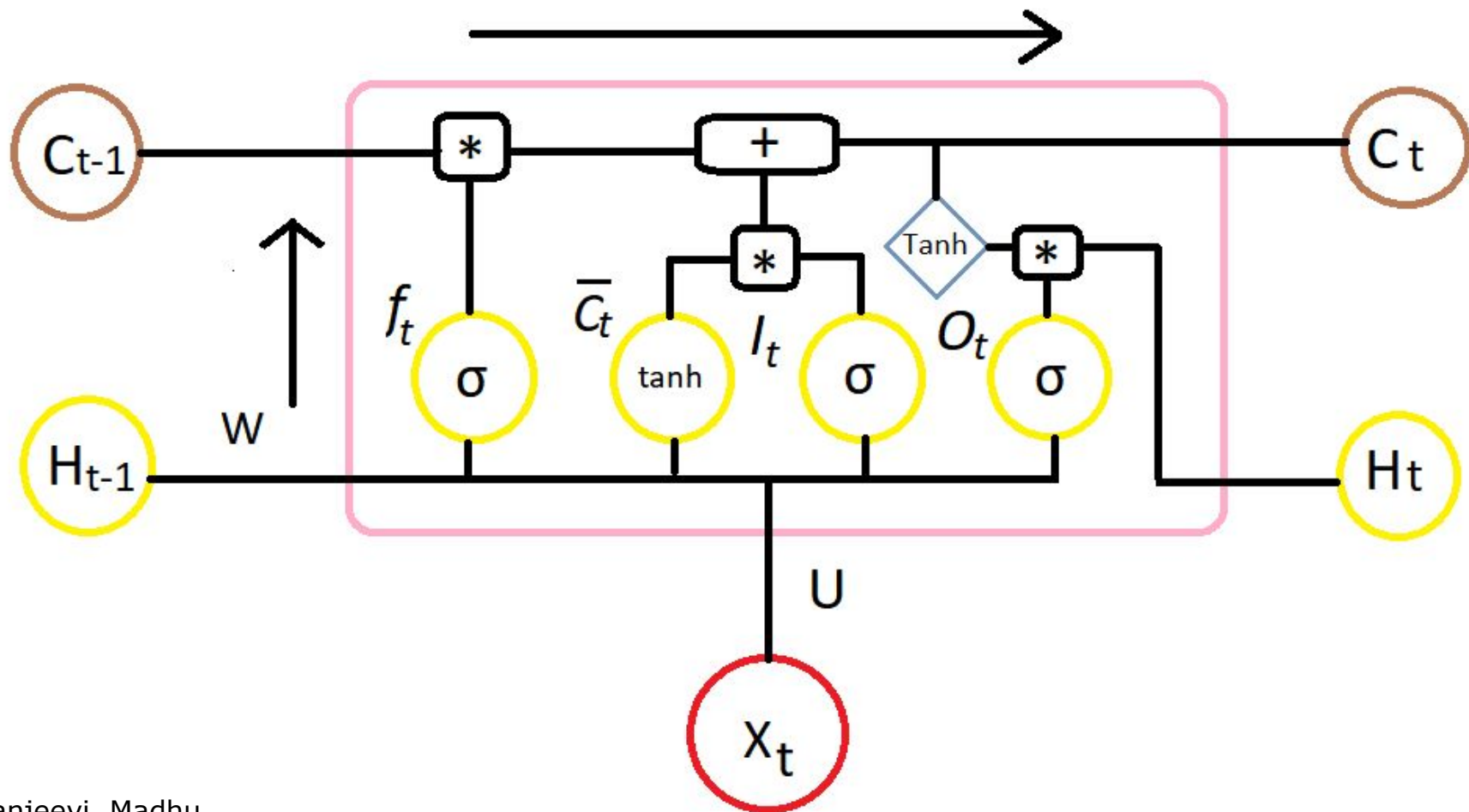
h_{t+2}



‘Vanilla’ Recurrent Neural Network

~~'Vanilla' Recurrent Neural Network~~

Long Short Term Memory Networks





The fall of RNN / LSTM



Eugenio Culurciello

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Summary

What they are:

a deep neural network designed to work with sequences

How do they work:

a sequence of feed-forward networks connected by a weight vector

Disadvantages:

vanishing gradient or exploding gradient



References

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