1. RNN
2. LSTM
3. GRU

1. RNN (recurrent NN)

Great for modeling sequential data.

Eg of sequential data - speech, audio, text etc

Use cases - speech recognition, language translation, stock prediction etc

Text can also be sequence data

Text

can also be sequence data

Example of a sequential memory

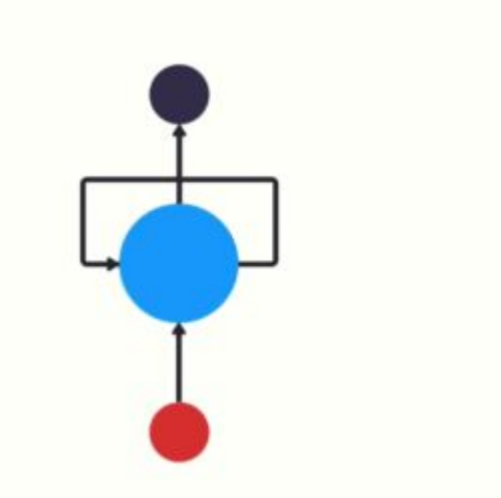
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

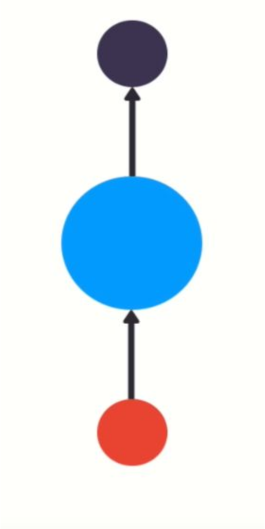
ZYXWVUTSRQPONMLKJIHGFEDCBA

H I J K L M N O P Q R S T U V W X Y Z

THAT MEANS SEQ. DATA IS EASIER TO REMEMBER!

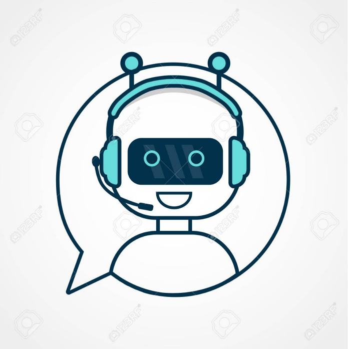
& RNNs ARE ABSTRACT CONCEPT OF SEQ. MEMORY





CHATBOT EXAMPLE

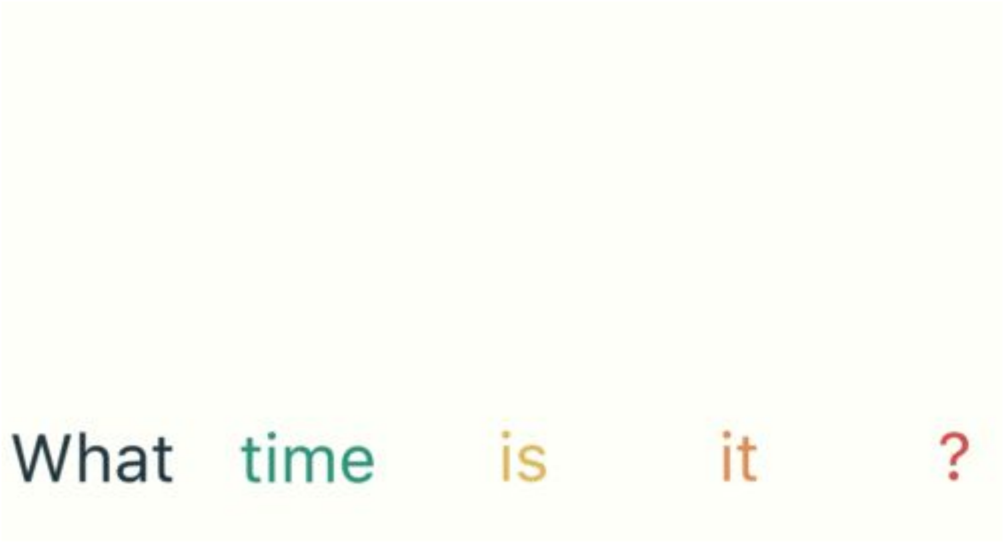
YOU: WHAT TIME IS IT ?



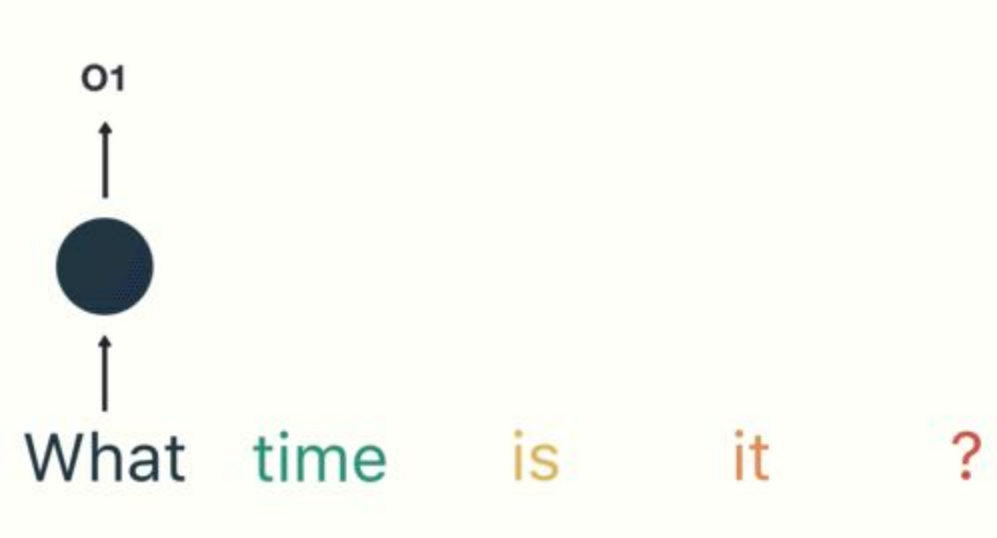
ASKING FOR TIME ….

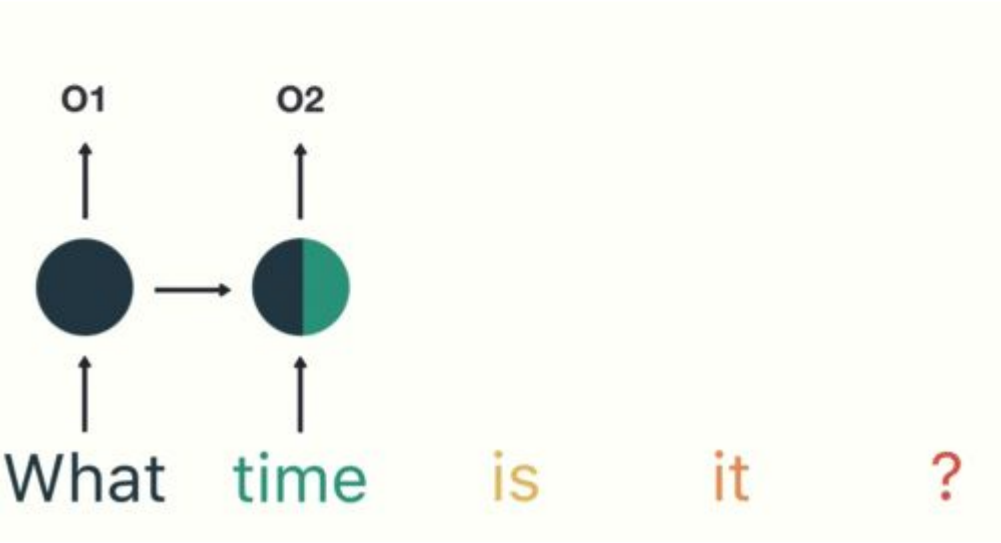
What time is it?

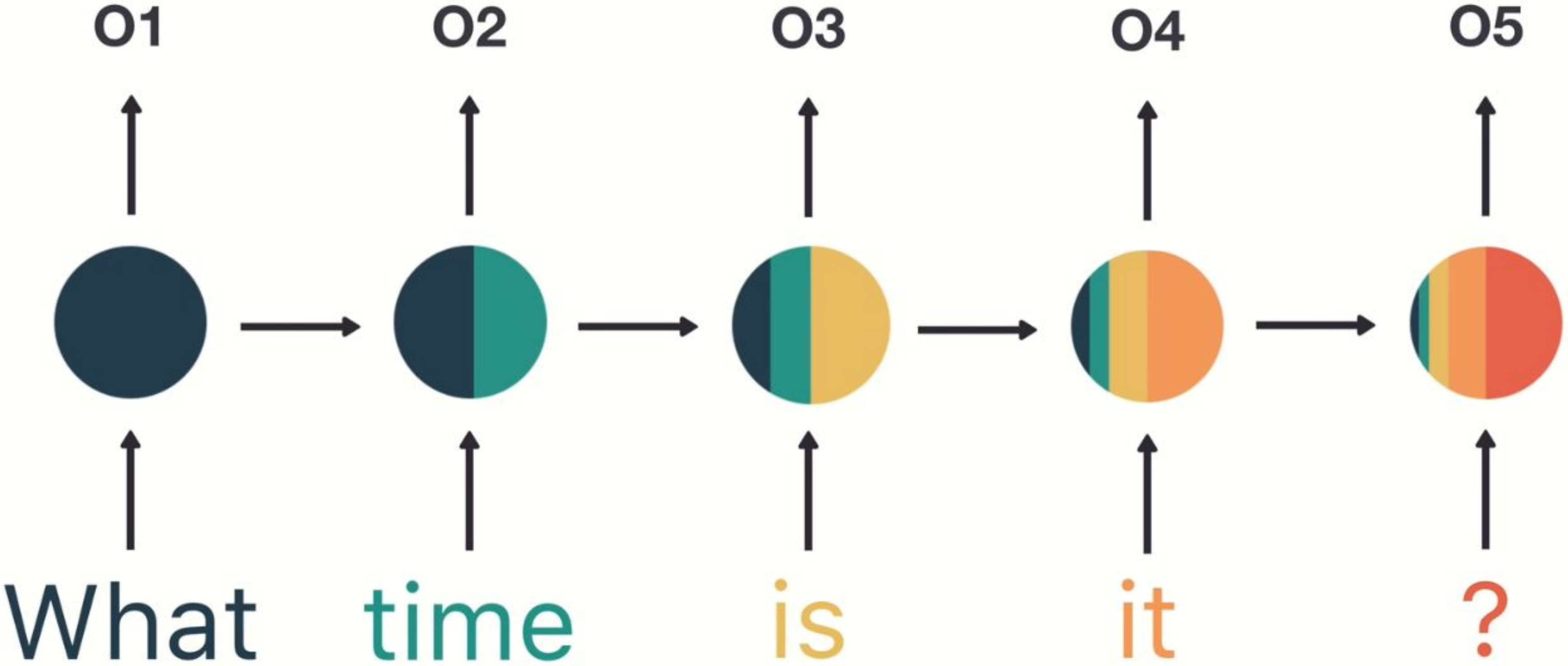
What time is it ?

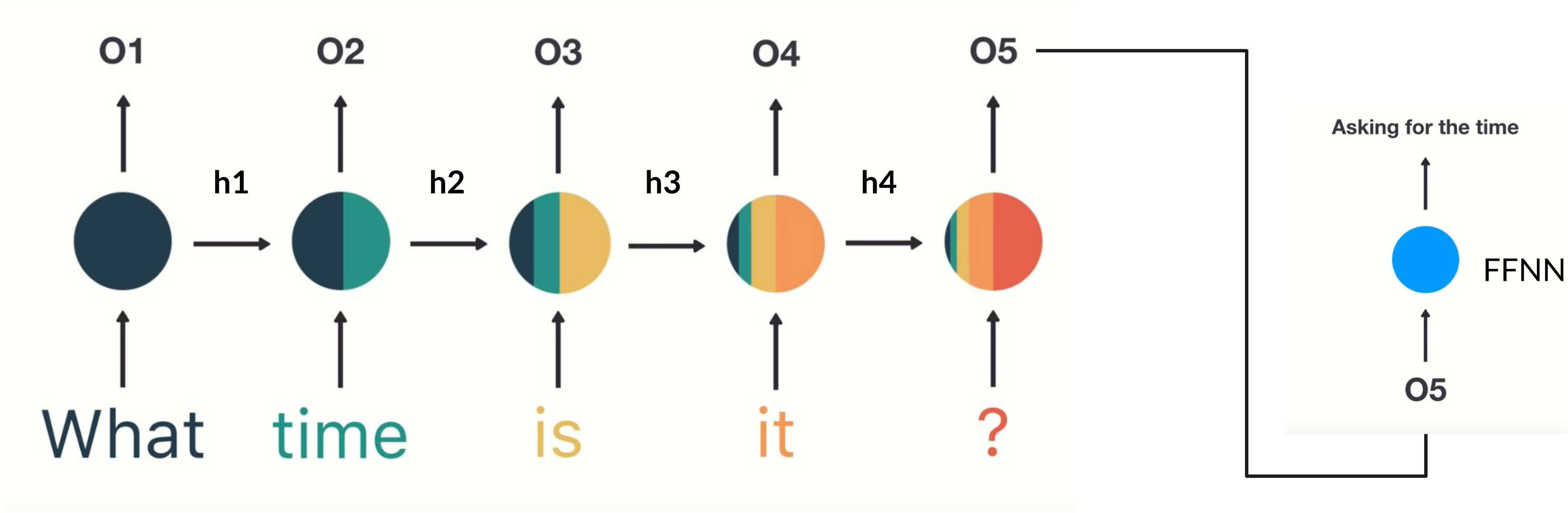


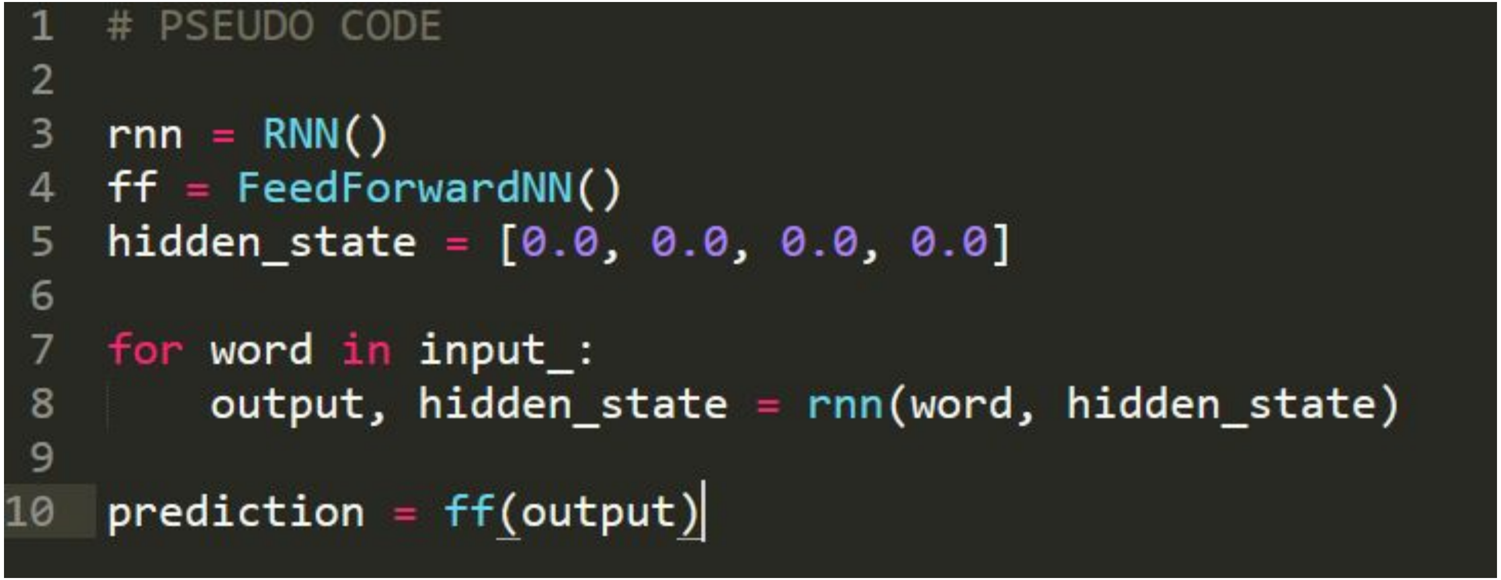
What time is it ?


O1
What
time
is
it
?

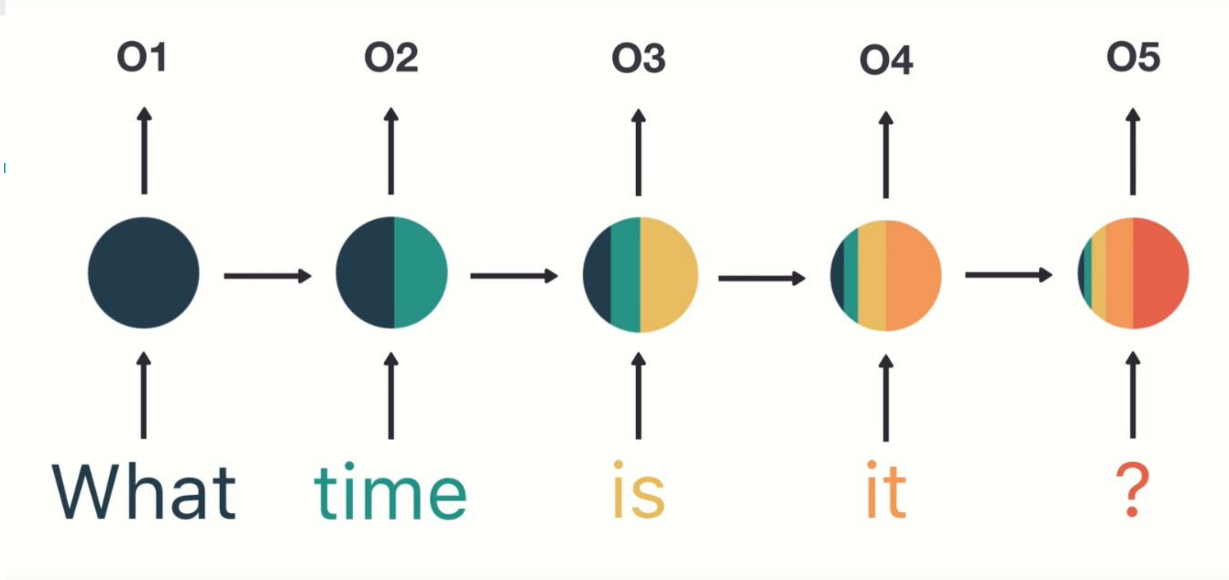

O1
O2
What
time
is
it
?


O1
O2
O3
O4
O5
What
time
is
it
?

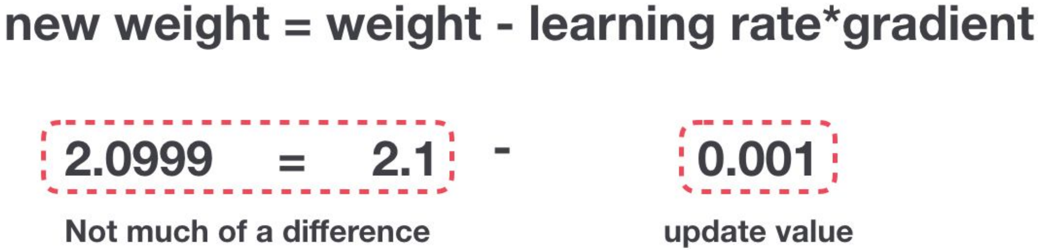

O1
O2
O3
O4
O5
h1
h2
h3
h4
What
time
is
it
?
Asking for the time
FFNN
O5



```
# PSEUDO CODE

rnn = RNN()
ff = FeedForwardNN()
hidden_state = [0.0, 0.0, 0.0, 0.0]

for word in input_:
    output, hidden_state = rnn(word, hidden_state)

prediction = ff(output)
```



RNNs suffer from vanishing gradient hence they have short term memory.

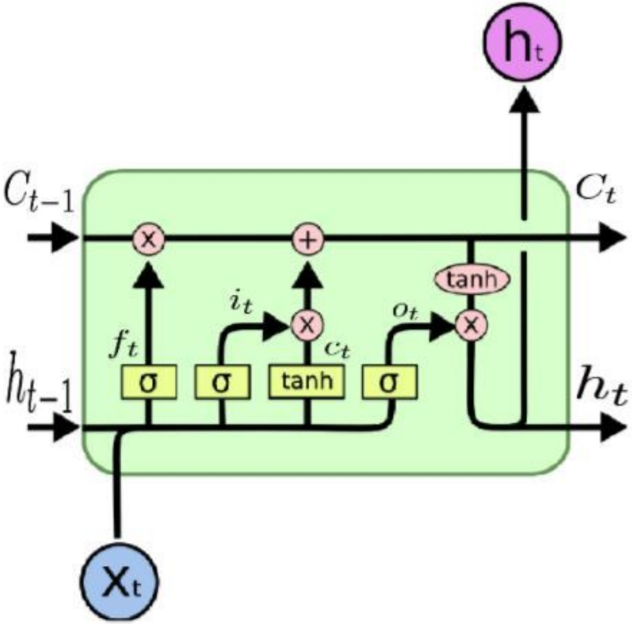

new weight = weight - learning rate*gradient

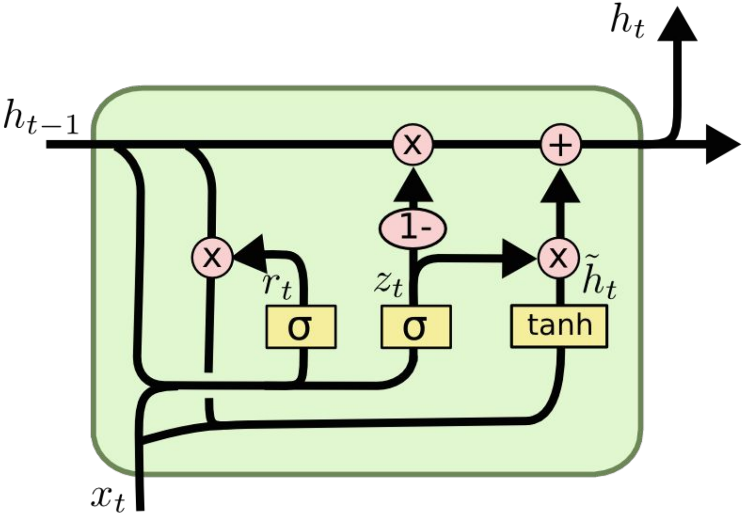
2.0999 = 2.1 - 0.001

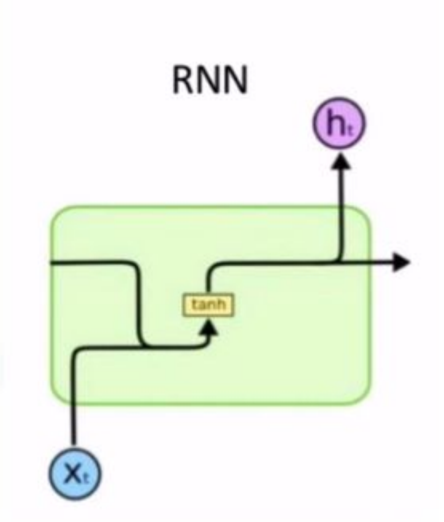
Not much of a difference

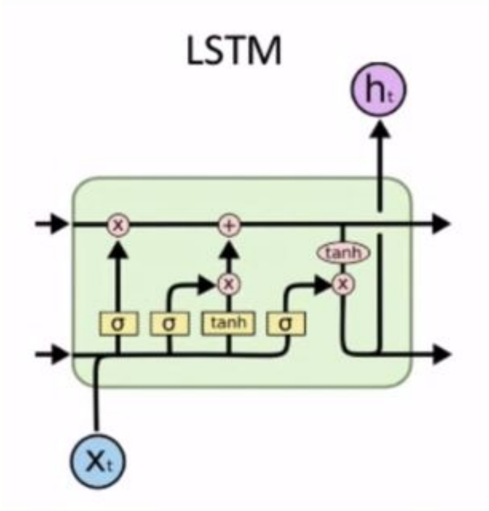
update value

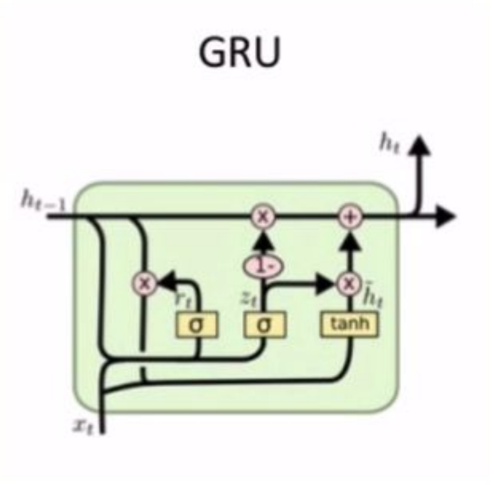
LSTM and GRU (comes to rescue to tackle short term memory issue)





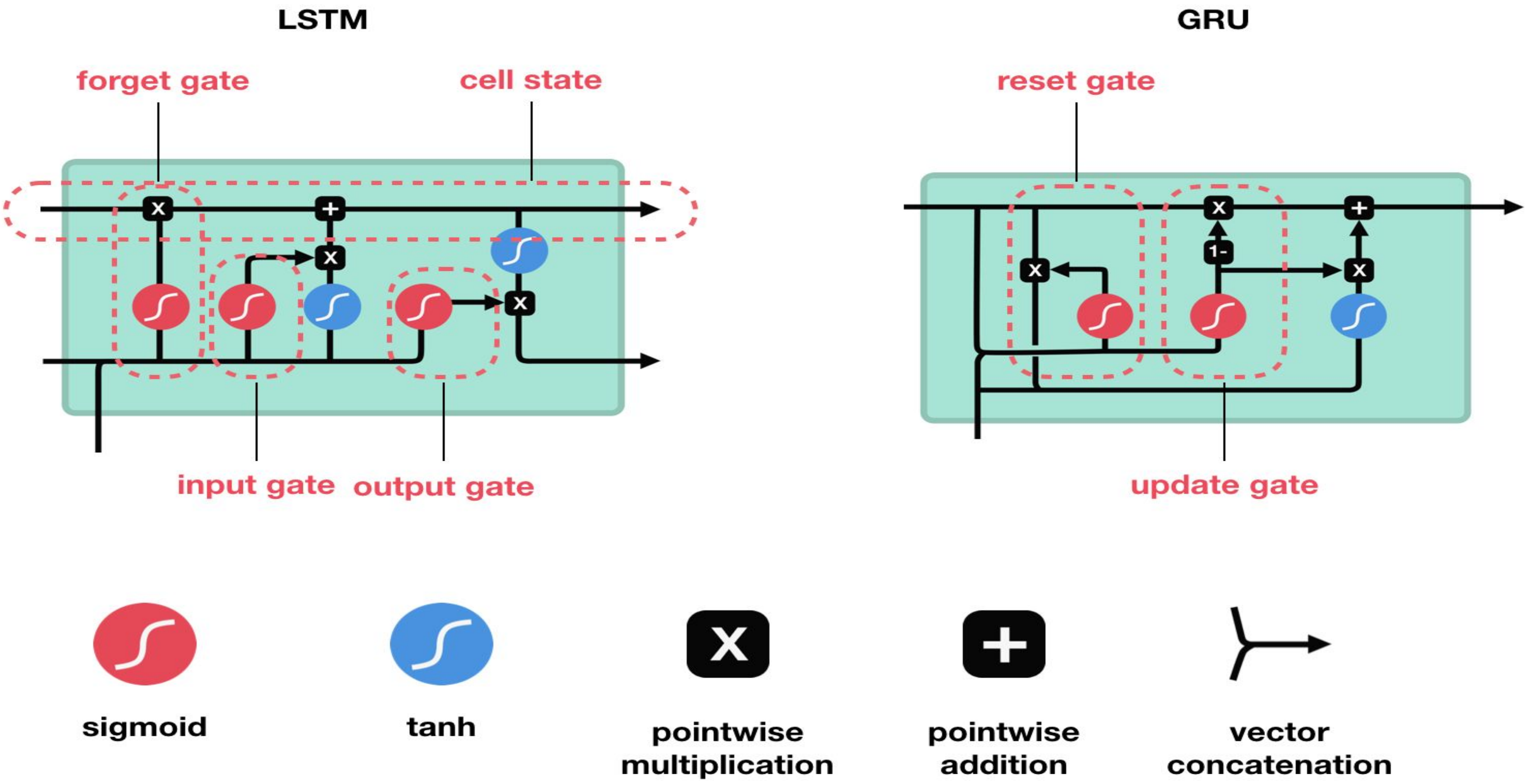






1. Simple arch.
2. Good for speed as it has less tensor ops.
3. Suffers short term memory.

1. Quite complex.
2. Good for modeling longer sequences which has long term dependencies.
3. Conquers short term memory.


LSTM
forget gate
cell state
input gate
output gate
GRU
reset gate
update gate
1-
sigmoid
tanh
pointwise multiplication
pointwise addition
vector concatenation

USE cases -

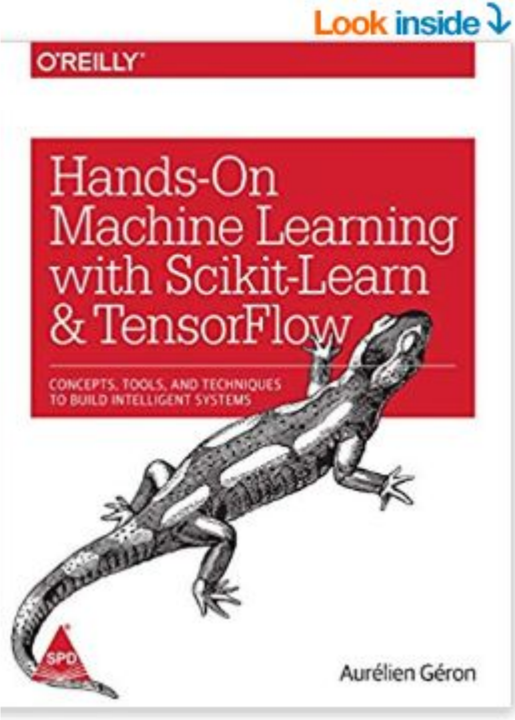
1. Speech recognition
2. Generating caption for a pic
3. Text generation

Customer review example-

5.0 out of 5 stars

A perfect book for ML Scikit and Tensorflow

This is one of the best books you can get for someone who is just starting out in ML, in its libraries such as Tensorflow, *It covers the basics very good.* As a book, it is 5/5


Look inside
O'REILLY
Hands-On Machine Learning with Scikit-Learn & TensorFlow
CONCEPTS, TOOLS, AND TECHNIQUES TO BUILD INTELLIGENT SYSTEMS
SPD
Aurélien Géron

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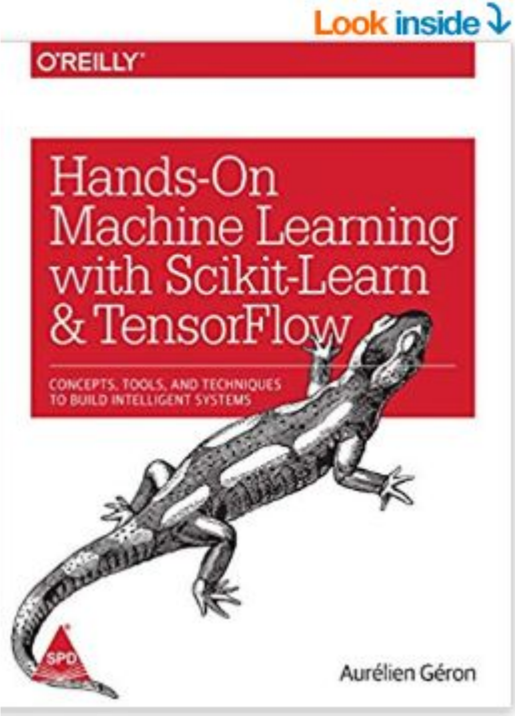
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O'REILLY
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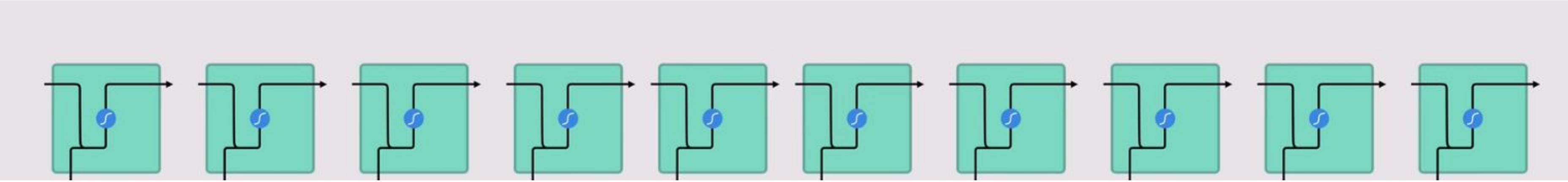
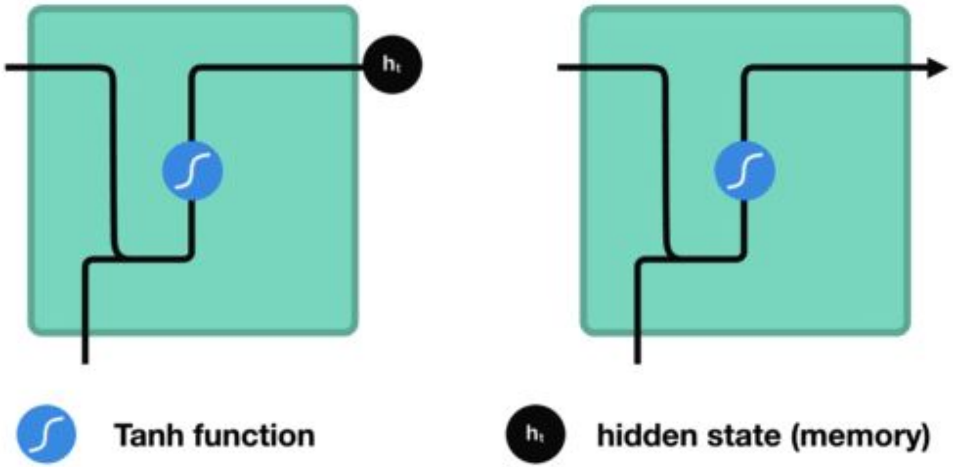
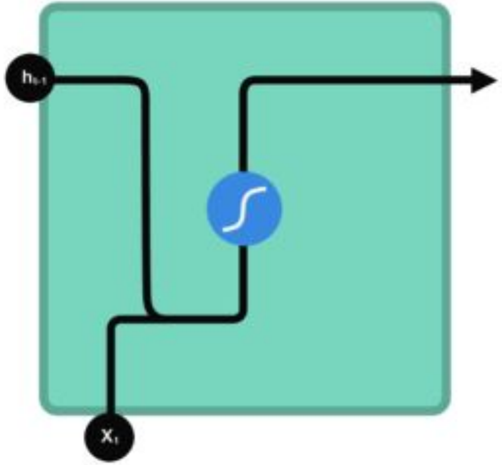
SPD
Aurélien Géron



perfect book for ML Scikit and Tensorflow This is one


ht
ht
Tanh function
hidden state (memory)



Tanh function

h_t new hidden state

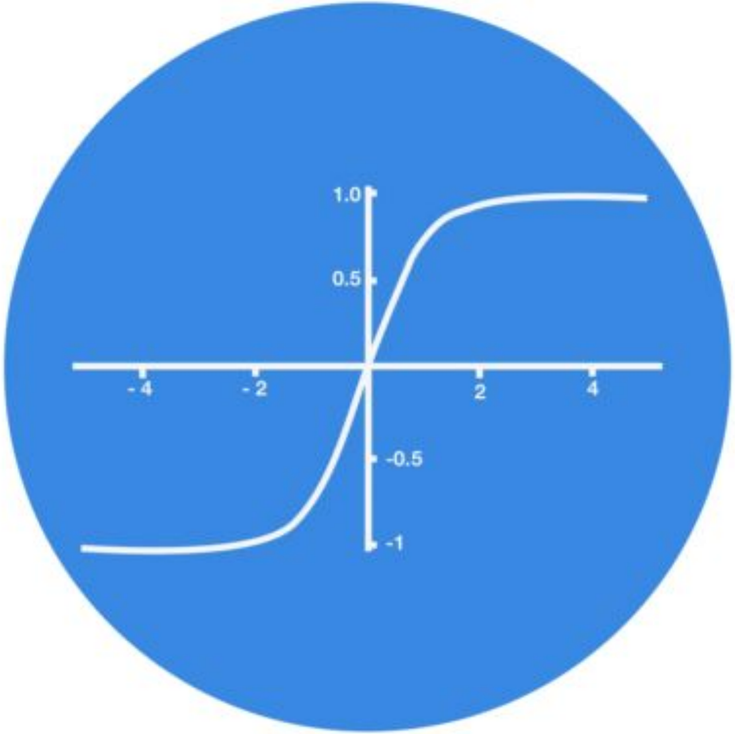
h_{t-1} previous hidden state

X_t input

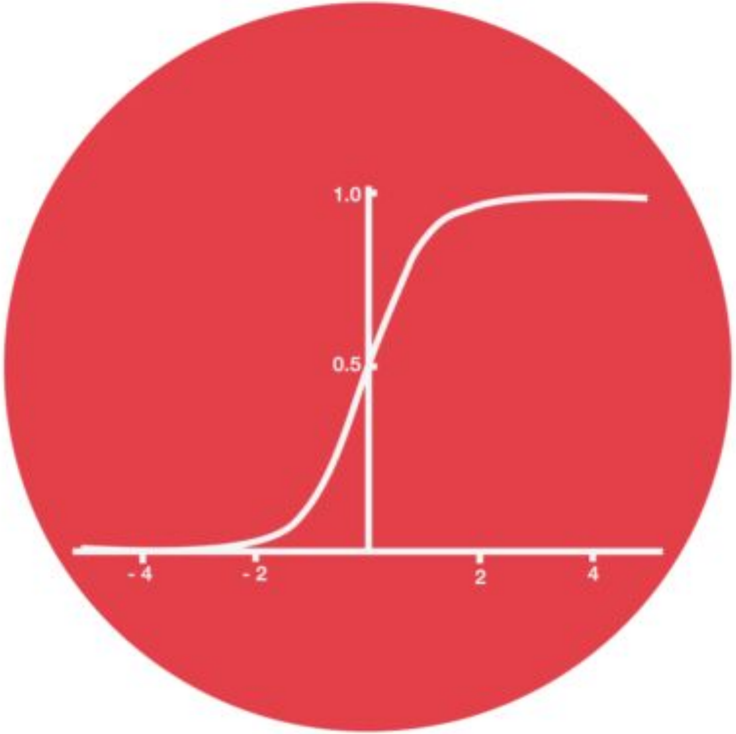
concatenation

Tanh function and Sigmoid function

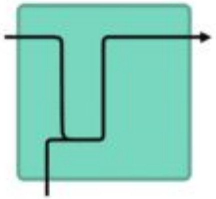
5
0.1
-0.5

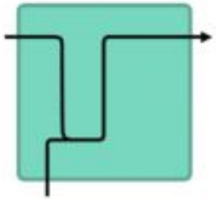


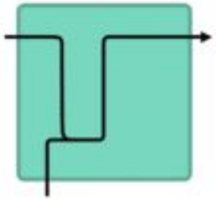
5
0.1
-0.5

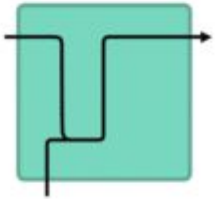


5
0.01
-0.5

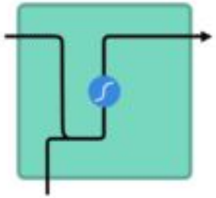


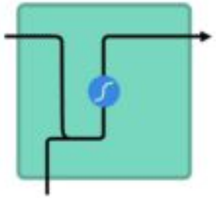


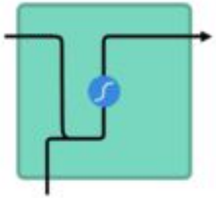


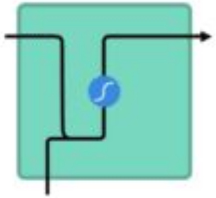


5
0.01
-0.5

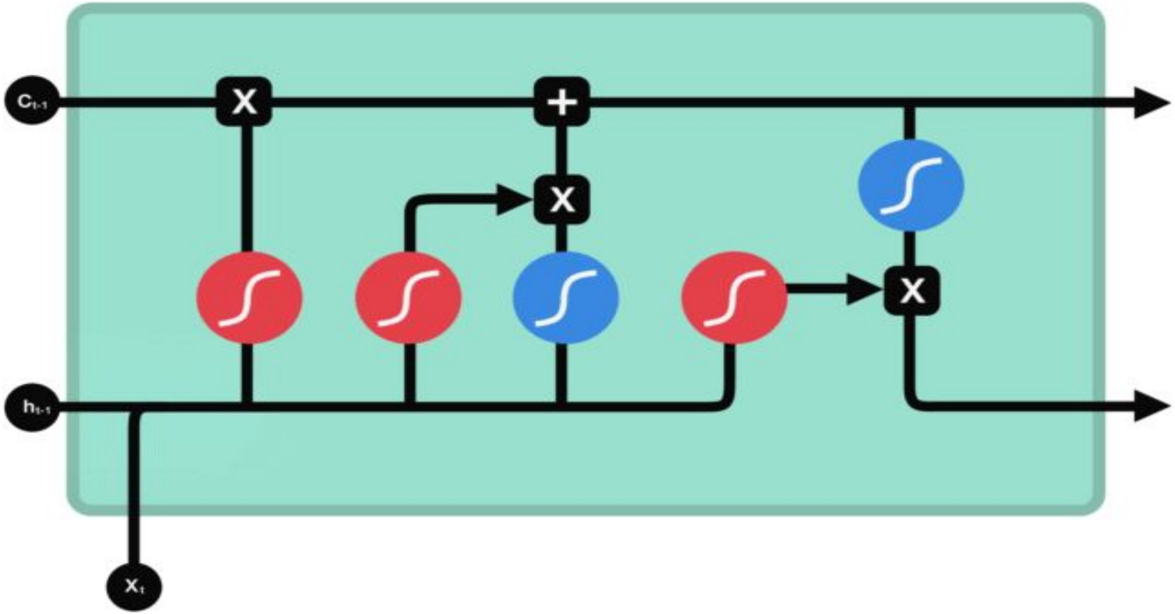








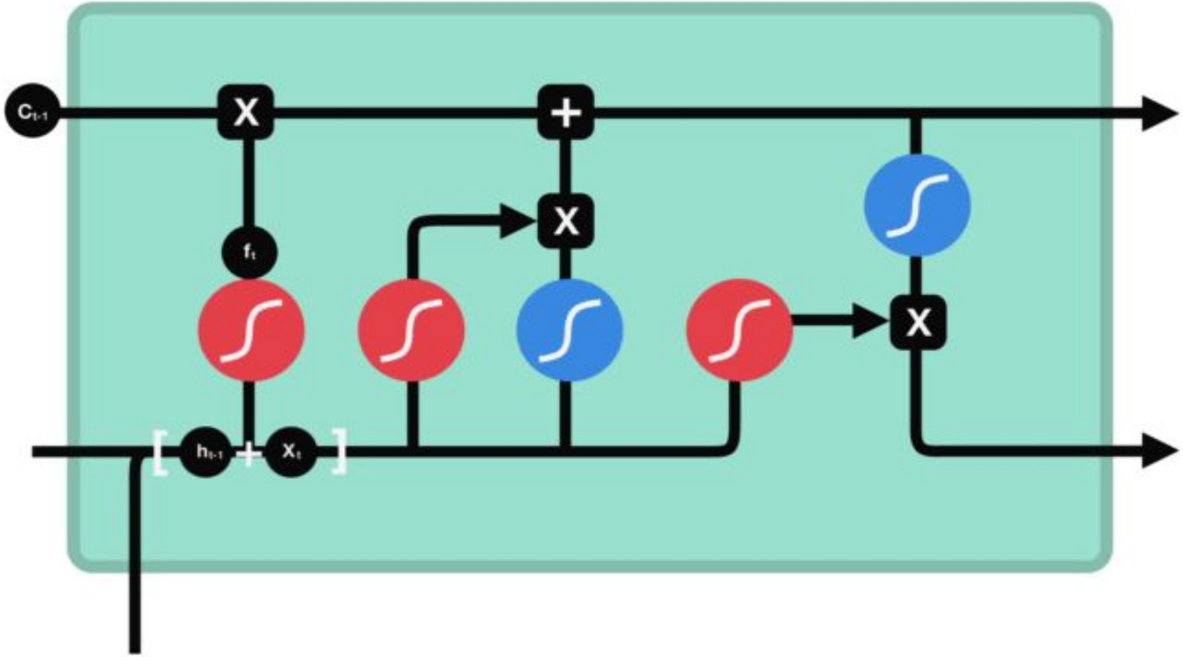
Forget gate



● c_{t-1} previous cell state

● f_t forget gate output

Input Gate



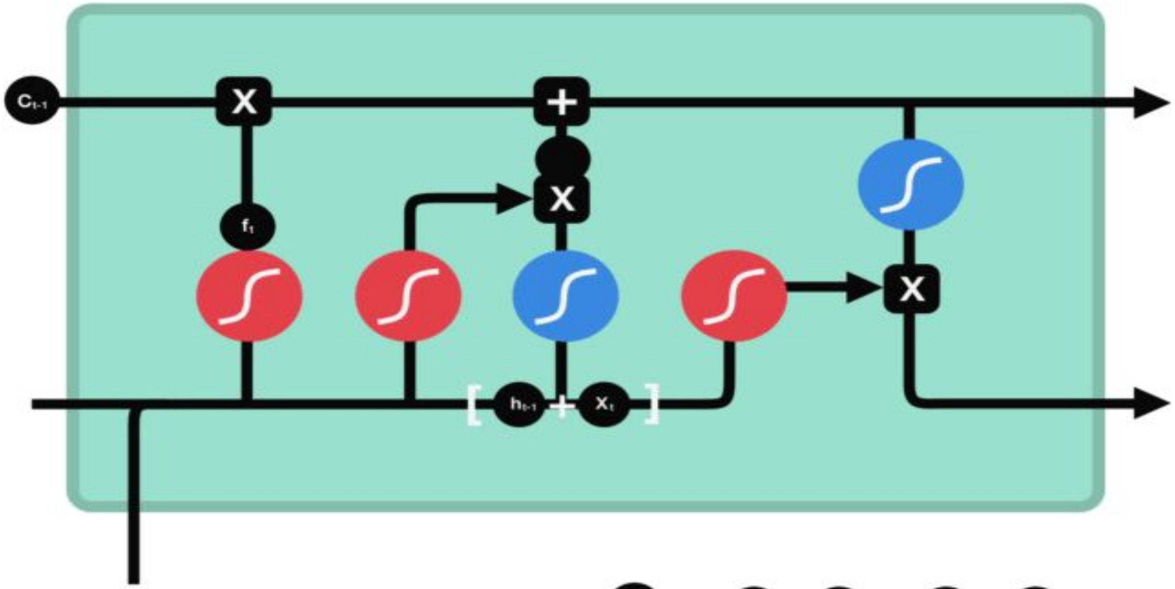
C_{t-1} previous cell state

f_t forget gate output

i_t input gate output

$\tilde{C}_t$ candidate

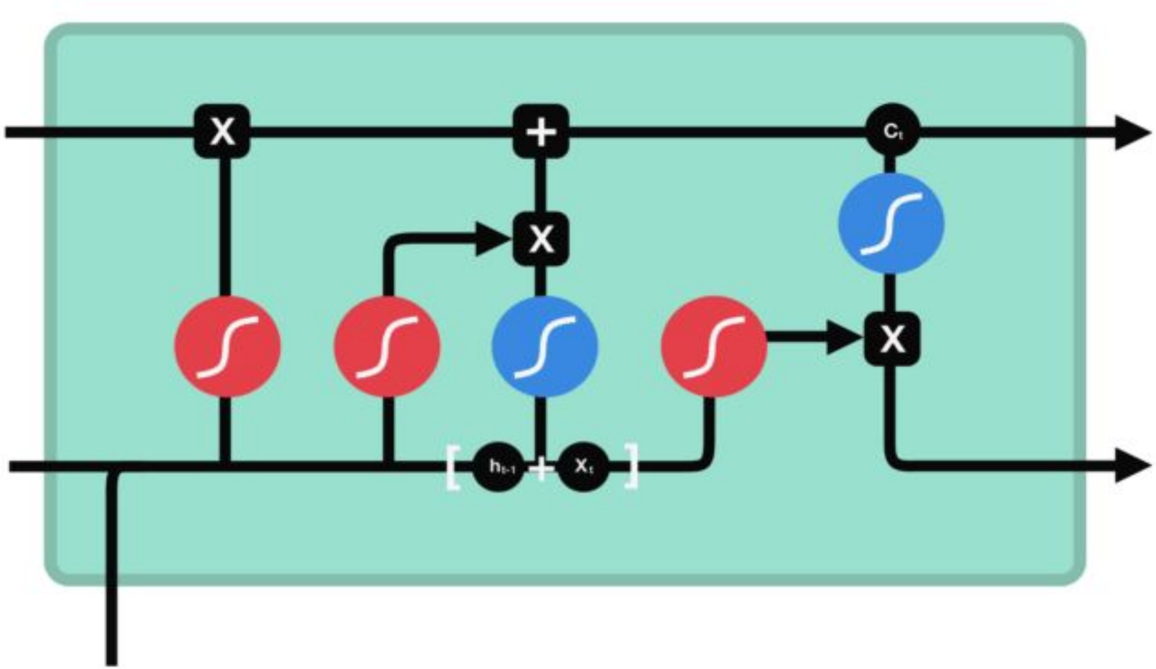
Cell State



- C_{t-1} previous cell state
- f_t forget gate output
- i_t input gate output
- $\tilde{C}_t$ candidate
- C_t new cell state

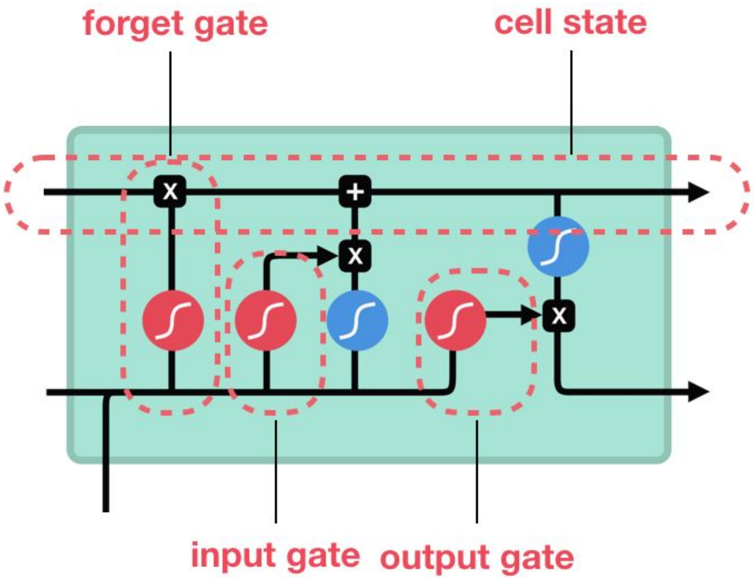
$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t$$

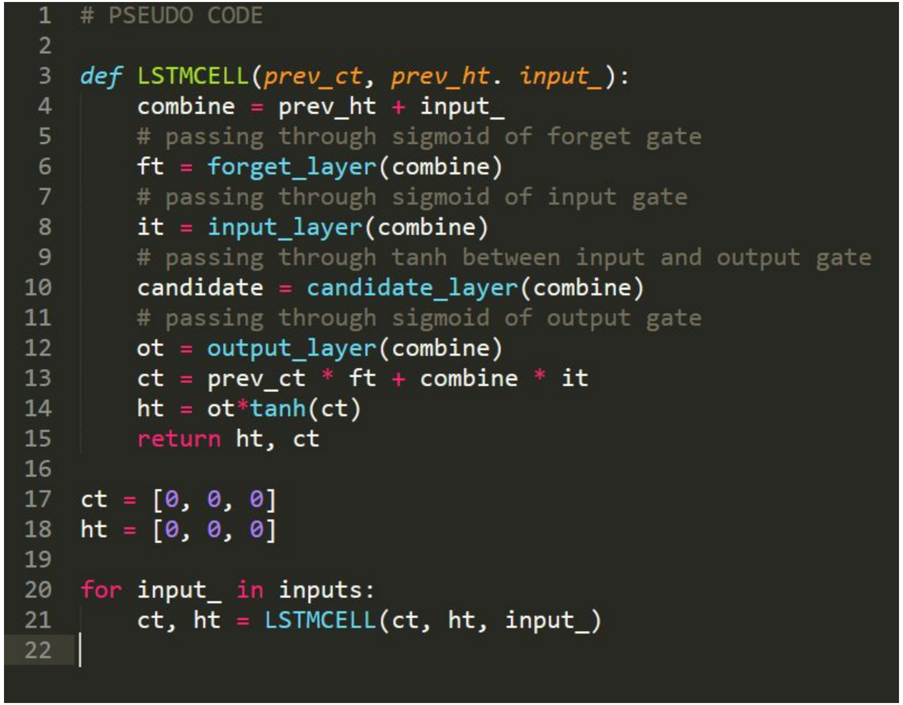
Output Gate



- C_{t-1} previous cell state
- f_t forget gate output
- i_t input gate output
- $\tilde{C}_t$ candidate
- C_t new cell state
- o_t output gate output
- h_t hidden state

LSTM



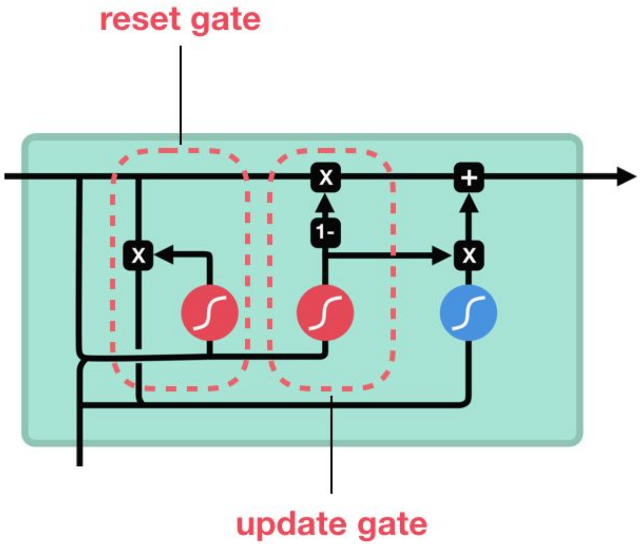

```
# PSEUDO CODE

def LSTMCELL(prev_ct, prev_ht. input_):
    combine = prev_ht + input_
    # passing through sigmoid of forget gate
    ft = forget_layer(combine)
    # passing through sigmoid of input gate
    it = input_layer(combine)
    # passing through tanh between input and output gate
    candidate = candidate_layer(combine)
    # passing through sigmoid of output gate
    ot = output_layer(combine)
    ct = prev_ct * ft + combine * it
    ht = ot*tanh(ct)
    return ht, ct

ct = [0, 0, 0]
ht = [0, 0, 0]

for input_ in inputs:
    ct, ht = LSTMCELL(ct, ht, input_)
```

GRU



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