

Artificial Neural Networks and Deep Learning

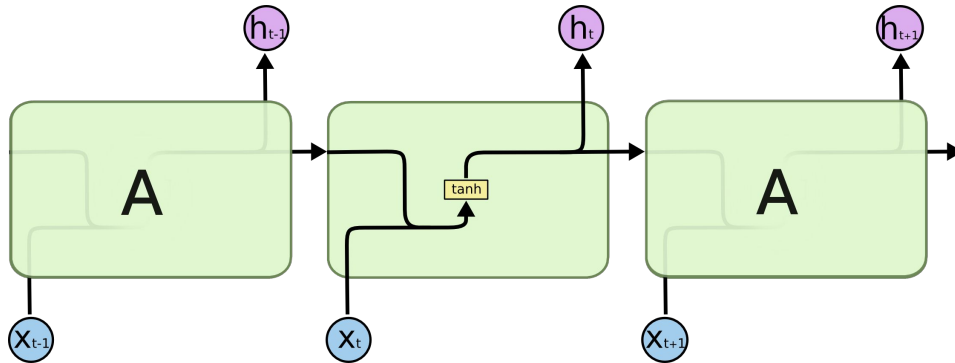
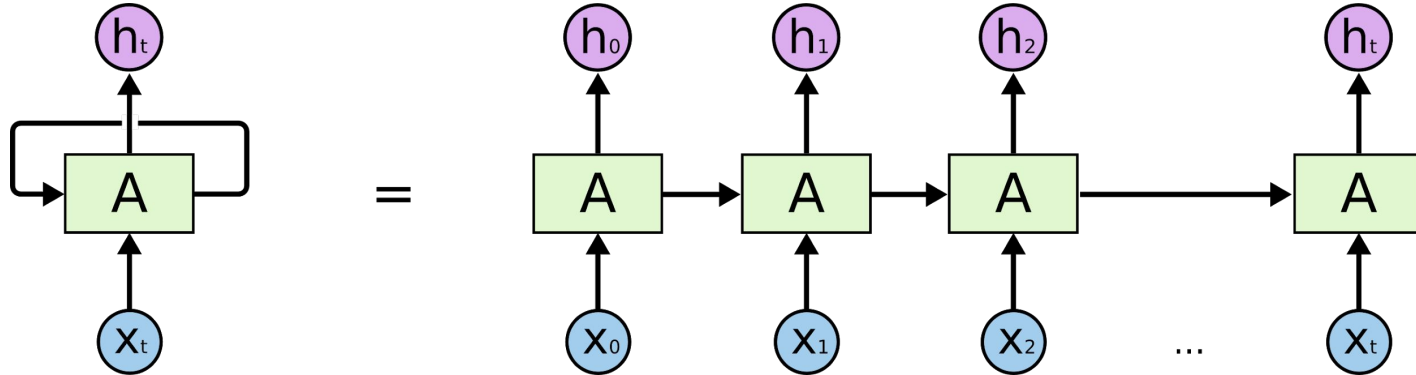
Keras tutorial - 13/12/2019

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Artificial Intelligence and Robotics Laboratory

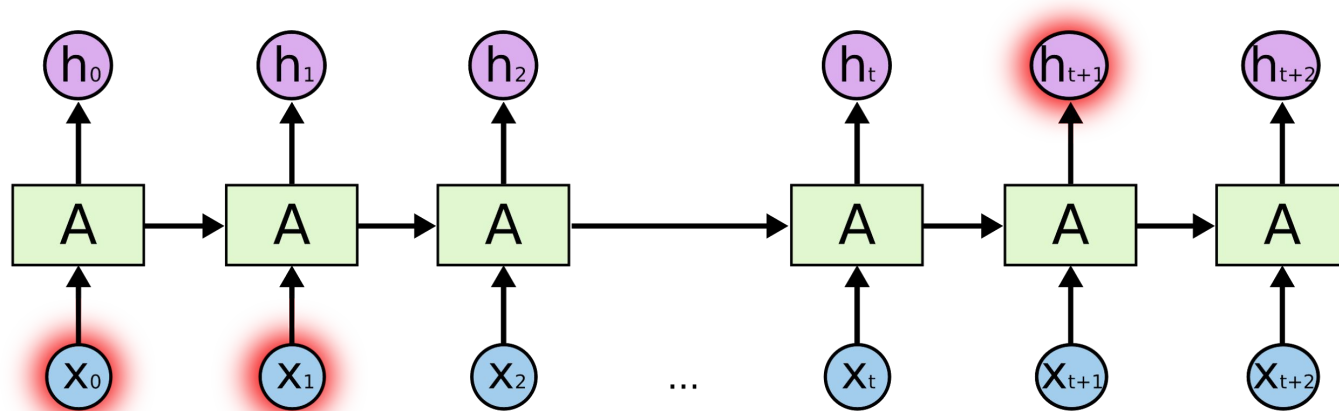


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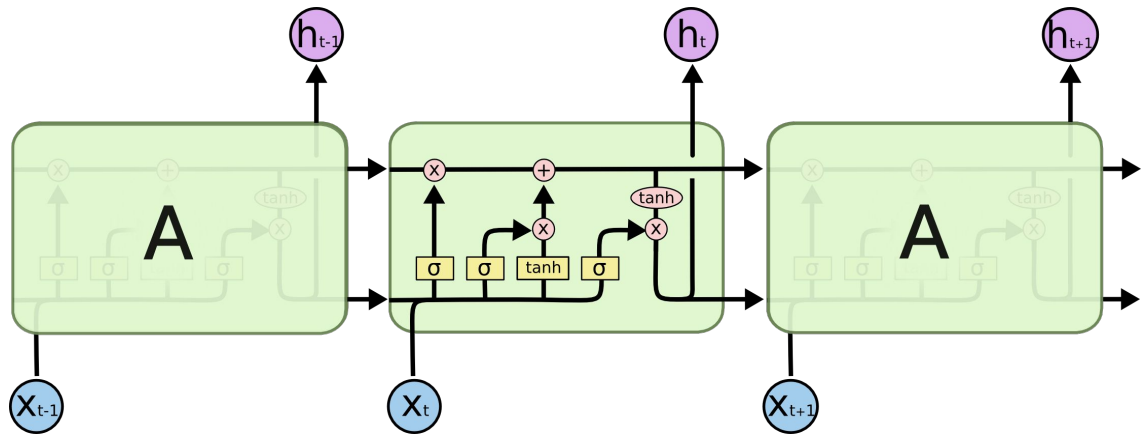
$$a_h^t = \sum_{i=1}^I w_{ih} x_i^t + \sum_{h'=1}^H w_{h'h} b_{h'}^{t-1}$$

$$b_h^t = \theta_h(a_h^t)$$

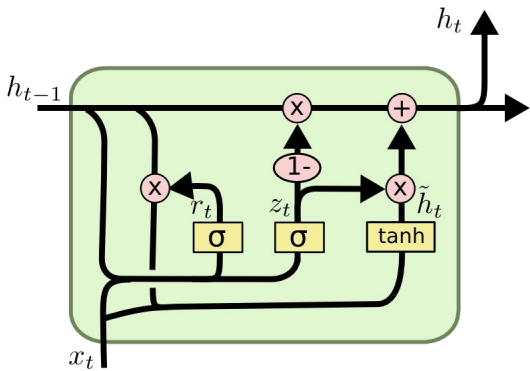


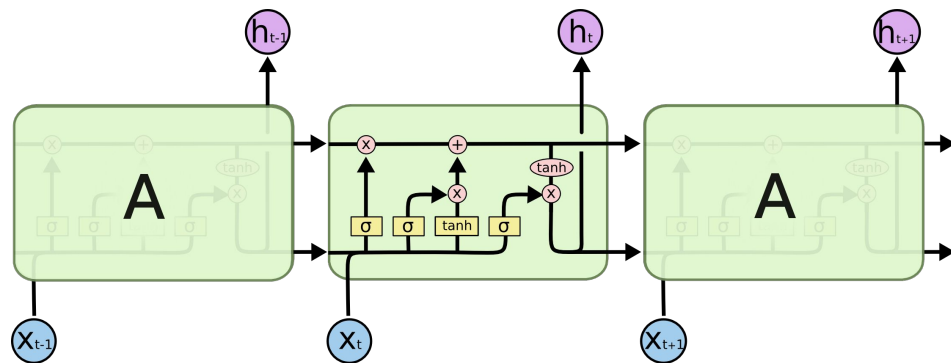
Difficulties in learning long-term dependences..

Long Short-Term Memory (LSTM) Hochreiter & Schmidhuber (1997)



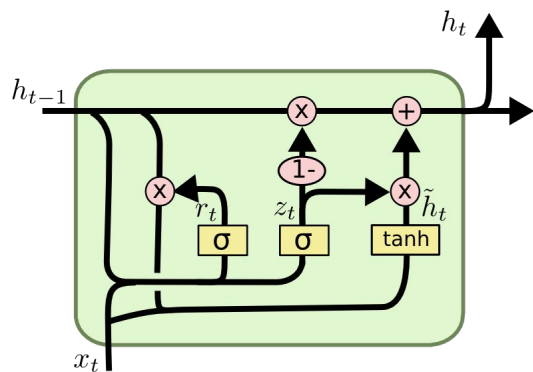
Gated Recurrent Unit (GRU) Cho, et al. (2014)





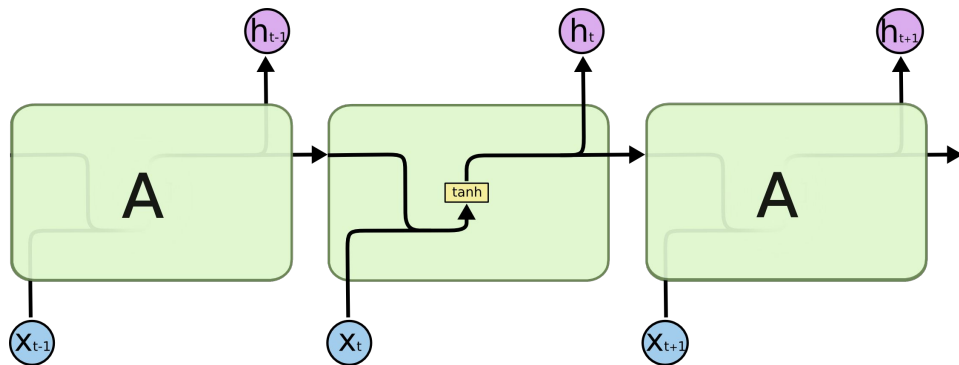
https://www.tensorflow.org/api_docs/python/tf/keras/layers/LSTM

```
LSTM(
    units,
    activation='tanh',
    recurrent_activation='sigmoid',
    use_bias=True,
    kernel_initializer='glorot_uniform',
    recurrent_initializer='orthogonal',
    bias_initializer='zeros',
    unit_forget_bias=True,
    kernel_regularizer=None,
    recurrent_regularizer=None,
    bias_regularizer=None,
    activity_regularizer=None,
    kernel_constraint=None,
    recurrent_constraint=None,
    bias_constraint=None,
    dropout=0.0,
    recurrent_dropout=0.0,
    implementation=2,
    return_sequences=False,
    return_state=False,
    go_backwards=False,
    stateful=False,
    time_major=False,
    unroll=False,
    **kwargs)
```



https://www.tensorflow.org/api_docs/python/tf/keras/layers/GRU

```
GRU(
    units,
    activation='tanh',
    recurrent_activation='sigmoid',
    use_bias=True,
    kernel_initializer='glorot_uniform',
    recurrent_initializer='orthogonal',
    bias_initializer='zeros',
    kernel_regularizer=None,
    recurrent_regularizer=None,
    bias_regularizer=None,
    activity_regularizer=None,
    kernel_constraint=None,
    recurrent_constraint=None,
    bias_constraint=None,
    dropout=0.0,
    recurrent_dropout=0.0,
    implementation=2,
    return_sequences=False,
    return_state=False,
    go_backwards=False,
    stateful=False,
    unroll=False,
    time_major=False,
    reset_after=True,
    **kwargs)
```



https://www.tensorflow.org/api_docs/python/tf/keras/layers/SimpleRNN

```
SimpleRNN(
    units,
    activation='tanh',
    use_bias=True,
    kernel_initializer='glorot_uniform',
    recurrent_initializer='orthogonal',
    bias_initializer='zeros',
    kernel_regularizer=None,
    recurrent_regularizer=None,
    bias_regularizer=None,
    activity_regularizer=None,
    kernel_constraint=None,
    recurrent_constraint=None,
    bias_constraint=None,
    dropout=0.0,
    recurrent_dropout=0.0,
    return_sequences=False,
    return_state=False,
    go_backwards=False,
    stateful=False,
    unroll=False,
    **kwargs)
```