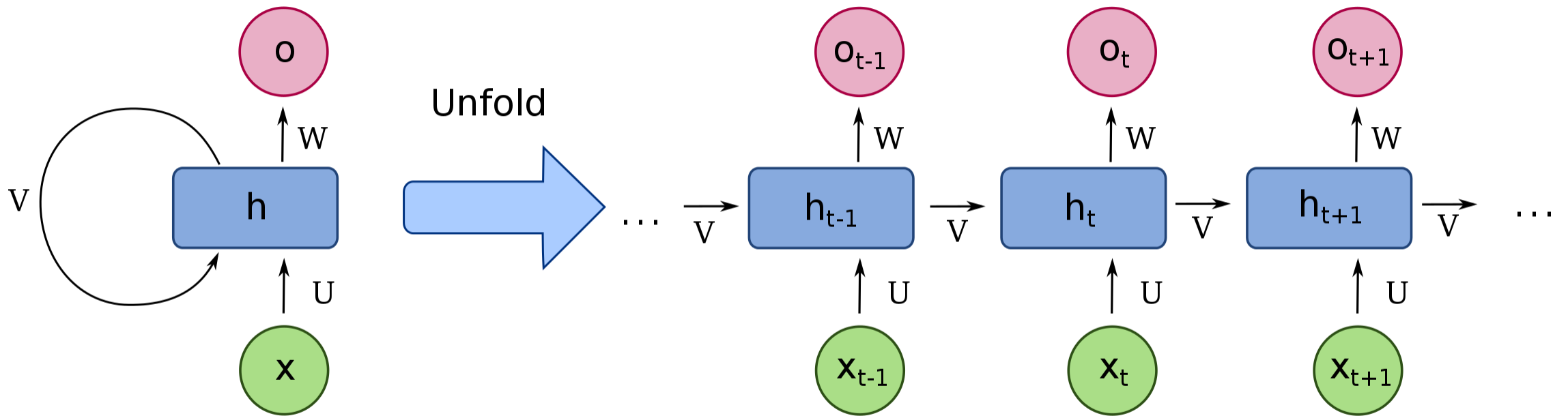
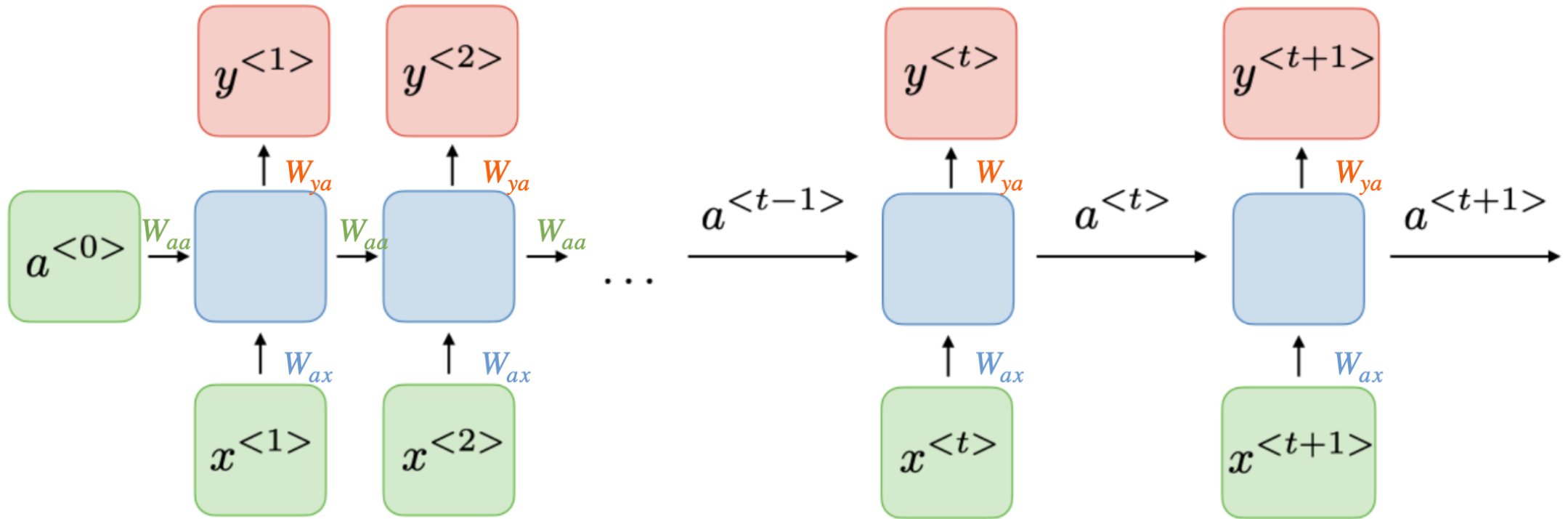




# RNN model



# RNN model

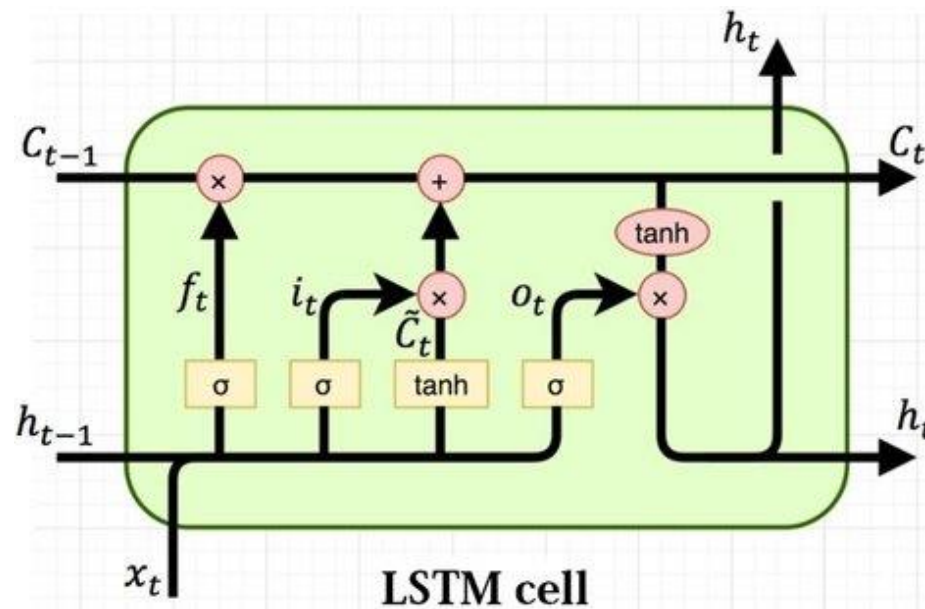


$$a^{<t>} = g_1(W_{aa}a^{<t-1>} + W_{ax}x^{<t>} + b_a)$$

$$y^{<t>} = g_2(W_{ya}a^{<t>} + b_y)$$

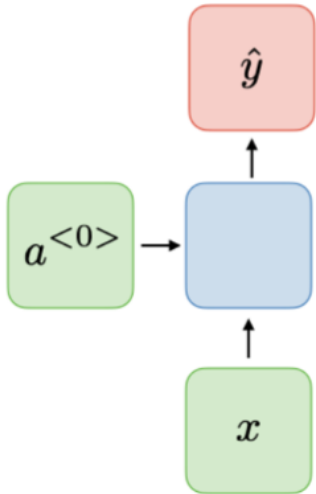
$W_{ax}, W_{aa}, W_{ya}, b_a$  and  $b_y$  are weights that are shared temporally and  $g_1, g_2$  activation functions

# LSTM model

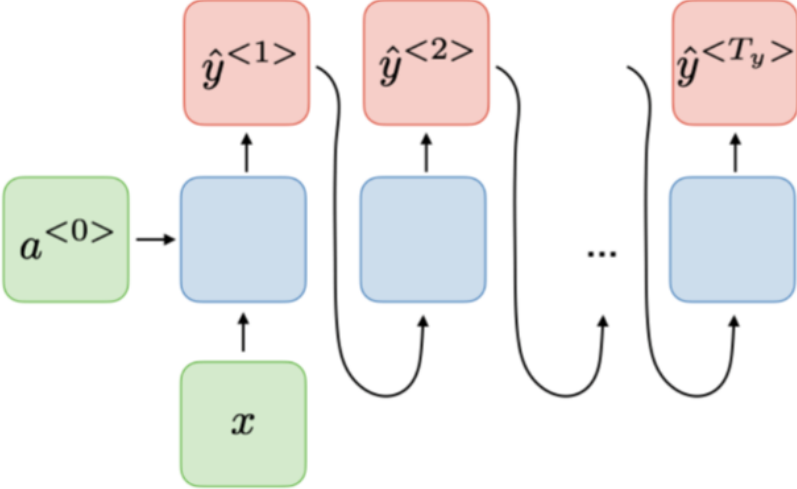


$$\begin{aligned}i_t &= \sigma(x_t U^i + h_{t-1} W^i) \\f_t &= \sigma(x_t U^f + h_{t-1} W^f) \\o_t &= \sigma(x_t U^o + h_{t-1} W^o) \\\tilde{C}_t &= \tanh(x_t U^g + h_{t-1} W^g) \\C_t &= \sigma(f_t * C_{t-1} + i_t * \tilde{C}_t) \\h_t &= \tanh(C_t) * o_t\end{aligned}$$

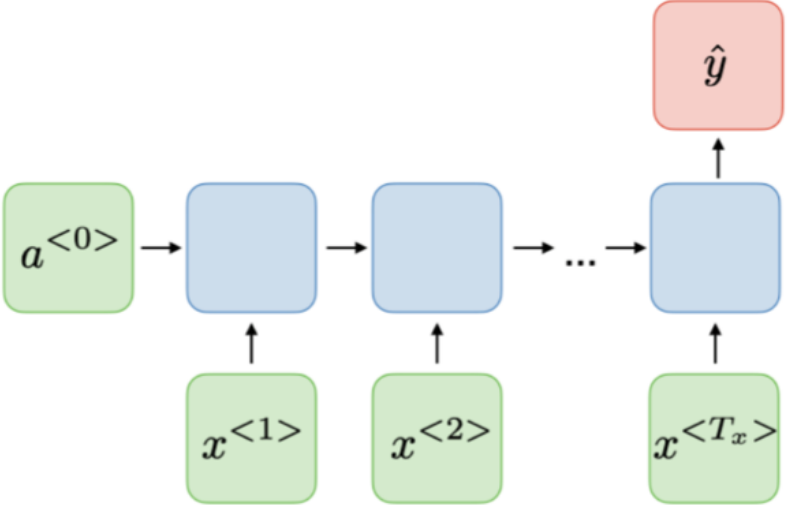
# Applications of RNN

Type of RNN	Illustration	Example
One-to-one $T_x = T_y = 1$		Traditional neural network

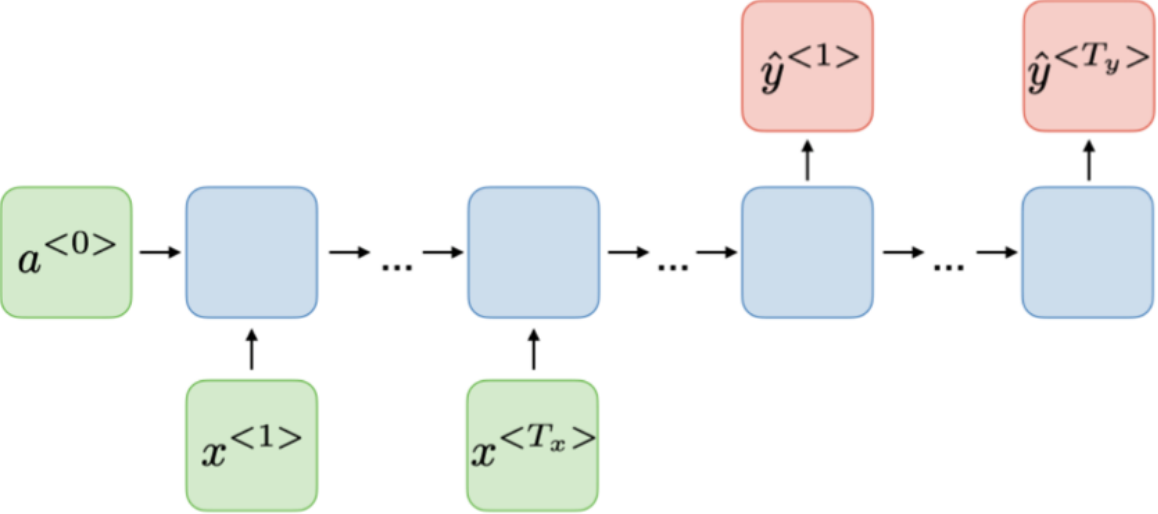
# Applications of RNN

Type of RNN	Illustration	Example
One-to-many $T_x = 1, T_y > 1$	 <p>The diagram illustrates a one-to-many RNN architecture. It shows a sequence of hidden states (blue boxes) connected by curved arrows representing recurrent connections. A single input <math>x</math> (green box) is fed into the first hidden state. The output of the first hidden state is <math>\hat{y}^{&lt;1&gt;}</math> (red box). This output is fed back as the input <math>a^{&lt;0&gt;}</math> (green box) to the second hidden state. The second hidden state produces output <math>\hat{y}^{&lt;2&gt;}</math> (red box), which is fed back as input <math>a^{&lt;1&gt;}</math> to the third hidden state. This process continues until the final hidden state produces output <math>\hat{y}^{&lt;T_y&gt;}</math> (red box). Ellipses (...) indicate intermediate hidden states and outputs.</p>	Music generation

# Applications of RNN

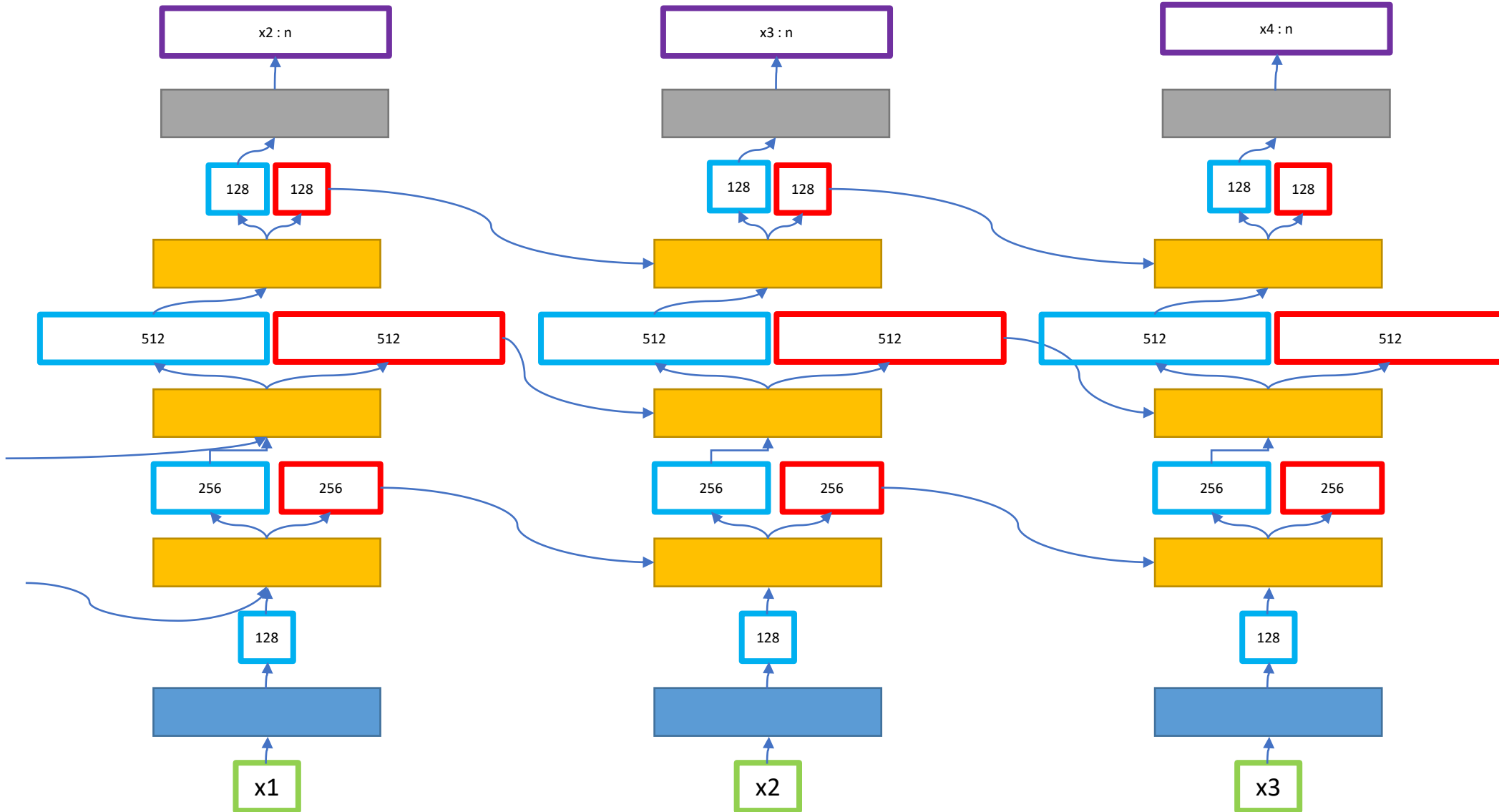
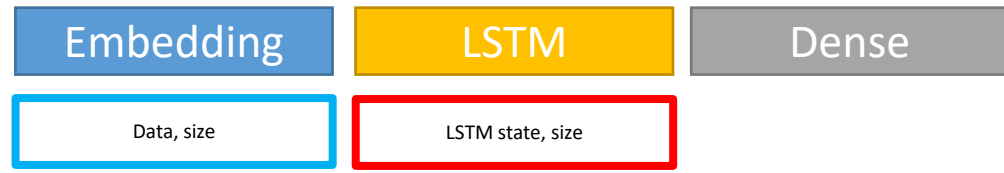
Type of RNN	Illustration	Example
Many-to-one $T_x > 1, T_y = 1$	 <p>The diagram illustrates a Many-to-one RNN architecture. It shows a sequence of input boxes labeled <math>x^{&lt;1&gt;}</math>, <math>x^{&lt;2&gt;}</math>, and <math>x^{&lt;T_x&gt;}</math> feeding into a sequence of hidden state boxes. The final hidden state feeds into an output box labeled <math>\hat{y}</math>.</p>	Sentiment classification

# Applications of RNN

Type of RNN	Illustration	Example
Many-to-many $T_x \neq T_y$		Machine translation



# LSTM model



# Key elements of neural networks

- Fully connected (dense) layer
- Drop out
- Normalization
- Residual connection
- Attention mechanism