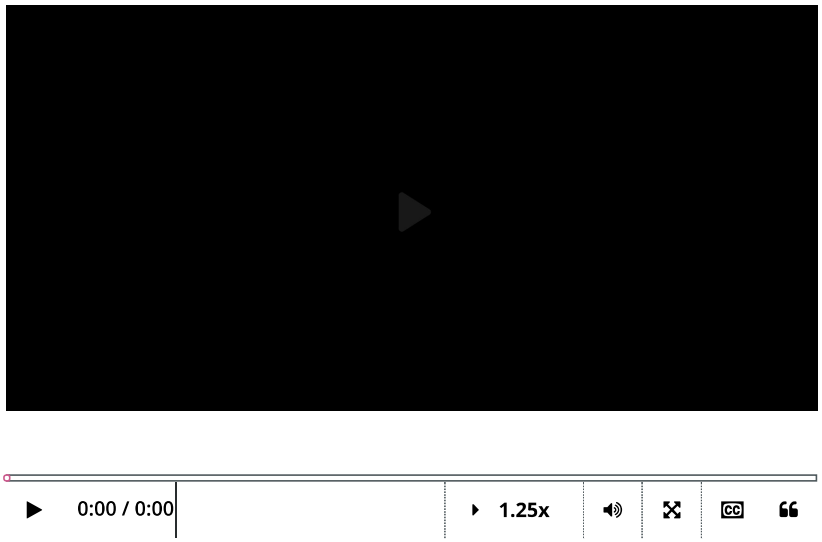
5. Gating and LSTM

Exercises due Oct 28, 2020 05:29 IST *Completed*

Gating and LSTM



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Gating

1/1 point (graded)
Recall that the most simple, single-layered RNN can be written in equation as:

$$s_t = \tanh\left(W^{s,s}s_{t-1} + W^{s,x}x_t\right).$$

Recognize that, in the above formulation, s_t is always overwritten with the calculated result $\tanh\left(W^{s,s}s_{t-1} + W^{s,x}x_t\right)$.

Now, we introduce a gate vector g_t of the same dimension as s_t, which determines "how much information to overwrite in the next state." In equation, a single-layered gated RNN can be written as:

$$\begin{aligned} g_t &= \text{sigmoid}\left(W^{g,s}s_{t-1} + W^{g,x}x_t\right) \\ s_t &= (1-g_t) \odot s_{t-1} + g_t \odot \tanh\left(W^{s,s}s_{t-1} + W^{s,x}x_t\right). \end{aligned}$$

where the sign $\odot$ denotes element-wise multiplication. Now, which of the following is true about the gate g_t? (Choose all those apply.)

- [ ] If the ith element of g_t is 1, the ith element of s_t and that of s_{t-1} are equal
- [x] If the ith element of g_t is 0, the ith element of s_t and that of s_{t-1} are equal
- [ ] If g_t is a vector whose elements are all 1, s_t and s_{t-1} are equal
- [x] If g_t is a vector whose elements are all 0, s_t and s_{t-1} are equal

✔

Solution:

Let the ith element of s_t, g_t, s_{t-1} be s_t^i, g_t^i, s_{t-1}^i.

If the ith element of g_t is 0, $(1 - g_t^i) = 1$, so

$$s_t^i = s_{t-1}^i.$$

Thus, if the ith element of g_t is 0, the ith element of s_t and that of s_{t-1} are equal. Also, if g_t is a vector whose elements are all 0, s_t and s_{t-1} are equal.

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Answers are displayed within the problem

LSTM

1/1 point (graded)

Which of the following components of an LSTM represent the context or state? (Choose all that apply.)

- [x] c_t
- [x] h_t
- [ ] o_t
- [ ] i_t

Solution:

c_t represents the memory cell, and h_t represents the visible state. Together they make up the context or state. The other two choices are the output and input gate, respectively. They simply accomodate new inputs and output predictions, and are not part of the context/state

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LSTM Calculations

1/1 point (graded)

Let all the neural network's weight matrices, the hidden state, and the memory cell be a scalar 1. Let the new x-value be 5. Calculate the value of the new hidden state. Round sigmoid to 1 or 0, and round $\tanh$ to -1 or 1.

$$f_t = \text{sigmoid}(W^{f,h} h_{t-1} + W^{f,x} x_t) \quad \text{forget gate}$$
$$i_t = \text{sigmoid}(W^{i,h} h_{t-1} + W^{i,x} x_t) \quad \text{input gate}$$
$$o_t = \text{sigmoid}(W^{o,h} h_{t-1} + W^{o,x} x_t) \quad \text{output gate}$$
$$c_t = f_t \odot c_{t-1} + i_t \odot \tanh(W^{c,h} h_{t-1} + W^{c,x} x_t) \quad \text{memory cell}$$
$$h_t = o_t \odot \tanh(c_t) \quad \text{visible state}$$

-1

1

0

5

Solution:

The forget gate is equal to sigmoid(6), or 1. The same applies for the input and output gate. The memory cell is equal to 1+ tanh(1+5), which is 2. The new hidden state is therefore tanh(2), or 1.

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Discussion

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Topic: Unit 3 Neural networks (2.5 weeks):Lecture 10. Recurrent Neural Networks 1 / 5. Gating and LSTM

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Understanding LSTM Networks (link) 2
Resources to complement the actual lecture. Hope it helps http://colah.github.io/posts/2015-08-Understanding-LSTMs/ https://www.you...
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Why tanh(1+6) in the solution? 6
I've got problem with understanding the solution in this part: why is there tanh(1+6) and not again tanh(1+5)?

Hidden state? 7
The last exercise refers to "hidden state" but does not explain what quantity this term is referring to. From context, this seems to be h t...

HELP what is sigmoid(6) 3
How do you compute this sigmoid funcion. For example sigmoid(2)? thank you

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