

Recurrent Neural Networks

Quiz, 10 questions

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1.

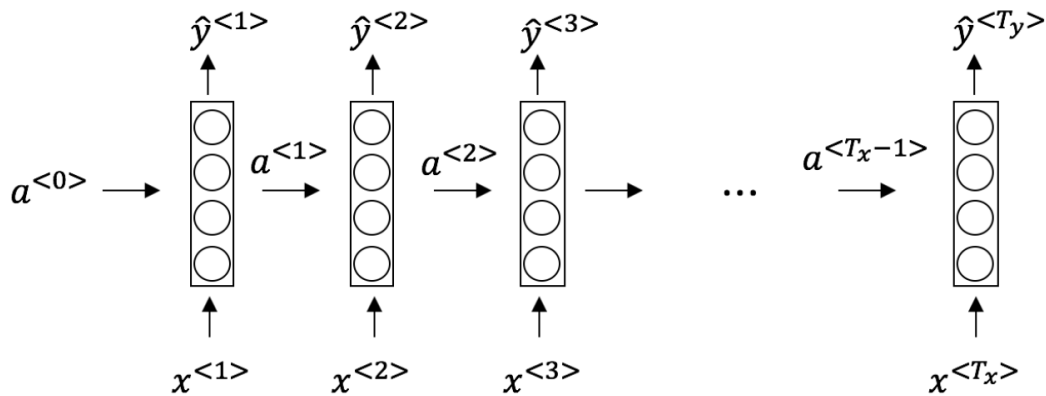
Suppose your training examples are sentences (sequences of words). Which of the following refers to the j^{th} word in the i^{th} training example?

- ☒ $x^{(i)<j>}$
 - ☐ $x^{<i>(j)}$
 - ☐ $x^{(j)<i>}$
 - ☐ $x^{<j>(i)}$
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2.

Consider this RNN:



This specific type of architecture is appropriate when:

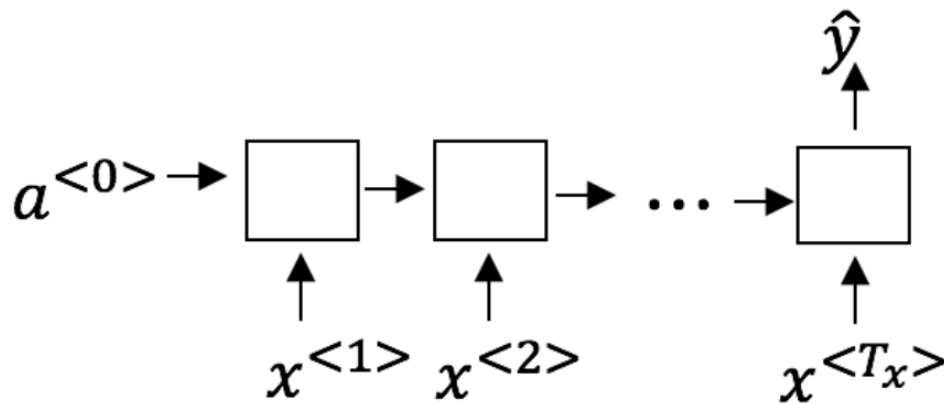
- ☒ $T_x = T_y$
 - ☐ $T_x < T_y$
 - ☐ $T_x > T_y$
 - ☐ $T_x = 1$
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3.

To which of these tasks would you apply a many-to-one RNN architecture? (Check all that apply).

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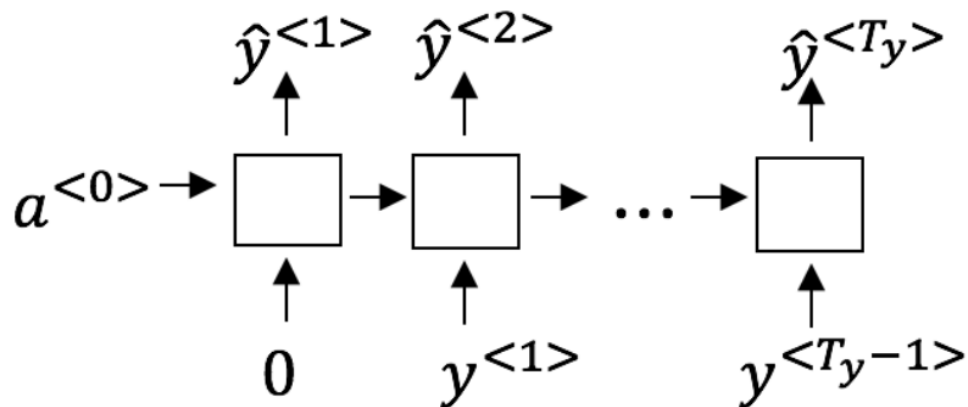


- ☐ Speech recognition (input an audio clip and output a transcript)
- ☒ Sentiment classification (input a piece of text and output a 0/1 to denote positive or negative sentiment)
- ☐ Image classification (input an image and output a label)
- ☒ Gender recognition from speech (input an audio clip and output a label indicating the speaker's gender)

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4.

You are training this RNN language model.



At the t^{th} time step, what is the RNN doing? Choose the best answer.



Estimating $P(y^{<1>}, y^{<2>}, \dots, y^{<t-1>})$

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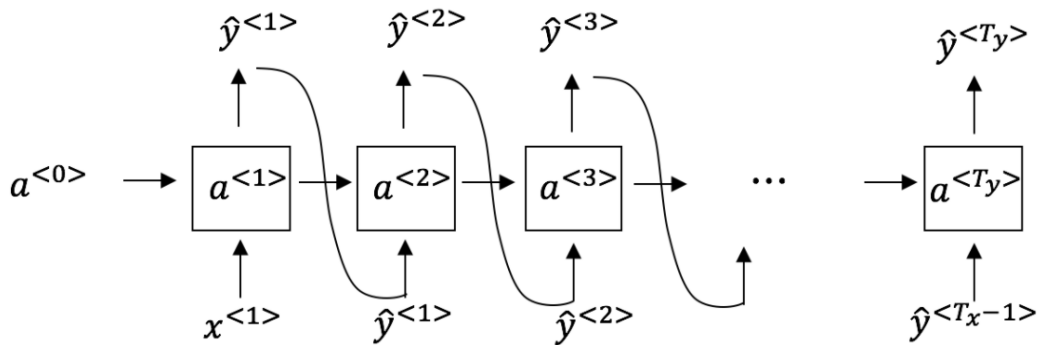
☒ Estimating $P(y^{<t>} | y^{<1>}, y^{<2>}, \dots, y^{<t-1>})$

☐ Estimating $P(y^{<t>} | y^{<1>}, y^{<2>}, \dots, y^{<t>})$

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5.

You have finished training a language model RNN and are using it to sample random sentences, as follows:



What are you doing at each time step t ?

- ☐ (i) Use the probabilities output by the RNN to pick the highest probability word for that time-step as $\hat{y}^{<t>}$. (ii) Then pass the ground-truth word from the training set to the next time-step.
- ☐ (i) Use the probabilities output by the RNN to randomly sample a chosen word for that time-step as $\hat{y}^{<t>}$. (ii) Then pass the ground-truth word from the training set to the next time-step.
- ☐ (i) Use the probabilities output by the RNN to pick the highest probability word for that time-step as $\hat{y}^{<t>}$. (ii) Then pass this selected word to the next time-step.
- ☒ (i) Use the probabilities output by the RNN to randomly sample a chosen word for that time-step as $\hat{y}^{<t>}$. (ii) Then pass this selected word to the next time-step.

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6.

You are training an RNN, and find that your weights and activations are all taking on the value of NaN ("Not a Number"). Which of these is the most likely cause of this problem?

- ☐ Vanishing gradient problem.
- ☒ Exploding gradient problem.
- ☐ ReLU activation function $g(\cdot)$ used to compute $g(z)$, where z is too large.
- ☐ Sigmoid activation function $g(\cdot)$ used to compute $g(z)$, where z is too large.

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7.

Suppose you are training a LSTM. You have a 10000 word vocabulary, and are using an LSTM with 100-dimensional activations $\mathbf{a}^{<t>}$. What is the dimension of $\mathbf{\Gamma}_u$ at each time step?

- ☐ 1
- ☒ 100
- ☐ 300
- ☐ 10000

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8.

Here're the update equations for the GRU.

GRU

$$\tilde{c}^{<t>} = \tanh(W_c[\mathbf{\Gamma}_r * c^{<t-1>}, x^{<t>}] + b_c)$$

$$\mathbf{\Gamma}_u = \sigma(W_u[c^{<t-1>}, x^{<t>}] + b_u)$$

$$\mathbf{\Gamma}_r = \sigma(W_r[c^{<t-1>}, x^{<t>}] + b_r)$$

$$c^{<t>} = \mathbf{\Gamma}_u * \tilde{c}^{<t>} + (1 - \mathbf{\Gamma}_u) * c^{<t-1>}$$

$$\mathbf{a}^{<t>} = c^{<t>}$$

Alice proposes to simplify the GRU by always removing the $\mathbf{\Gamma}_u$. I.e., setting $\mathbf{\Gamma}_u = 1$. Betty proposes to simplify the GRU by removing the $\mathbf{\Gamma}_r$. I. e., setting $\mathbf{\Gamma}_r = 1$ always. Which of these models is more likely to work without vanishing gradient problems even when trained on very long input sequences?

- ☐ Alice's model (removing $\mathbf{\Gamma}_u$), because if $\mathbf{\Gamma}_r \approx 0$ for a timestep, the gradient can propagate back through that timestep without much decay.
- ☒ Alice's model (removing $\mathbf{\Gamma}_u$), because if $\mathbf{\Gamma}_r \approx 1$ for a timestep, the gradient can propagate back through that timestep without much decay.
- ☐ Betty's model (removing $\mathbf{\Gamma}_r$), because if $\mathbf{\Gamma}_u \approx 0$ for a timestep, the gradient can propagate back through that timestep without much decay.
- ☐ Betty's model (removing $\mathbf{\Gamma}_r$), because if $\mathbf{\Gamma}_u \approx 1$ for a timestep, the gradient can propagate back through that timestep without much decay.



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Here are the equations for the GRU and the LSTM:

GRU

$$\tilde{c}^{<t>} = \tanh(W_c[\Gamma_r * c^{<t-1>}, x^{<t>}] + b_c)$$

$$\Gamma_u = \sigma(W_u[c^{<t-1>}, x^{<t>}] + b_u)$$

$$\Gamma_r = \sigma(W_r[c^{<t-1>}, x^{<t>}] + b_r)$$

$$c^{<t>} = \Gamma_u * \tilde{c}^{<t>} + (1 - \Gamma_u) * c^{<t-1>}$$

$$a^{<t>} = c^{<t>}$$

LSTM

$$\tilde{c}^{<t>} = \tanh(W_c[a^{<t-1>}, x^{<t>}] + b_c)$$

$$\Gamma_u = \sigma(W_u[a^{<t-1>}, x^{<t>}] + b_u)$$

$$\Gamma_f = \sigma(W_f[a^{<t-1>}, x^{<t>}] + b_f)$$

$$\Gamma_o = \sigma(W_o[a^{<t-1>}, x^{<t>}] + b_o)$$

$$c^{<t>} = \Gamma_u * \tilde{c}^{<t>} + \Gamma_f * c^{<t-1>}$$

$$a^{<t>} = \Gamma_o * c^{<t>}$$

From these, we can see that the Update Gate and Forget Gate in the LSTM play a role similar to _____ and _____ in the GRU. What should go in the the blanks?

- ☒ Γ_u and $1 - \Gamma_u$
- ☐ Γ_u and Γ_r
- ☐ $1 - \Gamma_u$ and Γ_u
- ☐ Γ_r and Γ_u

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10.

You have a pet dog whose mood is heavily dependent on the current and past few days' weather. You've collected data for the past 365 days on the weather, which you represent as a sequence as $x^{<1>}, \dots, x^{<365>}$. You've also collected data on your dog's mood, which you represent as $y^{<1>}, \dots, y^{<365>}$. You'd like to build a model to map from $x \rightarrow y$. Should you use a Unidirectional RNN or Bidirectional RNN for this problem?

- ☐ Bidirectional RNN, because this allows the prediction of mood on day t to take into account more information.
- ☐ Bidirectional RNN, because this allows backpropagation to compute more accurate gradients.
- ☒ Unidirectional RNN, because the value of $y^{<t>}$ depends only on $x^{<1>}, \dots, x^{<t>}$, but not on $x^{<t+1>}, \dots, x^{<365>}$
- ☐ Unidirectional RNN, because the value of $y^{<t>}$ depends only on $x^{<t>}$, and not other days' weather.

