

# Recurrent Neural Networks

Quiz, 10 questions

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1.

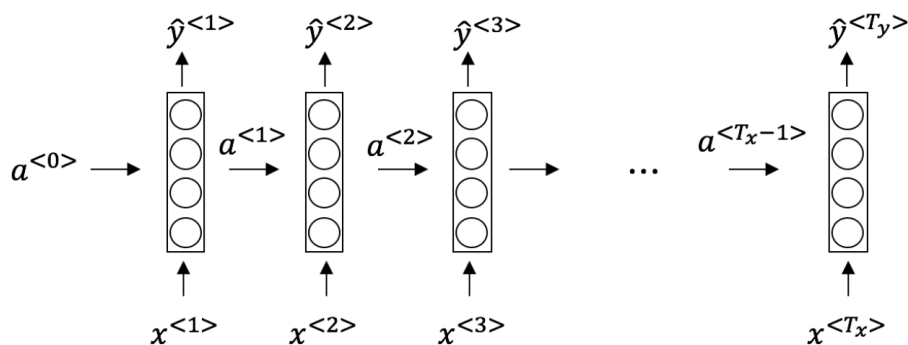
Suppose your training examples are sentences (sequences of words). Which of the following refers to the  $j^{th}$  word in the  $i^{th}$  training example?

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

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2.

Consider this RNN:



This specific type of architecture is appropriate when:

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

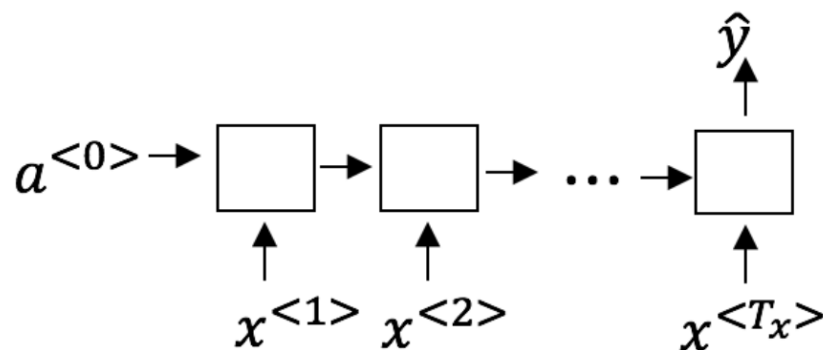
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3.

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



- ☐ 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)

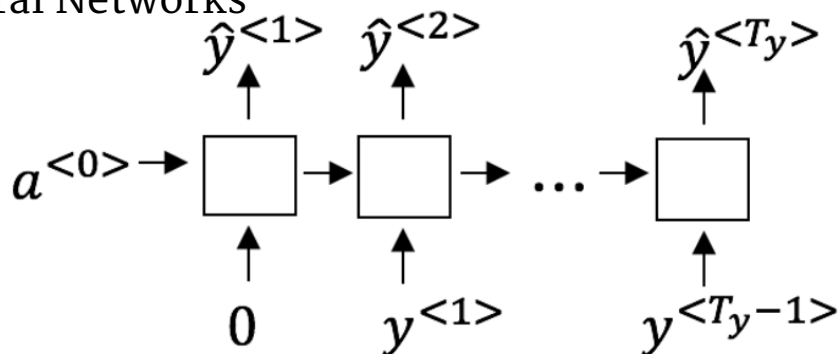
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4.

You are training this RNN language model.

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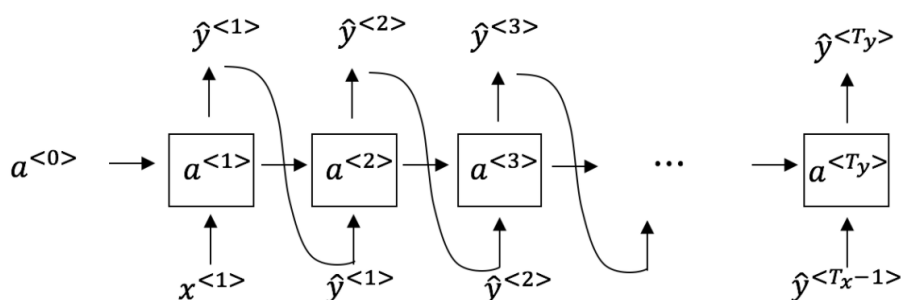
At the  $t^{th}$  time step, what is the RNN doing? Choose the best answer.

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

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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.
- ☐

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- ☐ (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  $a^{<t>}$ . What is the dimension of  $\Gamma_u$  at each time step?

- ☐ 1
- ☒ 100
- ☐ 300
- ☐ 10000

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8.

Here're the update equations for the GRU.

## GRU

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

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

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

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

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

Alice proposes to simplify the GRU by always removing the  $\Gamma_u$ . I.e., setting  $\Gamma_u = 1$ . Betty proposes to simplify the GRU by removing the  $\Gamma_r$ . I.e., setting  $\Gamma_r = 1$  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  $\Gamma_u$ ), because if  $\Gamma_r \approx 0$  for a timestep, the gradient can propagate back through that timestep without much decay.
- ☐ Alice's model (removing  $\Gamma_u$ ), because if  $\Gamma_r \approx 1$  for a timestep, the gradient can propagate back through that timestep without much decay.
- ☒ Betty's model (removing  $\Gamma_r$ ), because if  $\Gamma_u \approx 0$  for a timestep, the gradient can propagate back through that timestep without much decay.
- ☐ Betty's model (removing  $\Gamma_r$ ), because if  $\Gamma_u \approx 1$  for a timestep, the gradient can propagate back through that timestep without much decay.

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9.

Here are the equations for the GRU and the LSTM:

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

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

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

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

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

## 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?

- ☒  $\Gamma_u$  and  $1 - \Gamma_u$
- ☐  $\Gamma_u$  and  $\Gamma_r$
- ☐  $1 - \Gamma_u$  and  $\Gamma_u$
- ☐  $\Gamma_r$  and  $\Gamma_u$

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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.

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