RNN and Backpropagation

Quiz, 4 questions

Congratulations! You passed!

Next Item

1 / 1 point

1.
Consider a task with input sequences of fixed length. Could RNN architecture still be useful for such task?

- [x] Yes

Correct
RNN could be useful since it may need much less number of parameters.

- [ ] No

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1 / 1 point

2.
Consider an RNN for a language generation task. $\hat{y}_t$ is an output of this RNN at each time step, L is a length of the input sequence, N is a number of words in the vocabulary. Choose correct statements about $\hat{y}_t$:

- [x] $\hat{y}_t$ is a vector of length N.

Correct
The output at each time step is a distribution over a vocabulary, therefore the length of $\hat{y}_t$ is equal to the vocabulary size.

- [ ] $\hat{y}_t$ is a vector of length $(L-t)$.

Un-selected is correct

- [ ] $\hat{y}_t$ is a vector of length $L \times N$.

Un-selected is correct

- [ ] Each element of $\hat{y}_t$ is either 0 or 1.

Un-selected is correct

- [x] Each element of $\hat{y}_t$ is a number from 0 to 1.

Correct
Elements of $\hat{y}_t$ are probabilities so they are numbers from 0 to 1 and the sum of them equal to 1.

- [ ] Each element of $\hat{y}_t$ is a number from 0 to N.

Un-selected is correct

1 / 1 point

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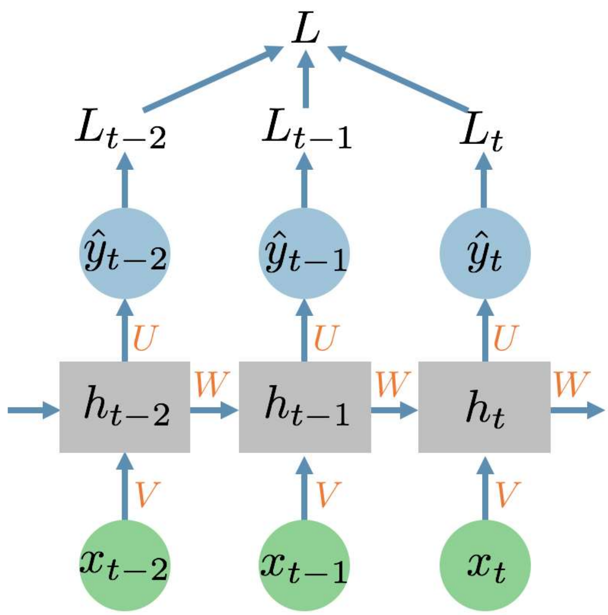
3.

Consider the RNN from the lecture:

$h_t = f_t(Vx_t + Wh_{t-1} + b_h)$

$\hat{y}_t = f_y(Uh_t + b_y)$



Calculate the gradient of the loss L with respect to the bias vector b_y. $\frac{\partial L}{\partial b_y} = ?$

- $\frac{\partial L}{\partial b_y} = \frac{\partial L}{\partial \hat{y}_t}\frac{\partial \hat{y}_t}{\partial b_y}$
- $\frac{\partial L}{\partial b_y} = \sum_{t=0}^{T}\left[\frac{\partial L_t}{\partial \hat{y}_t}\frac{\partial \hat{y}_t}{\partial b_y}\right]$

Correct
It is correct since b_y influence each L_t only once trough $\hat{y}_t$.

- $\frac{\partial L}{\partial b_y} = \sum_{t=0}^{T}\left[\frac{\partial L_t}{\partial \hat{y}_t}\frac{\partial \hat{y}_t}{\partial h_t}\frac{\partial h_t}{\partial b_y}\right]$
- $\frac{\partial L}{\partial b_y} = \sum_{t=0}^{T}\left[\frac{\partial L_t}{\partial \hat{y}_t}\frac{\partial \hat{y}_t}{\partial h_t}\sum_{k=0}^{t}\frac{\partial h_k}{\partial b_y}\right]$
- $\frac{\partial L}{\partial b_y} = \sum_{t=0}^{T}\left[\frac{\partial L_t}{\partial \hat{y}_t}\frac{\partial \hat{y}_t}{\partial h_t}\sum_{k=0}^{t}\left(\prod_{i=k+1}^{t}\frac{\partial h_i}{\partial h_{i-1}}\right)\frac{\partial h_k}{\partial b_y}\right]$

1 / 1 point

4.

Consider the RNN network from the previous question. Calculate the gradient of the loss L with respect to the bias vector b_h. $\frac{\partial L}{\partial b_h} = ?$

- $\frac{\partial L}{\partial b_h} = \frac{\partial L_t}{\partial \hat{y}_t}\frac{\partial \hat{y}_t}{\partial h_t}\frac{\partial h_t}{\partial b_h}$
- $\frac{\partial L}{\partial b_h} = \sum_{t=0}^{T}\left[\frac{\partial L_t}{\partial \hat{y}_t}\frac{\partial \hat{y}_t}{\partial h_t}\frac{\partial h_t}{\partial b_h}\right]$

$$\frac{\partial L}{\partial b_h} = \sum_{t=0}^{T} \left[\frac{\partial L_t}{\partial \hat{y}_t} \frac{\partial \hat{y}_t}{\partial h_t} \sum_{k=0}^{t} \frac{\partial h_k}{\partial b_h} \right]$$

$$\frac{\partial L}{\partial b_h} = \sum_{t=0}^{T} \left[\frac{\partial L_t}{\partial \hat{y}_t} \frac{\partial \hat{y}_t}{\partial h_t} \sum_{k=0}^{t} \left(\prod_{i=k+1}^{t} \frac{\partial h_i}{\partial h_{i-1}} \right) \frac{\partial h_k}{\partial b_h} \right]$$

Correct

It is correct. Hidden units depend on b_h at each time step, therefore we need to backpropagate through time here.