Quiz 3: Coursework

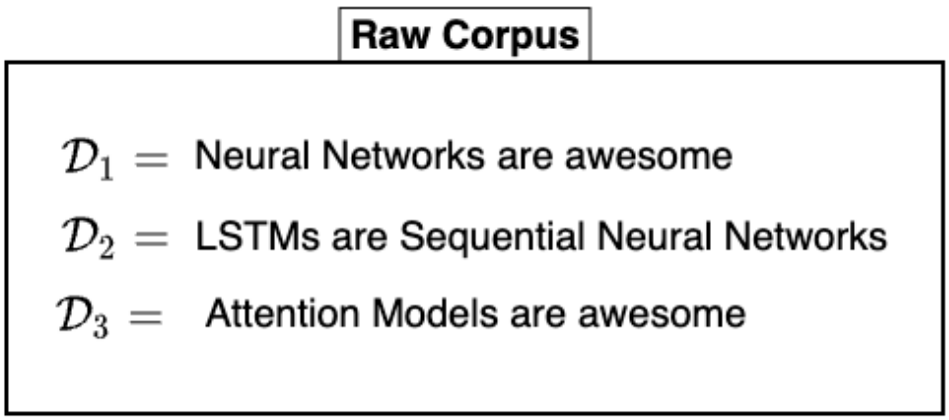
The Training Process

*Required

1. Please enter your name: *

The dataset

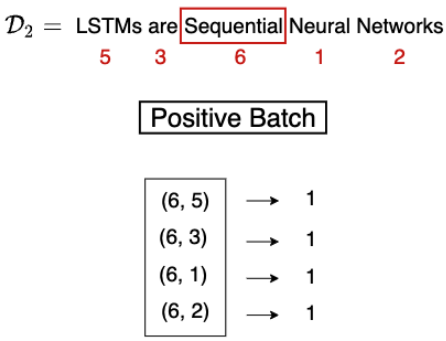
Let us consider the following corpus

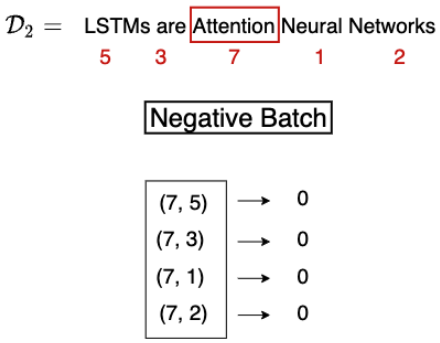


The word2idx dictionary associated with the Raw Corpus is the following dictionary:

```
Word2idx = {   Neural     : 1,
             Networks     : 2,
                  are     : 3,
              awesome     : 4,
                LSTMs     : 5,
           Sequential     : 6,
            Attention     : 7,
               Models     : 8  }
```

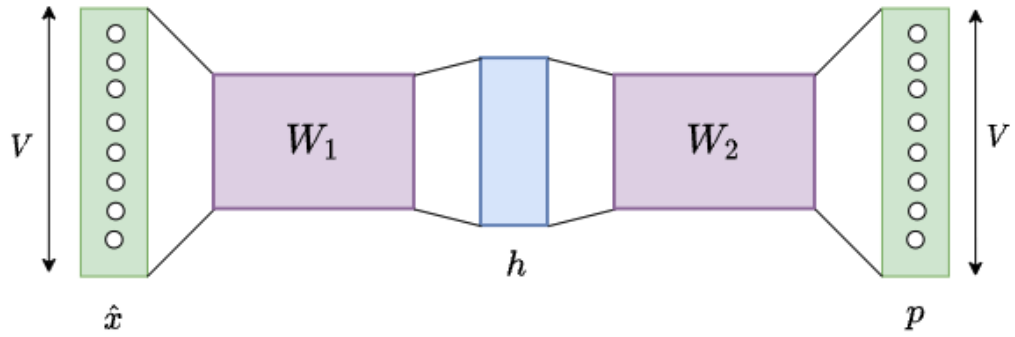
We consider the positive batch and the negative batch discussed in the previous quiz





The Forward Propagation

The following figure represents the Forward propagation. The objective is to predict the context words from the center word. We have the following hyperparameters: V=8, D=3



2. x_hat in the previous figure represents: 0 points

Mark only one oval.

- The one vector associated with an index x in {1, ..., V} representing a center word
- The one vector associated with an index x in {1, ..., V} representing a context word

The equations involved in the Forward propagation are summarized as follows:

A first linear transformation maps $\hat{x}$ to the D-dimensional vector h as follows:

$$h = W_1^T \hat{x}$$

A second transformation maps the hidden vector h to the V-dimensional vector $p = (p_1, \ldots, p_V)$ as follows:

$$p = \sigma\left(W_2^T h\right) \quad \text{where } \sigma \text{ is the sigmoid activation function.}$$

3. Which classification problem are we dealing with ? 1 point

Mark only one oval.

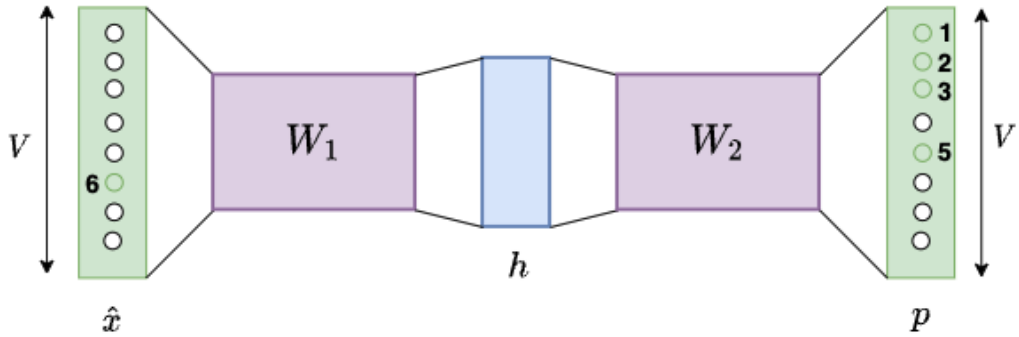
- A single binary classification problem
- A multiclass classification problem
- Several binary classification problems

4. Let us consider o in {1, ..., V}. What is the interpretation of p_o (the o-th dimension of the output vector p) ? 1 point

Mark only one oval.

- The probability that the word of index o is in the context of the center word x
- The probability that the couple (x, o) is a fake couple.

Let us consider the positive batch. From the true center word 6 we compute p_1, p_2, p_3 and p_5.



5. What is p_5 ? 1 point

Mark only one oval.

- The probability that the word "Neural" is in the context of "Sequential" ?
- The probability that the word "LSTMs" is in the context of "Sequential" ?
- The probability that the word "Sequential" is in the context of "Neural" ?

6. What is the loss function associated with a binary classification problem ? 1 point

Mark only one oval.

- The categorical cross entropy
- The binary cross entropy

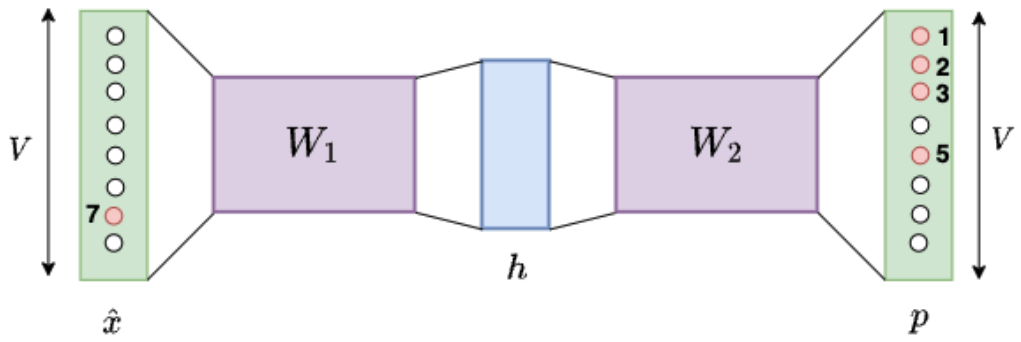
7. Here is the loss function associated with the positive batch. What are the elements of W_1 and W_2 which are involved in this expression ? 1 point

$$J_+ = -\frac{1}{4} \sum_{k \in \{1,2,3,5\}} \log(\sigma(W_1[6]^T W_2[k]))$$

Mark only one oval.

- The 6-th row of W_1 and the columns 1, 2, 3 and 5 of W_2
- The 6-th column of W_1 and the rows 1, 2, 3 and 5 of W_2
- All the rows and columns of W_1 and W_2

Let us consider the negative batch. From the fake center word 7 we compute p_1, p_2, p_3 and p_5.



8. What is p_5 ? 1 point

Mark only one oval.

- The probability that the word "Neural" is in the context of "Attention" ?
- The probability that the word "LSTMs" is in the context of "Sequential" ?
- The probability that the word "LSTMs" is in the context of "Attention" ?

9. Here is the loss function associated with the negative batch. What are the elements of W_1 and W_2 which are involved in this expression ? 1 point

$$J_- = -\frac{1}{4} \sum_{k \in \{1,2,3,5\}} \log(1 - \sigma(W_1[7]^T W_2[k]))$$

Mark only one oval.

- The row 7 of the matrix W_1 and the columns 1, 2, 3, 5 of the matrix W_2
- The column 7 of the matrix W_1 and the rows 1, 2, 3, 5 of the matrix W_2
- All the rows and columns in W_1, W_2

The Backward Propagation For the positive batch

We have the following expressions of the gradients:

$$\nabla_{W_1[6]} \left(\log(\sigma(W_1[6]^T W_2[k])\right) = \left(1 - \sigma(W_1[6]^T W_2[k])\right) W_2[k]$$
$$\nabla_{W_2[k]} \left(\log(\sigma(W_1[6]^T W_2[k])\right) = \left(1 - \sigma(W_1[6]^T W_2[k])\right) W_1[6] \quad k \in \{1,2,3,5\}$$

10. Which expression of the gradient is correct ? 1 point

(a) $\nabla_{W_1[6]} J_+ = \frac{1}{4} \sum_{k \in \{1,2,3,5\}} \left(\sigma(W_1[6]^T W_2[k]) - 1\right) W_2[k]$

(b) $\nabla_{W_1[6]} J_+ = -\frac{1}{4} \sum_{k \in \{1,2,3,5\}} \left(\sigma(W_1[6]^T W_2[k]) - 1\right) W_2[k]$

(c) $\nabla_{W_1[6]} J_+ = \sum_{k \in \{1,2,3,5\}} \left(\sigma(W_1[6]^T W_2[k]) - 1\right) W_2[k]$

Mark only one oval.

- (a)
- (b)
- (c)

11. We have the following update equations associated with the positive batch. What is the number of parameters updated ? 1 point

$$W_1[6] \leftarrow W_1[6] - \eta \nabla_{W_1[6]} J_+$$
$$W_2[k] \leftarrow W_2[k] - \eta \nabla_{W_2[k]} J_+ \quad k \in \{1, 2, 3, 5\}$$

Mark only one oval.

- 5*D
- 4*D
- 2*V*D

The Backward Propagation For the negative batch

We have the following expressions of the gradients:

$$\nabla_{W_1[7]} \left(\log(1-\sigma(W_1[7]^T W_2[k])\right) = -\sigma\left(W_1[7]^T W_2[k]\right) W_2[k]$$

$$\nabla_{W_2[k]} \left(\log(1-\sigma(W_1[7]^T W_2[k])\right) = -\sigma\left(W_1[7]^T W_2[k]\right) W_1[7] \quad k \in \{1,2,3,5\}$$

12. Which expression of the gradient is correct ? 1 point

(a) $\nabla_{W_2[k]} J_- = \frac{1}{4} \sum_{k\in\{1,2,3,5\}} \left(\sigma(W_1[7]^T W_2[k]) - 1\right) W_1[7]$

(b) $\nabla_{W_2[k]} J_- = \frac{1}{4} \left(\sigma(W_1[7]^T W_2[k]) - 1\right) W_1[7]$

(c) $\nabla_{W_2[k]} J_- = \frac{1}{4} \left(\sigma(W_1[7]^T W_2[k])\right) W_1[7]$

Mark only one oval.

- (a)
- (b)
- (c)

13. Any question ?