## Question

We will be looking into calculating the forward pass and deriving the equations for the backward pass of an RNN. The diagram is supplied at the end of the equation. This is a character level RNN which predicts the length of sequence one character at a time. Till time step t-1 it has calculated the length of sequence ‘h-e-l-l’. The next character predicted will be calculated by us for time step t. Answer questions part a-d.

1. **Calculate the output represented by vector O.**

W3 \* softmax ( I\*W1 + ht-1\*W2) = O

O = ?

Hint: Softmax can be calculated as:

A black text with a line between it

Description automatically generated with medium confidence

1. The given matrix represents the mapping of one-hot encoded representations of English letters to their respective characters. In this mapping:

[0 0 1 0] corresponds to 'h'

[0 1 0 0] corresponds to 'e'

[1 0 0 0] corresponds to 'l'

[0 0 0 1] corresponds to 'o'

**Now, considering argmax is used to approximate the one-hot encoding, which English letter does the vector [0 0 0 1] (corresponding to 'o') represent in this mapping?**

1. **Compute the loss using mean squared error (MSE) loss** (round upto two decimal places). Given that the gold prediction is:

Hint: A close-up of numbers

Description automatically generated

1. **Refer to the resource for deriving backpropagation in RNNs and read the resource** given here: [link](https://www.pycodemates.com/2023/08/backpropagation-through-time-explained-with-derivations.html).

Use the diagram below for reference.

A diagram of a machine

Description automatically generated

## Answer Key