Tuesday Feb 25, 2025

In-class Handout

COSC 410A Applied Machine Learning

Prof. Forrest Davis

Name:

Discuss and complete the following questions with the person nearest you. You **may** be asked to share your thoughts with the class.

For the first two questions consider the following network.

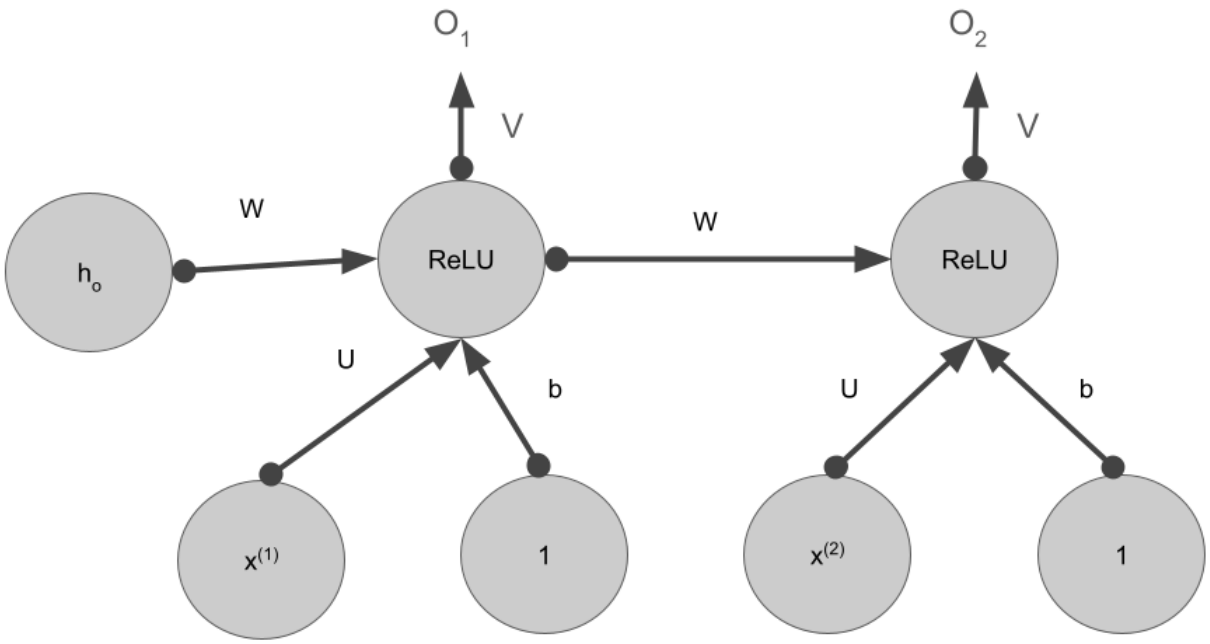

Figure 1: Small Graph

The original values of are:

- W is $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ U is $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$
- b is $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$ with the bias node a 1-dimensional vector [1]
- V is $\begin{bmatrix} 1 & 0 \end{bmatrix}$
- h_0 is $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$
- $x^{(1)}$ is $\begin{bmatrix} 2 \\ 3 \end{bmatrix}$ and $x^{(2)}$ is $\begin{bmatrix} 4 \\ 1 \end{bmatrix}$

1. What is the output (O_1 and O_2)? What does this network "do"? What do you expect the output to be if we continued with $[1, 6]$?

2. Modify W, U, and V so that the RNN does the same thing to the second input dimension. That is, O_1 should be 3 and O_2 should be 4.

3. Suppose we have a matrix

$$W = \begin{bmatrix} 0.1 & 0.2 \\ 0.2 & 0.1 \end{bmatrix}$$

Calculate WW.

4. What happens to the output as $n \to \infty$ for W^n

5. What if

$$W = \begin{bmatrix} 2 & 4 \\ 4 & 2 \end{bmatrix}$$

Tell me about the output as $n \to \infty$ for W^n

6. Relate these insights to RNNs