#NNs (Luis Serrano)

Example: perfect-room-mate who cooks simple dishes

dishes cooked: pie $\begin{bmatrix}1\\0\\0\end{bmatrix}$, burger $\begin{bmatrix}0\\1\\0\end{bmatrix}$, pizza $\begin{bmatrix}0\\0\\1\end{bmatrix}$

weather: sunny $\begin{bmatrix}1\\0\end{bmatrix}$ rainy $\begin{bmatrix}0\\1\end{bmatrix}$

(1) Simple feedforward NN

Rule to encode:

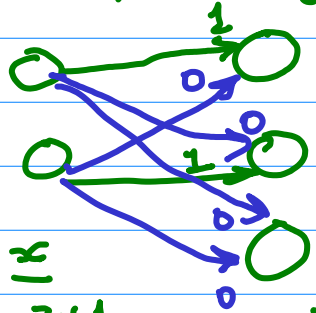
Weather { sunny $\begin{bmatrix}1\\0\end{bmatrix}$ → pie $\begin{bmatrix}1\\0\\0\end{bmatrix}$; rainy $\begin{bmatrix}0\\1\end{bmatrix}$ → burger $\begin{bmatrix}0\\1\\0\end{bmatrix}$

hard coded weights

$$\begin{bmatrix}1&0\\0&1\\0&0\end{bmatrix}\begin{bmatrix}1\\0\end{bmatrix}=\begin{bmatrix}1\\0\\0\end{bmatrix}$$

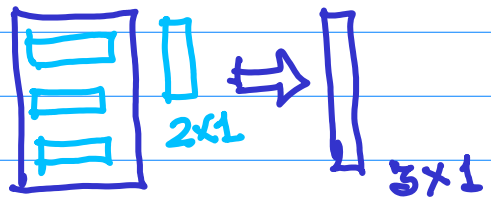
sunny → pie

simple 1-layer NN



$$\begin{bmatrix}1&0\\0&1\\0&0\end{bmatrix}\begin{bmatrix}0\\1\end{bmatrix}=\begin{bmatrix}0\\1\\0\end{bmatrix}$$

rainy → burger

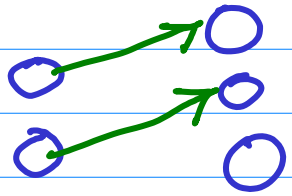


intuitive enough (2 food items ...)

$$z_j = \sum_{i=1}^{D=2} w_{ji}\, x_i + w_{j0}$$

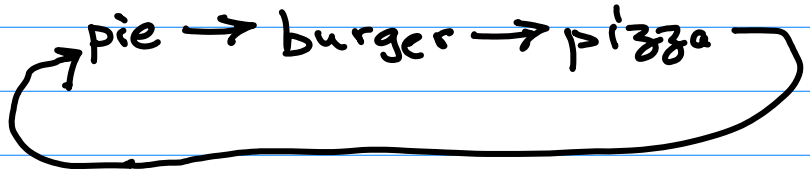
w_{j0}: bias = 0

representation for non-zero weight connections



Example 2: Simple RNN for a sequence, without an input

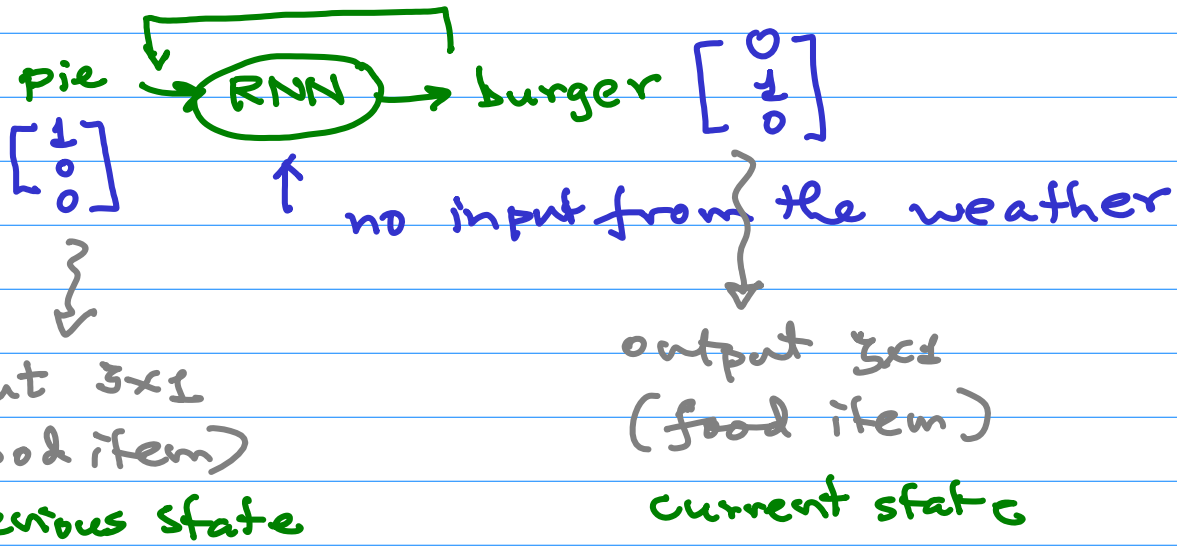
Suppose the room-mate cooks in sequence



Mon Tue Wed Thu Fri Sat Sun

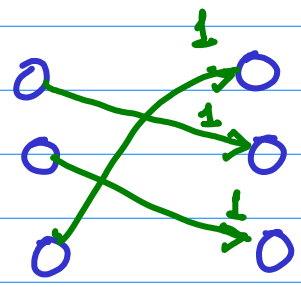
pie burger pizza pie burger pizza pie ....

→ this needs an RNN



$$\begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

pie burger



$$z_j = \sum_{i=1}^{D=3} w_{ji} x_i + w_{j0}$$

bias = 0

Example 3 : To encode an RNN with an input the weather

Given: Rule:

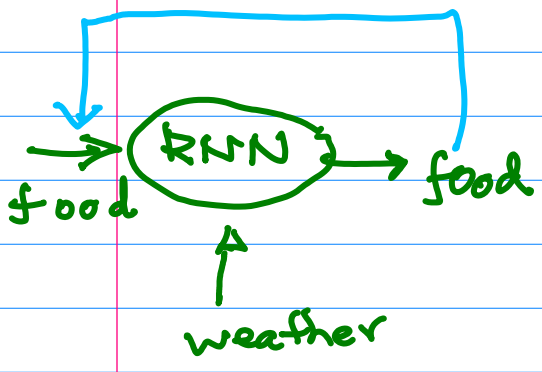
sunny $\begin{bmatrix}1\\0\end{bmatrix}$ → same food item as on the previous day

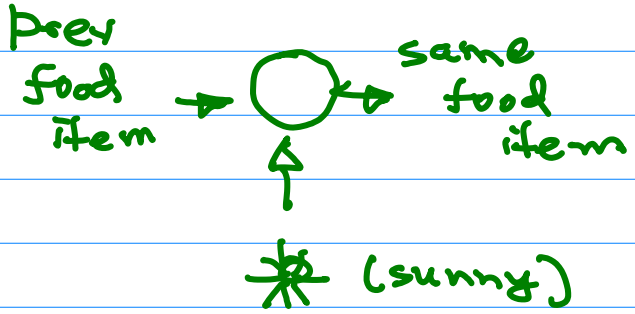
rainy $\begin{bmatrix}0\\1\end{bmatrix}$ → next item in sequence

apple → burger → pizza

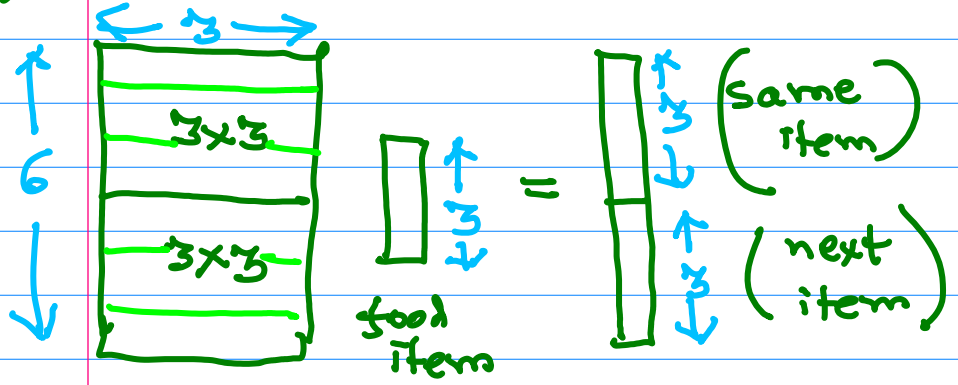
Mon Tue Wed Thu Fri Sat Sun

pie →





(1) Food matrix



(1) pie $\begin{bmatrix}1\\0\\0\end{bmatrix}$

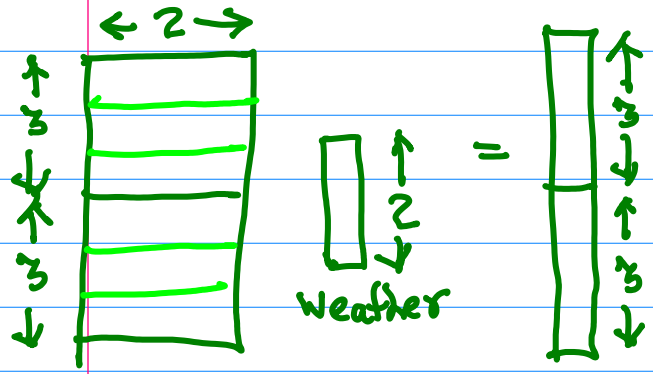
(2) burger $\begin{bmatrix}0\\1\\0\end{bmatrix}$

(3) pizza $\begin{bmatrix}0\\0\\1\end{bmatrix}$

Identity

$$\begin{bmatrix}1&0&0\\0&1&0\\0&0&1\\\hline 0&0&1\\1&0&0\\0&1&1\end{bmatrix}\underbrace{\begin{bmatrix}1\\0\\0\end{bmatrix}}_{\text{pie}}=\begin{array}{c}\text{pie}\\ \begin{bmatrix}1\\0\\0\\\hline 0\\1\\0\end{bmatrix}\\ \text{burger}\end{array}\begin{array}{l}\text{(same item)}\\ \\ \text{(next item)}\end{array}$$

(2) Weather matrix



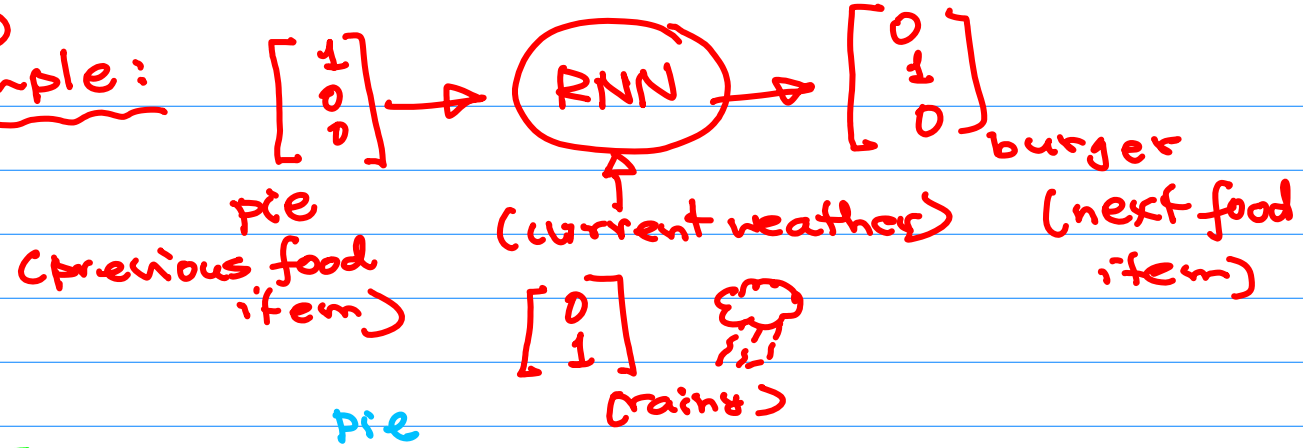
'yes'/'no' to the same item

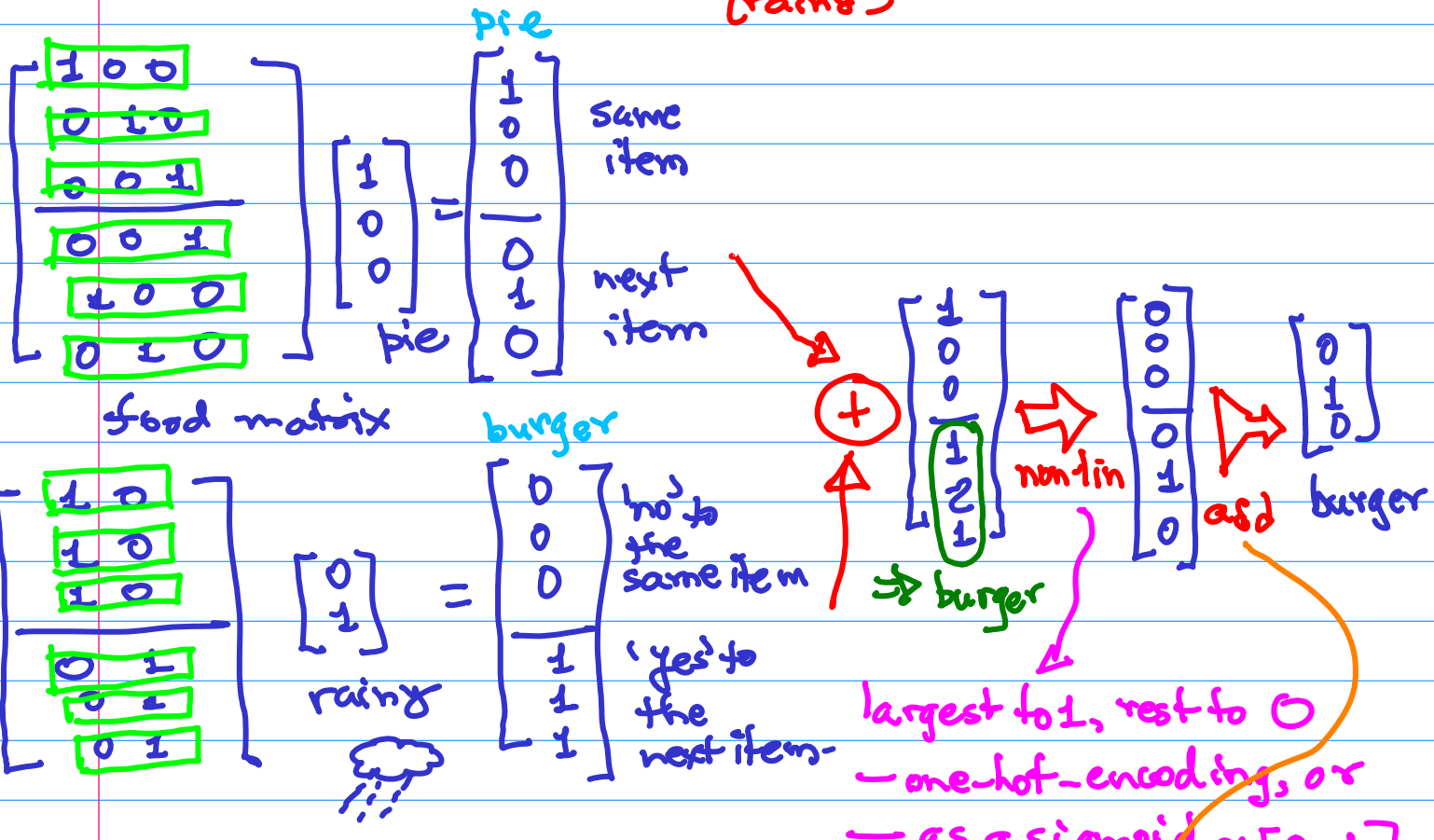
'no'/'yes' to the next item.

(1) sunny

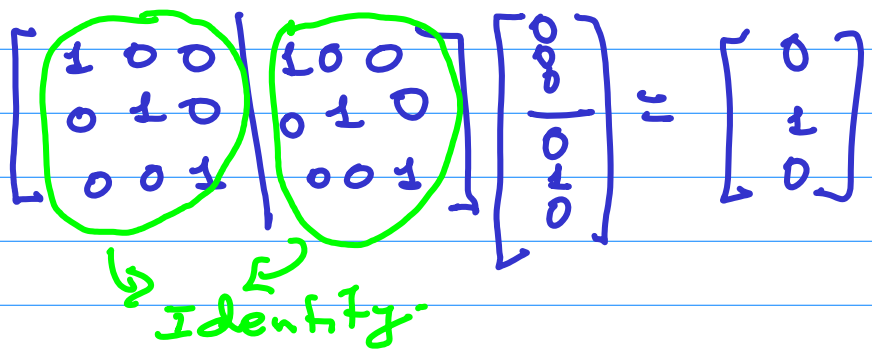
$$\begin{bmatrix}1&0\\1&0\\1&0\\\hline 0&1\\0&1\\0&1\end{bmatrix}\underbrace{\begin{bmatrix}1\\0\end{bmatrix}}_{\text{(sunny)}}=\begin{bmatrix}1\\1\\1\\\hline 0\\0\\0\end{bmatrix}\begin{array}{l}\rightarrow \text{'yes' to the same item}\\ \\ \rightarrow \text{'no' to the next item}\end{array}$$

(3)
Example:

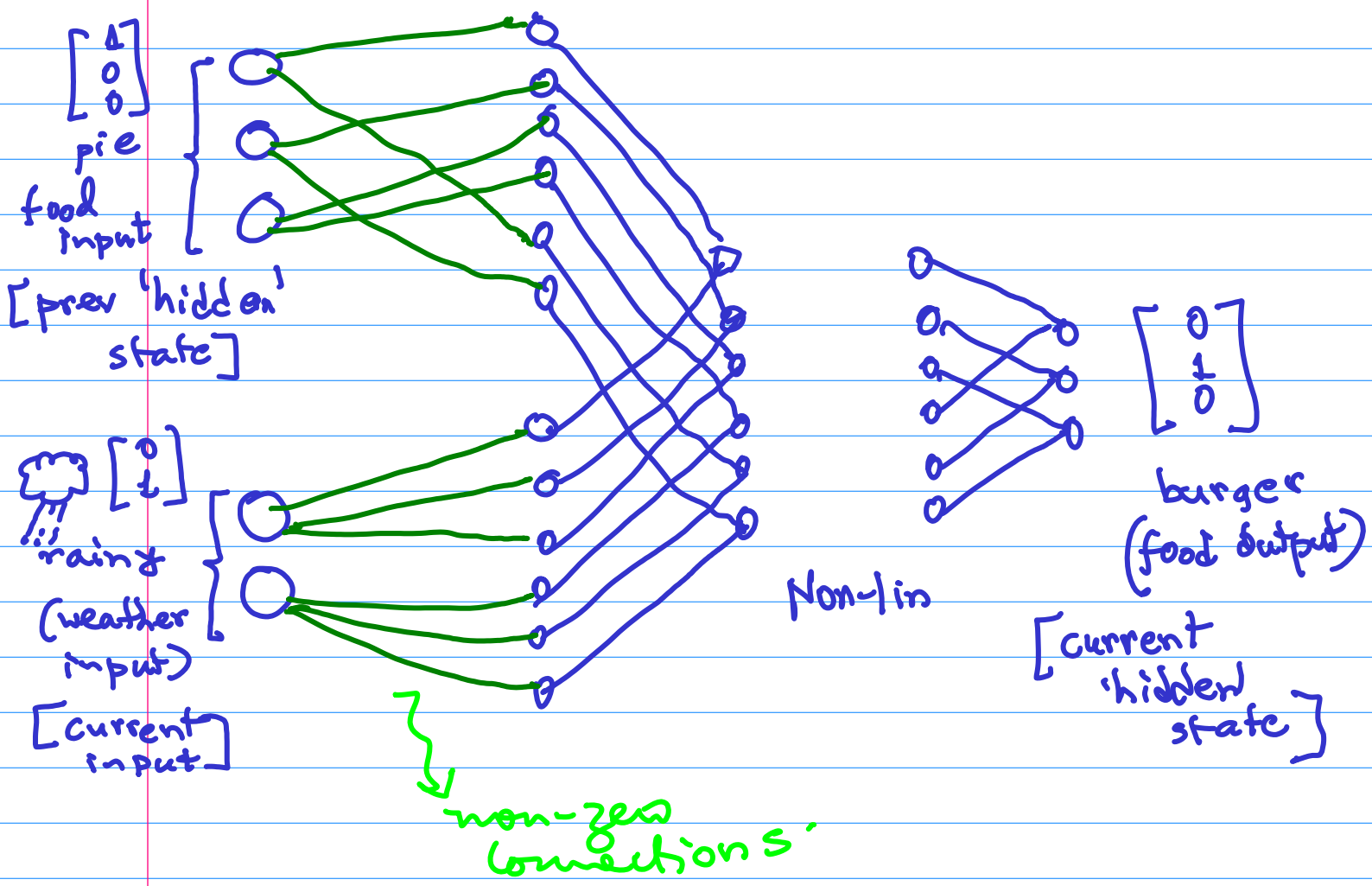




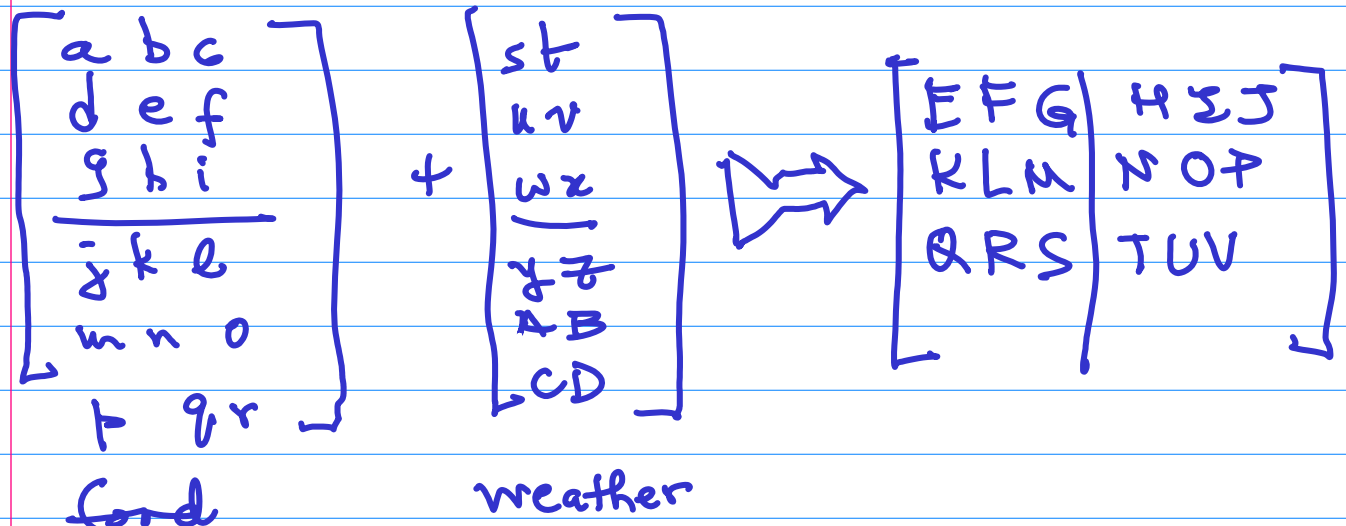
addition can also be represented as a matrix operation



Neural Network :-



How to train your ~~DRAGON~~ NEUR



Applications:

- stock predictions
- Auto correct for letters/words
- voice recognition