

Exercise: RNN

ca) Q (i) $h_1?$, $t=1$ (ii) $y_1?$ $t=1$ (iii) $y_2?$ $t=2$

h_0 W_{hh} W_{xh} W_{hy} $x_1 = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$ $x_2 = \begin{bmatrix} 1 \\ 6 \end{bmatrix}$
 Formula $h_t = \tanh(W_{hh} h_{t-1} + W_{xh} x_t)$

$$y_t = W_{hy} h_t$$

Solution (i) let $t=1$

$$h_1 = \tanh\left(\begin{bmatrix} 0.1 & 0.2 \\ 0.3 & 0.4 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0.5 & 0.2 \\ 0.1 & 0.1 \end{bmatrix} \begin{bmatrix} 3 \\ 4 \end{bmatrix}\right)$$

$$= \tanh\left(\begin{bmatrix} 2.3 \\ 1 \end{bmatrix}\right)$$

$$= \begin{bmatrix} 0.9801 \\ 0.7616 \end{bmatrix} \quad \begin{matrix} h_1 \\ \text{fx} - 991 \text{ cin } x \\ \text{op TN } 1 \end{matrix}$$

(ii) $y_1 = W_{hy} h_1$

$$= \begin{bmatrix} 0.1 & 0.4 \end{bmatrix} \begin{bmatrix} 0.9801 \\ 0.7616 \end{bmatrix} = 0.40265$$

(iii) $y_2 = W_{hy} h_2$ let $t=2$. $h_2 = \tanh(W_{hh} h_1 + W_{xh} x_2)$

$$h_2 = \tanh\left(\begin{bmatrix} 0.1 & 0.2 \\ 0.3 & 0.4 \end{bmatrix} \begin{bmatrix} 0.9801 \\ 0.7616 \end{bmatrix} + \begin{bmatrix} 0.5 & 0.2 \\ 0.1 & 0.1 \end{bmatrix} \begin{bmatrix} 1 \\ 6 \end{bmatrix}\right)$$

$$= \tanh \left[\begin{matrix} 2.13 \\ 1.89 \end{matrix} \right] \begin{bmatrix} 1.95033 \\ 1.39867 \end{bmatrix}$$

$$= \begin{bmatrix} 0.9721 \\ 0.9554 \end{bmatrix} \begin{bmatrix} 0.9603 \\ 0.8851 \end{bmatrix}$$

$$y_2 = W_h y_{h2} = \begin{bmatrix} 0.1 & 0.4 \end{bmatrix} \begin{bmatrix} 0.9603 \\ 0.8851 \end{bmatrix} = 0.4501$$