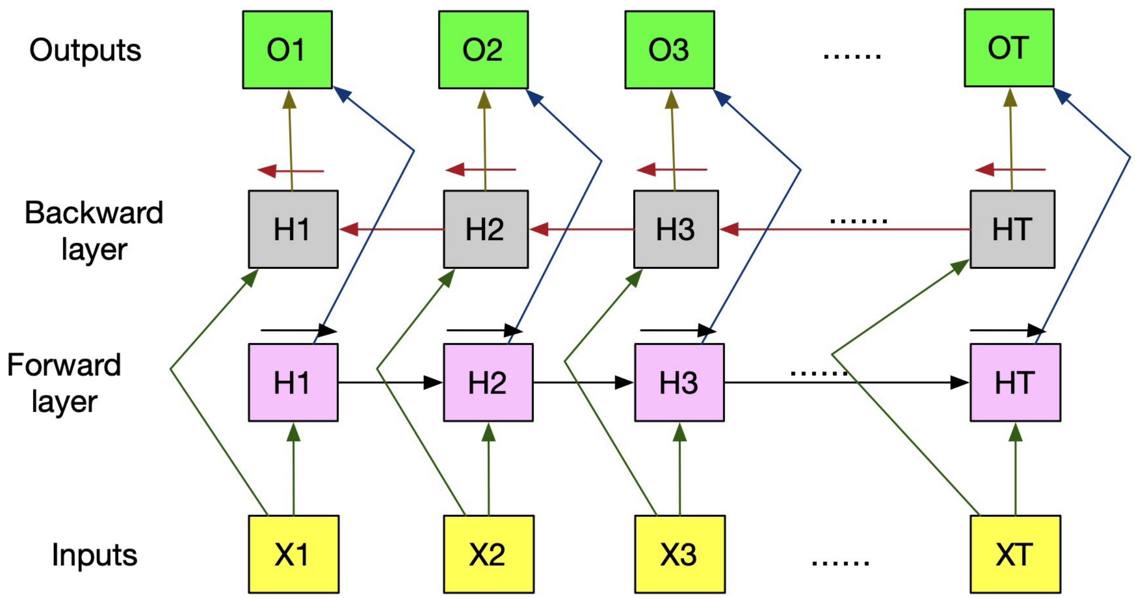
Echo Chen/Xianchi Zhang

Bidirectional RNN



$$\overrightarrow{H}_t = \phi(X_t W_{xh}^{(f)} + \overrightarrow{H}_{t-1} W_{hh}^{(f)} + b_h^{(f)}).$$

$$\overleftarrow{H}_t = \phi(X_t W_{xh}^{(b)} + \overleftarrow{H}_{t+1} W_{hh}^{(b)} + b_h^{(b)})$$

$$O_t = H_t W_{hq} + b_q$$

for input ['three', 'one', 'four', 'one', 'five', 'two', 'five', 'three', 'five']

output [4/3, 8/3, 2, 20/3, 8/3, 4, 10/3, 13/3, 8/3]

encoded: 'five' = [1, 0, 0, 0, 0]

'four' = [0, 1, 0, 0, 0]

'~~th~~one' = [0, 0, 1, 0, 0]

'three' = [0, 0, 0, 1, 0]

'two' = [0, 0, 0, 0, 1]

$$W_{xh} = \begin{bmatrix} 0 & \frac{5}{2} \\ 0 & \frac{4}{2} \\ 0 & \frac{1}{2} \\ 0 & \frac{3}{2} \\ 0 & \frac{2}{2} \end{bmatrix} \qquad W_{hh} = \begin{bmatrix} 0 & 0 \\ 2 & 0 \end{bmatrix} \qquad b_h^{(f)} = 0 \quad b_h^{(b)} = 0$$

$$O_t = H_t W_{hq} + b_q : \quad W_{hq} = \begin{bmatrix} \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{3} \end{bmatrix} \qquad b_q = 0$$

example:

for $t=1$ input 'three'

Note: Starting point is (0,0)

$$\overrightarrow{H_t} = [0,0,0,1,0] \begin{bmatrix} 0 & \frac{5}{2} \\ 0 & 2 \\ 0 & \frac{1}{2} \\ 0 & \frac{3}{2} \\ 0 & 1 \end{bmatrix} + [0,0] \begin{bmatrix} 0 & 0 \\ 2 & 0 \end{bmatrix} = [0, \frac{3}{2}]$$

$$\overleftarrow{H_t} = [0,0,0,1,0] \begin{bmatrix} 0 & \frac{5}{2} \\ 0 & 2 \\ 0 & \frac{1}{2} \\ 0 & \frac{3}{2} \\ 0 & 1 \end{bmatrix} + [3, \frac{1}{2}] \begin{bmatrix} 0 & 0 \\ 2 & 0 \end{bmatrix} = [1, \frac{3}{2}]$$

$$O_t = [0, \frac{3}{2}, 1, \frac{3}{2}] \begin{bmatrix} \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{3} \end{bmatrix} + 0 = \frac{4}{3}$$

for $t=2$ input 'one'

$$\overrightarrow{H_t} = [0, \frac{1}{2}] + [0, \frac{3}{2}] \begin{bmatrix} 0 & 0 \\ 2 & 0 \end{bmatrix} = [3, \frac{1}{2}]$$

$$\overleftarrow{H_t} = [0, \frac{1}{2}] + [4, 0] = [4, \frac{1}{2}]$$

$$O_t = \frac{8}{3}$$

for $t=3$ input 'four'

$$\overrightarrow{H_t} = [0,2] + [1,0] = [1,2]$$

$$\overleftarrow{H_t} = [1,2] \qquad O_t = 2$$

for $t=9$ input 'five'

$$\overrightarrow{H_t} = [3, \tfrac{5}{2}] \qquad \overleftarrow{H_t} = [0, \tfrac{5}{2}] \qquad O_t = \tfrac{8}{3}$$