Task A

$a_0 = [0.9, 0.2]$, $I_0 = [1,0]$, $I_1 = [0,1]$, $I_2 = [1,0]$

$W_{aa} = \begin{bmatrix} 0.2 & 0.5 \\ 0.1 & 0.7 \end{bmatrix}$, $W_{ax} = \begin{bmatrix} 0.6 & 0.3 \\ 0.8 & 0.4 \end{bmatrix}$, $W_{ya} = \begin{bmatrix} 0.25 & 0.95 \\ 0.3 & 0.6 \end{bmatrix}$

$b_a = [0.3, 0.15]$, $b_y = [0.1, 0.4]$

$a^{<t>} = \delta(W_{aa} \times a^{<t-1>} + W_{ax} * x^{<t>} + b_a)$

$y^{<t>} = \delta(W_{ya} \times a^{<t>} + b_y)$

$W_{aa} \times a^{<t-1>} = \begin{bmatrix} 0.2 & 0.5 \\ 0.1 & 0.7 \end{bmatrix} \times [0.9, 0.2] = [0.18+0.1, 0.09+0.14] = [0.28, 0.23]$

$W_{ax} \times x^{<t>} = \begin{bmatrix} 0.6 & 0.3 \\ 0.8 & 0.4 \end{bmatrix} \times [1,0] = [0.6, 0.8]$ $\quad \delta = \frac{e}{1+e^{-z}}$

$a^{<1>} = \delta([0.28, 0.23] + [0.6, 0.8] + [0.3, 0.15]) = \delta([1.18, 1.18]) = [0.765, 0.765]$

$O\_1 = y^{<1>} = \delta\left(\begin{bmatrix} 0.25 & 0.95 \\ 0.3 & 0.6 \end{bmatrix} \times [0.765, 0.765] + [0.1, 0.4]\right) = \delta([0.917, 0.668] + [0.1, 0.4])$

$= \delta([1.018, 1.068]) = [0.735, 0.748] \leftarrow O\_1$

$a^{<2>} = \delta\left(\begin{bmatrix} 0.2 & 0.5 \\ 0.1 & 0.7 \end{bmatrix} \times \overset{0.765}{\cancel{0.765}}, \overset{0.765}{\cancel{0.765}}] + \begin{bmatrix} 0.6 & 0.3 \\ 0.8 & 0.4 \end{bmatrix} \times [0,1] + [0.3, 0.15]\right) =$

$= \delta([0.535, 0.612] + [0.3, 0.4] + [0.3, 0.15]) = \delta([1.13, 1.16]) =$

$= [0.756, 0.761]$

$O\_2 = y^{<2>} = \delta\left(\begin{bmatrix} 0.25 & 0.95 \\ 0.3 & 0.6 \end{bmatrix} \times [0.756, 0.761] + [0.1, 0.4]\right) = \delta([1.012, 1.084]) =$

$= [0.733, 0.747] \leftarrow O\_2$

$a^{<3>} = \delta\left(\begin{bmatrix} 0.2 & 0.5 \\ 0.1 & 0.7 \end{bmatrix} \times [0.756, 0.761] + \begin{bmatrix} 0.6 & 0.3 \\ 0.8 & 0.4 \end{bmatrix} \times [1,0] + [0.3, 0.15]\right) =$

$= \delta([0.5317, 0.6083] + [0.6, 0.8] + [0.3, 0.15]) = \delta([1.43, 1.56]) =$

$= [0.807, 0.826]$

$O\_3 = y^{<3>} = \delta\left(\begin{bmatrix} 0.25 & 0.95 \\ 0.3 & 0.6 \end{bmatrix} \times [0.807, 0.826] + [0.1, 0.4]\right) = \delta([1.08, 1.13]) =$

$= [0.747, 0.757] \leftarrow O\_3$

$O\_1 = [0.735, 0.748]$, $O\_2 = [0.733, 0.747]$, $O\_3 = [0.747, 0.757]$

Task A part 2

$a^{<1>} = [0.765, 0.765]$

$0\_1 = y^{<1>} = [0.735, 0.748]$

$a^{<2>} = \delta\left(\begin{bmatrix} 0.2 & 0.5 \\ 0.1 & 0.7 \end{bmatrix} \times [0.765, 0.765] + \begin{bmatrix} 0.6 & 0.3 \\ 0.8 & 0.4 \end{bmatrix} \times [0.735, 0.748] + [0.3, 0.15]\right) = \delta([0.535, 0.612] + [0.665, 0.887] + [0.3, 0.15]) =$

$= \delta([1.5, 1.65]) = [0.817, 0.838]$

$0\_2 = y^{<2>} = \delta\left(\begin{bmatrix} 0.25 & 0.35 \\ 0.3 & 0.6 \end{bmatrix} \times [0.817, 0.838] + [0.1, 0.4]\right) = \delta([1.10, 1.148]) =$

$= ([0.75, 0.759] \leftarrow 0\_2)$

$a^{<3>} = \delta\left(\begin{bmatrix} 0.2 & 0.5 \\ 0.1 & 0.7 \end{bmatrix} \times [0.817, 0.838] + \begin{bmatrix} 0.6 & 0.3 \\ 0.8 & 0.4 \end{bmatrix} \times [0.75, 0.759] + [0.3, 0.15]\right) =$

$= \delta([0.58, 0.66] + [0.677, 0.90] + [0.3, 0.15]) = \delta([1.56, 1.72]) =$

$= [0.826, 0.848]$

$0\_3 = y^{<3>} = \delta\left(\begin{bmatrix} 0.25 & 0.35 \\ 0.3 & 0.6 \end{bmatrix} \times [0.826, 0.848] + [0.1, 0.4]\right) = \delta([1.112, 1.156]) =$

$= ([0.752, 0.76] \leftarrow 0\_3)$

$0\_1 = [0.735, 0.748]$, $0\_2 = [0.75, 0.759]$, $0\_3 = [0.752, 0.76]$