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EE 456 **Homework - 16** October 28, 2020

Question: ARTMAP - Continue the ARTMAP exercise shown in class through the first cycle.

Solution:

From the class, following are the values of the b matrix and t matrix:

$$b = \begin{bmatrix} 2/3 & 0 & 0.2 \\ 2/3 & 0 & 0.2 \\ 0 & 0 & 0.2 \\ 0 & 1 & 0.2 \end{bmatrix}, \; t = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

- Currently Y_1 recognizes S_1 and Y_2 recognizes S_2.
- Vigilance Parameter i.e. $\rho = 0.4$

1. Present $S_3 = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$, $||S_3|| = 1$
   - $Y_1 = (1 \times 2/3) + (0 \times 2/3) + (0 \times 0) + (0 \times 0) = 2/3 = 0.66$
   - $Y_2 = (1 \times 0) + (0 \times 0) + (0 \times 0) + (0 \times 1) = 0$
   - $Y_3 = (1 \times 0.2) + (0 \times 0.2) + (0 \times 0.2) + (0 \times 0.2) = 0.2$
   - Therefore $0.66 > \rho$, Y_1 will recognize S_3
2. Train b and t
   - $b_{1_{new}} = \frac{2 \times x_i}{1 + ||x_i||}$
   - After updating first column of b matrix, following is the b matrix
   - $b = \begin{bmatrix} 1 & 0 & 0.2 \\ 0 & 0 & 0.2 \\ 0 & 0 & 0.2 \\ 0 & 1 & 0.2 \end{bmatrix}$
   - After updating first row of t matrix, following is the t matrix
   - $t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$
3. Present $S_4 = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$, $||S_4|| = 2$
   - $Y_1 = (0 \times 1) + (0 \times 0) + (1 \times 0) + (1 \times 0) = 0$

- $Y_2 = (0 \times 0) + (0 \times 0) + (1 \times 0) + (1 \times 1) = 1$
- $Y_3 = (0 \times 0.2) + (0 \times 0.2) + (1 \times 0.2) + (1 \times 0.2) = 0.4$
- Since Y_2 is stronger than Y_3 and $1 > \rho$, therefore Y_2 recognizes S_4

4. Train b and t

- $b_{2_{new}} = \frac{2 \times x_i}{1 + ||x_i||}$
- After updating second column of b matrix, following is the b matrix
- $b = \begin{bmatrix} 1 & 0 & 0.2 \\ 0 & 0 & 0.2 \\ 0 & 2/3 & 0.2 \\ 0 & 2/3 & 0.2 \end{bmatrix}$
- After updating first row of t matrix, following is the t matrix
- $t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$