

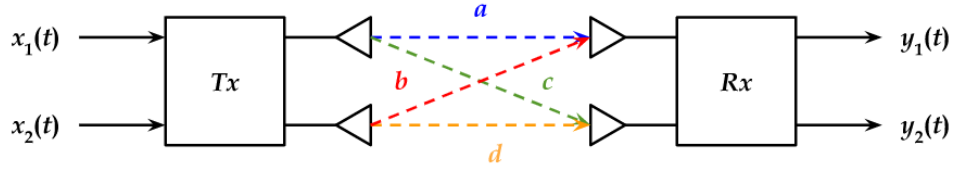
CCIT4076: Engineering and Information Sciences

Assignment 3 (Bonus)

Due 5:30pm on Wednesday, December 14, 2022

Instructions: Please read [this document](#) before handing in any submission. The full mark of this assignment is **30 points**. The estimated duration of completing this problem set is 30 minutes.

Q1. Given a 2-by-2 multiple-input multiple-output system:



in which the receiver (Rx) reads:

$$\begin{bmatrix} y_1(0) & \dots & y_1(4) \\ y_2(0) & \dots & y_2(4) \end{bmatrix} = \begin{bmatrix} -0.2141 & -0.7849 & -0.8035 & -0.0344 & -0.1683 \\ 0.9109 & 1.6327 & 1.6050 & 0.0031 & 0.9676 \end{bmatrix}$$

for five successive time slots $t = 0, 1, 2, 3, 4$. It is given that the channel coefficients are $(a, b, c, d) = (-0.62, -0.19, 0.75, 0.89)$. Estimate the transmission signals $x_1(t)$ and $x_2(t)$.
Hint: Use the mathematical fact on matrix inverse:

$$\mathbf{G} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \rightarrow \mathbf{G}^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix} \quad \text{if } ad - bc \neq 0.$$

Q2. Consider the following network:

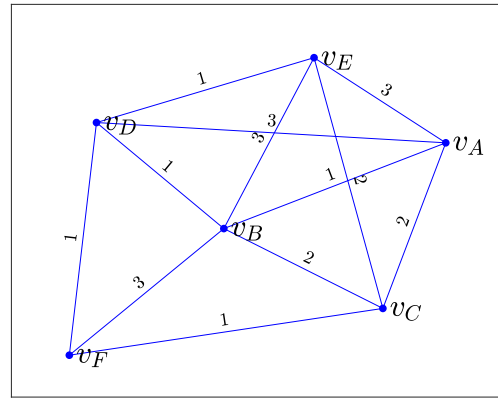
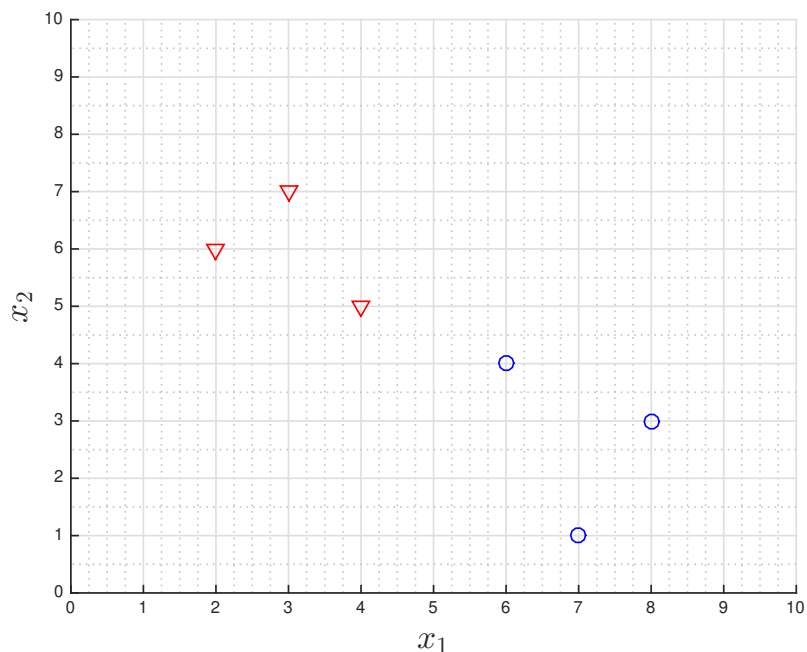


Figure: Question 2.

- (a) Compile the adjacency matrix representing the above network.
- (b) Find the shortest routing paths from the source node v_C to every other nodes using the Dijkstra's algorithm. Show all your steps.

Q3. Given the following data points:

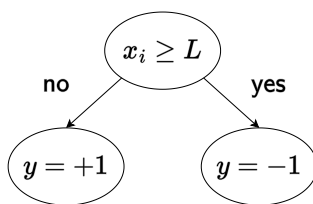


wherein **triangles** ∇ are data points labelled as $y = +1$; and that **circles** \circ are data points labelled as $y = -1$.

- (a) Specify a linear classifier $\mathbf{w} = (w_0, w_1, w_2)$ that gives a 100% accuracy in classifying the above data set. In other words, find \mathbf{w} such that

$$\text{sign}(w_0 + w_1x_1 + w_2x_2) = \begin{cases} +1, & \text{if } (x_1, x_2) \text{ is a red triangle } \nabla \\ -1, & \text{if } (x_1, x_2) \text{ is a blue circle } \circ \end{cases}.$$

- (b) Specify a one-level decision tree classifier:



that gives a 100% accuracy in classifying the above data set.

— THE END —