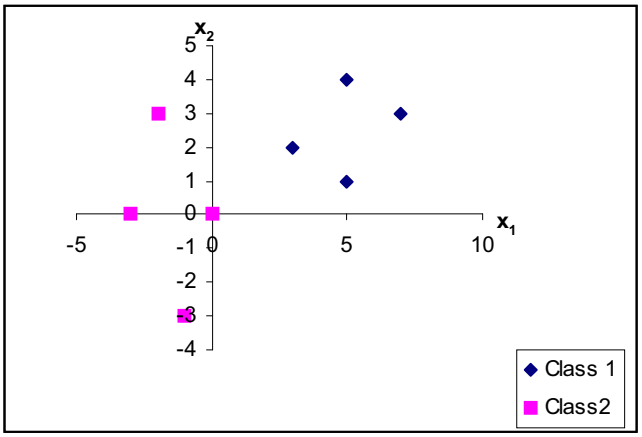
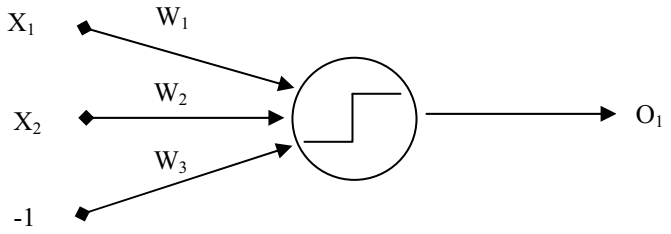
FIT5186 Intelligent Systems

Week 3 Tutorial Solution

(a) The two classes are linearly separable as lines can be drawn to separate the two classes.

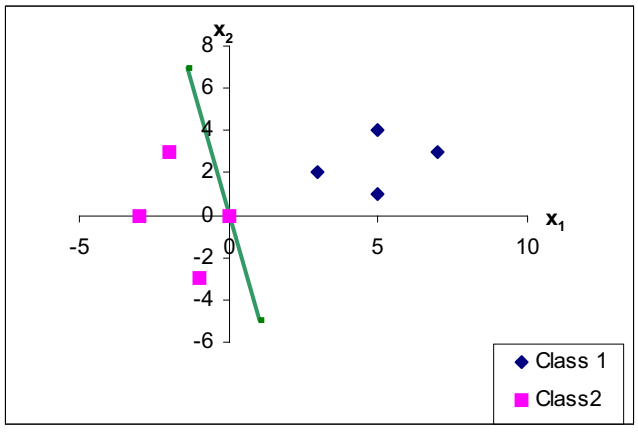


(b) Dichotimiser

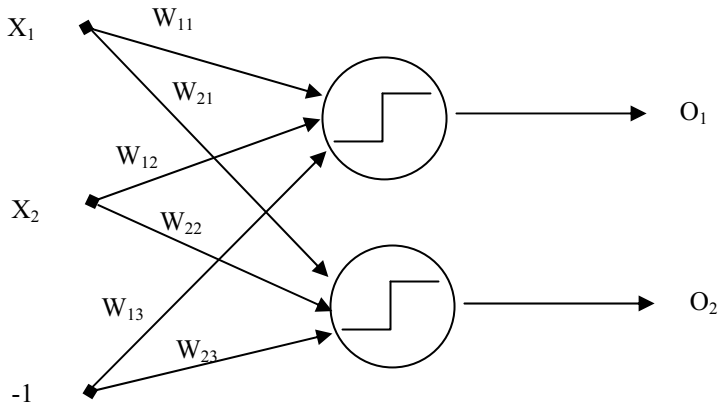


Inputs (x_1, x_2)	5 1 -1	7 3 -1	3 2 -1	5 4 -1	0 0 -1	-1 -3 -1	-2 3 -1	-3 0 -1
Outputs(desired)	0	0	0	0	1	1	1	1

Final weights = $(-5 \quad -1 \quad 0)$ (using dichot.exe)
Equation of boundary lines: $-5x_1 - x_2 - 0 = 0$



(c) 2-category classifier

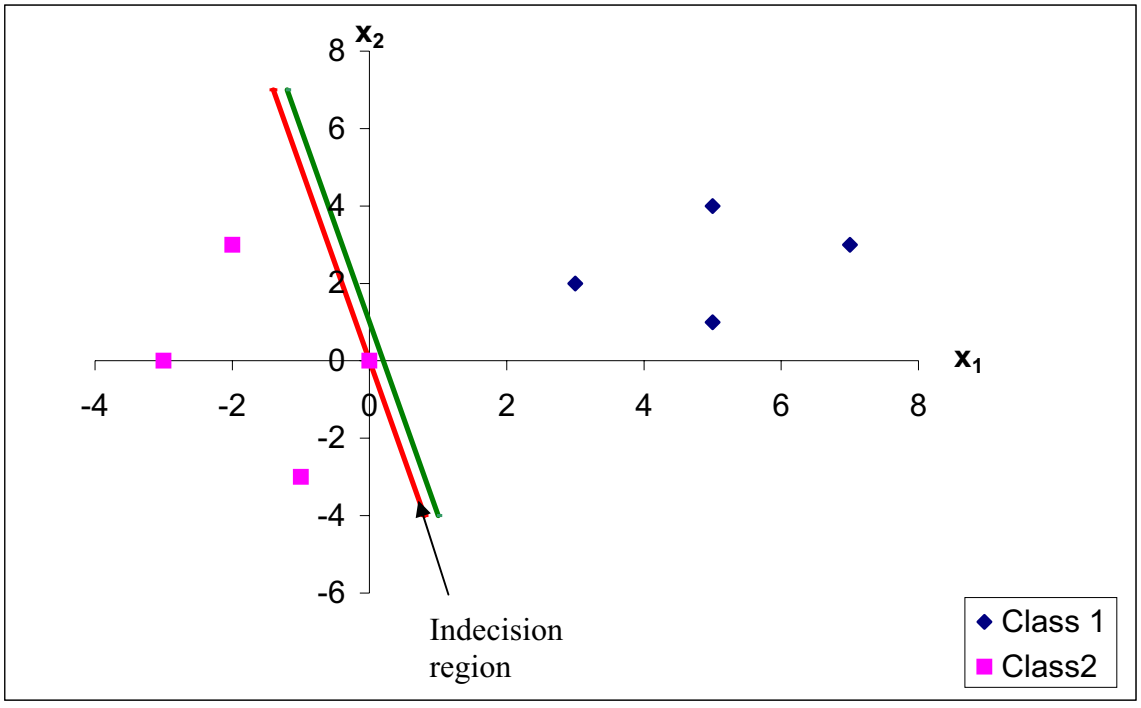


Inputs (x_1, x_2)	5 1 -1	7 3 -1	3 2 -1	5 4 -1	0 0 -1	-1 -3 -1	-2 3 -1	-3 0 -1
Outputs(desired)	1 0	1 0	1 0	1 0	0 1	0 1	0 1	0 1

Final weights = $\begin{pmatrix} 5 & 1 & 1 \\ -5 & -1 & 0 \end{pmatrix}$ (using rclass.exe)

Equation of boundary lines: $5x_1 + x_2 - 1 = 0$

$-5x_1 - x_2 - 0 = 0$



(d) Dichotimiser

Method 1

$$\text{Input} = (2, 0),\ o = f\left[(-5\ \ -1\ \ 0)\begin{pmatrix}2\\0\\-1\end{pmatrix}\right] = f(-10) = 0 \Rightarrow \text{Class 1}$$

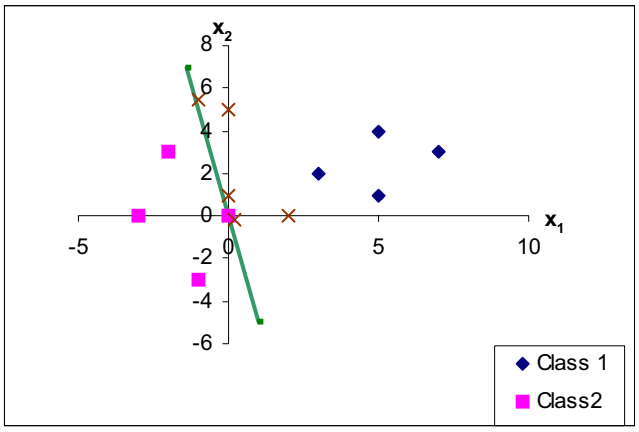
$$\text{Input} = (0, 1),\ o = f\left[(-5\ \ -1\ \ 0)\begin{pmatrix}0\\1\\-1\end{pmatrix}\right] = f(-1) = 0 \Rightarrow \text{Class 1}$$

$$\text{Input} = (0, 5),\ o = f\left[(-5\ \ -1\ \ 0)\begin{pmatrix}0\\5\\-1\end{pmatrix}\right] = f(-5) = 0 \Rightarrow \text{Class 1}$$

$$\text{Input} = (0.2, -0.2),\ o = f\left[(-5\ \ -1\ \ 0)\begin{pmatrix}0.2\\-0.2\\-1\end{pmatrix}\right] = f(-0.8) = 0 \Rightarrow \text{Class 1}$$

$$\text{Input} = (-1, 5.5),\ o = f\left[(-5\ \ -1\ \ 0)\begin{pmatrix}-1\\5.5\\-1\end{pmatrix}\right] = f(-0.5) = 0 \Rightarrow \text{Class 1}$$

Method 2



2-Category Classifier

Method 1

Input = (2, 0), $o = f\left[\begin{pmatrix} 5 & 1 & 1 \\ -5 & -1 & 0 \end{pmatrix}\begin{pmatrix} 2 \\ 0 \\ -1 \end{pmatrix}\right] = f\begin{pmatrix} 9 \\ -10 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \Rightarrow$ Class 1

Input = (0, 1), $o = f\left[\begin{pmatrix} 5 & 1 & 1 \\ -5 & -1 & 0 \end{pmatrix}\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}\right] = f\begin{pmatrix} 0 \\ -1 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \Rightarrow$ Class 1

Input = (0, 5), $o = f\left[\begin{pmatrix} 5 & 1 & 1 \\ -5 & -1 & 0 \end{pmatrix}\begin{pmatrix} 0 \\ 5 \\ -1 \end{pmatrix}\right] = f\begin{pmatrix} 4 \\ -5 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \Rightarrow$ Class 1

Input = (0.2, -0.2), $o = f\left[\begin{pmatrix} 5 & 1 & 1 \\ -5 & -1 & 0 \end{pmatrix}\begin{pmatrix} 0.2 \\ -0.2 \\ -1 \end{pmatrix}\right] = f\begin{pmatrix} -0.2 \\ -0.8 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \Rightarrow$ Indecision region

Input = (-1, 5.5), $o = f\left[\begin{pmatrix} 5 & 1 & 1 \\ -5 & -1 & 0 \end{pmatrix}\begin{pmatrix} -1 \\ 5.5 \\ -1 \end{pmatrix}\right] = f\begin{pmatrix} -0.5 \\ -0.5 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \Rightarrow$ Indecision region

Method 2