William Medwid
CSC487
Vector and perceptron worksheet

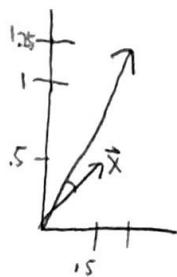1) $|\vec{w}| = \sqrt{0.5^2 + 0.5^2} = \sqrt{0.5} = 0.7071$

2) $[.5 \ .5] \begin{bmatrix} .75 \\ 1.25 \end{bmatrix} = [.5 \cdot .75 + .5 \cdot 1.25] = 1$

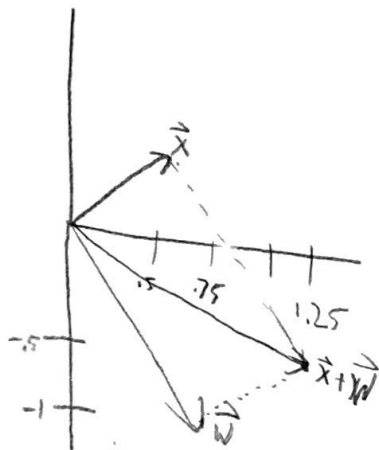3) $[.75 \ 1.25] \begin{bmatrix} .5 \\ .5 \end{bmatrix} = 1$

4) $[.5 \ .5][.75 \ 1.25] = 1$

5) $\cos(\theta) = \frac{a \cdot b}{|a||b|} = \frac{1}{\sqrt{.5}\sqrt{.75^2 + 1.25^2}}$

$\theta = \cos^{-1}(0.97) = \boxed{14°}$

6)

7) Prediction: continuous/numeric variables
   Classification: Categorical target variable

8)

8)
x_0	x_1	x_2	or y
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$W = [0 \ \ 0.5 \ -0.5]$

$\hat{y} = \begin{bmatrix} 0 \\ -0.5 \\ 0.5 \\ 0 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} 0 \\ 1.5 \\ 0.5 \\ 1 \end{bmatrix}$

$\Delta w = [0 \ 0 \ 0]$
$\Delta w = [1.5 \ 0 \ 1.5]$
$\Delta w = [0.5 \ 0 \ 0.5]$
$\Delta w = [1 \ 0 \ 1]$
$[3 \ 0 \ 3] \ \mu = [\frac{3}{4} \ 0 \ \frac{3}{4}]$

$W = [\frac{3}{4} \ \frac{1}{2} \ \frac{1}{4}]$

$\hat{y} = \begin{bmatrix} \frac{3}{4} \\ 1 \\ 5/4 \\ 0 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} -3/4 \\ 0 \\ -1/4 \\ 1 \end{bmatrix}$

$\Delta w = [-\frac{3}{4} \ 0 \ 0]$
$\Delta w = [\frac{1}{4} \ \frac{1}{4} \ ]$
$\Delta w [1 \ 0 \ 1]$ $\quad \nu \cdot \Delta w = [0 \ -\frac{1}{16} \ \frac{1}{4}]$

$W = [\frac{3}{4} \ \frac{7}{16} \ \frac{1}{4}]$

$\hat{y} = \begin{bmatrix} 3/4 \\ 5/4 \\ 19/16 \\ 31/16 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} 1/4 \\ -1/4 \\ -3/16 \\ -15/16 \end{bmatrix}$

$\nu \cdot \Delta w = [\frac{-18}{64} \ \frac{-18}{64} \ \frac{-19}{64}]$

8)

$$X = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & -1 \\ 1 & -1 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad Y = \begin{bmatrix} 0 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$w = \begin{bmatrix} 0 & 0.5 & -0.5 \end{bmatrix} \quad \hat{y} = \begin{bmatrix} 0 \\ -.5 \\ .5 \\ 0 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} 0. \\ -1.5 \\ -0.5 \\ -1 \end{bmatrix} \quad \varepsilon X^T = \begin{bmatrix} -3 \\ -1.5 \\ -2.5 \end{bmatrix} \quad -\nabla \varepsilon X^T = \Delta w = \begin{bmatrix} \frac{3}{4} & \frac{3}{8} & \frac{-5}{8} \end{bmatrix}$

$w = \begin{bmatrix} \frac{3}{4} & \frac{7}{8} & \frac{9}{8} \end{bmatrix} \quad \hat{y} = \begin{bmatrix} .75 \\ 1.875 \\ 1.625 \\ 2.75 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} .75 \\ .875 \\ .625 \\ 1.75 \end{bmatrix} \quad \varepsilon X^t = \begin{bmatrix} 4 \\ 2.375 \\ 2.625 \end{bmatrix} \quad \Delta w = \begin{bmatrix} -1 & -0.594 & -0.656 \end{bmatrix}$

$w = \begin{bmatrix} -0.25 & 0.281 & 0.469 \end{bmatrix} \quad \hat{y} = \begin{bmatrix} -.25 \\ 0.219 \\ 0.031 \\ 0.5 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} -0.25 \\ -0.781 \\ -0.969 \\ -0.5 \end{bmatrix} \quad \Delta w = \begin{bmatrix} 0.625 & 0.367 & 0.32 \end{bmatrix}$

$w = \begin{bmatrix} 0.375 & 0.648 & 0.789 \end{bmatrix} \quad \hat{y} = \begin{bmatrix} .375 \\ 1.164 \\ 1.023 \\ 1.813 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} 0.375 \\ 0.164 \\ 0.023 \\ 0.813 \end{bmatrix} \quad \Delta w = \begin{bmatrix} 0.031 & 0.439 & 0.545 \end{bmatrix}$

$w = \begin{bmatrix} 0.031 & 0.439 & 0.545 \end{bmatrix} \quad \hat{y} = \begin{bmatrix} 0.031 \\ 0.576 \\ 0.47 \\ 1.015 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} .031 \\ -.424 \\ -.53 \\ .015 \end{bmatrix} \quad \Delta w = \begin{bmatrix} 0.227 & 0.129 & 0.102 \end{bmatrix}$

$w = \begin{bmatrix} 0.258 & 0.568 & 0.647 \end{bmatrix} \quad \hat{y} = \begin{bmatrix} 0.258 \\ 0.905 \\ 0.826 \\ 1.473 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} 0.258 \\ -0.095 \\ -0.174 \\ 0.473 \end{bmatrix} \quad \Delta w = \begin{bmatrix} 0.1155 & -0.075 & -0.095 \end{bmatrix}$

$w = \begin{bmatrix} 0.143 & 0.493 & 0.553 \end{bmatrix} \quad \hat{y} = \begin{bmatrix} 0.143 \\ 0.646 \\ 0.636 \\ 1.189 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} 0.143 \\ -.104 \\ -0.364 \\ 0.189 \end{bmatrix} \quad \Delta w = \begin{bmatrix} 0.227 & 0.537 & 0.582 \end{bmatrix}$

$w = \begin{bmatrix} 0.227 & 0.537 & 0.522 \end{bmatrix}$