Artifical Intelligence Problem Set 8

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Problem 1.
0.9: classifier accepts a and b, rejects the rest.

- Precision is $\frac{2}{2} = 1$
- Recall is $\frac{2}{8} = \frac{1}{4}$
- F-score is $(\frac{4+1}{2})^{-1} = \frac{2}{5}$

0.6: classifier accepts items a through i, rejects the rest.

- Precision is $\frac{5}{9}$
- Recall is $\frac{5}{8}$
- F-score is $(\frac{\frac{9}{5}+\frac{8}{5}}{2})^{-1} = \frac{10}{17}$

0.4: classifier accepts items a through n, rejects the rest.

- Precision is $\frac{6}{14} = \frac{3}{7}$
- Recall is $\frac{6}{8} = \frac{3}{4}$
- F-score is $(\frac{\frac{7}{3}+\frac{4}{3}}{2})^{-1} = \frac{6}{11}$

0.1: classifier accepts items a through r, rejects s and t.

- Precision is $\frac{7}{18}$
- Recall is $\frac{7}{8}$
- F-score is $(\frac{\frac{18}{7}+\frac{8}{7}}{2})^{-1} = \frac{7}{13}$

Problem 2.

A. Points A, C, and D are classified incorrectly.

$$\begin{aligned} E_T(\vec{\omega}) &= \sum_{\mathbf{p}\in T, \mathbf{p} \text{ misclassified}} |\omega_1 \mathbf{p}_x + \omega_2 \mathbf{p}_y + \omega_3| \\ &= |1 \cdot 1 + 1 \cdot 1 - 3| + |1 \cdot 2 + 1 \cdot 2 - 3| + |1 \cdot 3 + 1 \cdot 4 - 3| \\ &= 6 \end{aligned}$$

B.

$$\begin{aligned} \vec{\nabla} E|_{\vec{\omega}} &= \sum_{\mathbf{p}\in T} s_{\vec{\omega}}(\mathbf{p}) \cdot \langle \mathbf{p}_x, \mathbf{p}_y, 1 \rangle \\ &= (-1 \cdot \langle 1, 1, 1 \rangle) + \vec{0} + (1 \cdot \langle 2, 2, 1 \rangle) + (1 \cdot \langle 3, 4, 1 \rangle) + \vec{0} \\ &= \langle 4, 5, 1 \rangle \end{aligned}$$

C.

$$\begin{aligned}\vec{\omega}' &= \vec{\omega} - 0.1 \cdot \vec{\nabla} E|_{\vec{\omega}} \\ &= \langle 1, 1, -3 \rangle - 0.1 \cdot \langle 4, 5, 1 \rangle \\ &= \langle 0.6, 0.5, -3.1 \rangle\end{aligned}$$

D. If $0.6x + 0.5y - 3.1 > 0$, **then** BLUE, **else** RED.

$$\begin{aligned}0.6x + 0.5y - 3.1 &> 0 \\ 0.5y &> -0.6x + 3.1 \\ y &> -1.2x + 6.2\end{aligned}$$

A. $1 \not> -1.2 \cdot 1 + 6.2 = 5$

B. $3 \not> -1.2 \cdot 1 + 6.2 = 5$

C. $2 \not> -1.2 \cdot 2 + 6.2 = 3.8$

D. $4 > -1.2 \cdot 3 + 6.2 = 2.6$

E. $2 > -1.2 \cdot 4 + 6.2 = 1.4$

Subistituting coordinates, we see that D and E satisfy the inequality, while A, B, and C do not. $\vec{\omega}'$ classifies A, B, and C as RED, and D and E as BLUE.

E.

$$\begin{aligned}E_T(\vec{\omega}) &= \sum_{\mathbf{p} \in T, \mathbf{p} \text{ misclassified}} |\omega_1 \mathbf{p}_x + \omega_2 \mathbf{p}_y + \omega_3| \\ &= |0.6 \cdot 1 + 0.5 \cdot 1 - 3.1| + |0.6 \cdot 1 + 0.5 \cdot 3 - 3.1| + |0.6 \cdot 3 + 0.5 \cdot 4 - 3.1| \\ &= 3.7\end{aligned}$$