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a) Let y be the vector that contains entries $+1$ or -1 depending on if the patient has disease or not.

We can define,

$$y = \text{sign}(x^T w)$$

for $x = \begin{bmatrix} \text{cough} \\ \text{fever} \\ \text{swollen toes} \end{bmatrix}$ { x^T has dimensions 1×3 }

$w = \begin{bmatrix} w_1 \\ w_2 \\ w_3 \end{bmatrix}$ where $w_i \in \{1, 2, 3\}$ are weights of having each symptom { w has dimensions 3×1 }

Thus, $y = \text{sign}\left(\begin{bmatrix} \text{cough} & \text{fever} & \text{swollen toes} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ w_3 \end{bmatrix} \right)$

b) Line for each y_i,

$$y_0 = x_{i0}^T w$$

we can define a matrix

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}, \quad n \in 1, \ldots n$$

y has dimensions $n \times 1$

&

$$X = \begin{bmatrix} x_1^T \\ x_2^T \\ \vdots \\ x_n^T \end{bmatrix} \quad X \text{ has dimensions } n \times 3$$

Thus, $y = Xw$, where w is still 3×1

we can define a least squares solution as $\min_w \|Xw - d\|_2^2$

the solution to which is

$$w = (X^T X)^{-1} X^T d$$

d) we can use cross validation to solve problem.

learn w from $i = 716$ to 827

Compute $E = \frac{1}{|\alpha|} \sum_{i \in \alpha} \frac{|y_i - \text{sign}(x_i^T w)|}{2}$

then calculate w_2 from $i = 1$ to 715

Compute Error as the same way

Then calculate error for whole $i = 1$ to 827

Compute Error rate between the first two.