## Methodology

feature space → <u>5 features</u> = $[x_1, x_2, x_3, x_4, x_5]$

$$\text{posterior} = \frac{\text{likelihood} \times \text{prior}}{\text{evidence}}$$

$$P(w_i/\bar{x}) = \frac{P(\bar{x}/w_i) \times P(w_i)}{P(\bar{x})}$$

if $P(w_1/\bar{x}) > P(w_2/\bar{x})$, label $x$ as $w_1$
else label $x$ as $w_2$.

now,

$$P(\bar{x}/w_1) = P([x_1, x_2, x_3, x_4, x_5] / w_1)$$

$$= P(x_1/w_1)\,P(x_2/w_1)\,P(x_3/w_1)\,P(x_4/w_1)\,P(x_5/w_1)$$

because features are independent

Thus, we only need to find likelihoods of feature values in both classes.

since evidence is same, we only need to check $P(\bar{x}/w_i)\,P(w_i)$ & further –

$$P(x_1/w_i)\,P(x_2/w_i)\,P(x_3/w_1)\,P(x_4/w_1)\,P(x_5/w_1)\,P(w_i)$$

Laplacian Smoothing -

Add data points to training sample space so that each feature value appears atleast once in the training data.

$$P_{Lap,k}(X_i = x_i) = \frac{count(X_i = x_i) + k}{N + k|X_i|}$$

$k = 1$ $\qquad$ $k$ = Laplacian smoothing factor.

$$\Rightarrow P_{Lap,k}\left(X_i = x_i / Y = y\right) = \frac{count(X_i = x_i, Y = y) + k}{count(Y = y) + k|X_i|}$$

$|X_i|$ = # values $X_i$ can take

$X_i \to$ class of feature

This is done so that joint probability is not zero.