6) Naive Bayes Classification

- P(x | Play Tenis) = ?

P(play Tenis = Yes) = 9/14 P(play Tenis = NO) = 5/14

$P(\text{Outlook} = \text{Rainy} \mid \text{play Tenis} = \text{Yes}) = \frac{P(\text{Rainy}, \text{Yes})}{P(\text{yes})} = \frac{3/14}{9/14} = \frac{3}{9} = 1/3$

$P(\text{Rainy} \mid \text{NO}) = \frac{2/14}{5/14} = \frac{2}{5}$ P(overcast | yes) = 4/9

$P(\text{overcast} \mid \text{No}) = \frac{0}{5} = 0$ P(sunny | yes) = 2/9

P(sunny | NO) = 3/5

$P(\text{Hot} \mid \text{yes}) = \frac{3}{9}$ $P(\text{Hot} \mid \text{NO}) = \frac{1}{5}$

$P(\text{Mild} \mid \text{yes}) = \frac{4}{9}$ $P(\text{Mild} \mid \text{NO}) = \frac{2}{5}$

$P(\text{Cool} \mid \text{yes}) = \frac{2}{9}$ $P(\text{cool} \mid \text{NO}) = \frac{2}{5}$

$P(\text{High} \mid \text{yes}) = \frac{4}{9}$ $P(\text{High} \mid \text{NO}) = \frac{3}{5}$

$P(\text{Normal} \mid \text{yes}) = \frac{5}{9}$ $P(\text{Normal} \mid \text{NO}) = \frac{2}{5}$

$P(\text{False} \mid \text{yes}) = \frac{6}{9}$ $P(\text{False} \mid \text{NO}) = \frac{2}{5}$

$P(\text{True} \mid \text{yes}) = \frac{3}{9}$ $P(\text{True} \mid \text{NO}) = \frac{3}{5}$

$P(yes \mid sunny, Hot, Normal, False) = P(yes) \times P(sunny \mid yes) \times P(Hot \mid yes) \times P(Normal \mid yes) \times P(False \mid yes)$

$= \frac{9}{14} \times \frac{2}{9} \times \frac{3}{9} \times \frac{5}{9} \times \frac{6}{9} = \frac{10}{567}$

$P(NO \mid sunny, Hot, Normal, False) = P(NO) \times P(sunny \mid NO) \times P(Hot \mid NO) \times P(Normal \mid NO) \times P(False \mid NO)$

$= \frac{5}{14} \times \frac{3}{5} \times \frac{1}{5} \times \frac{2}{5} \times \frac{2}{5} = \frac{6}{875}$

playTenis = yes

$$\frac{10/567}{10/567 + 6/875} = \frac{625}{868} = 0.72$$

playTenis = NO

$$\frac{6/875}{10/567 + 6/875} = \frac{243}{868} = 0.279$$

The liklihood of playTenis=yes is 0.72.

$P(NO \mid Rainy, Cool) = P(NO) \times P(Rainy \mid NO) \times P(Cool \mid NO)$

$= \frac{5}{14} \times \frac{2}{5} \times \frac{2}{5} = \frac{2}{35}$