ASSIGNMENT 4

Title : Email Classification using Naive Bayes Algorithm.

Problem Statement :

A SMS unsolicited mail is any junk message brought to a cell phone as textual content messaging via the SMS like probabilistic approach to implement SMS spam altering system. SMS messages are categorized as spam or ham using features like length of message, word, dependant, unique keywords, etc.

Objective :

The assignment will help the students to realize how the naive bayes algo. works in classification of text.

Theory :

Naive bayes classifiers are a collection of classification algos. based on Bayes' Theorem. It's not a single algo. but a family of algorithm, where all of them share a common principle, i.e. every pair of features bring classified is independant of each other.

Assumption : The fundamental Naive Bayes Algo. assumption is that each feature makes an independant & equal contribution to the outcome.

Bayes theorem :

Bayes' theorem is a way to figure out conditional probability. It's the probability of an event happening, given that it has some relationship to one or more events.

Formula :

$$P(A \mid B) = \frac{P(B \mid A) \cdot P(A)}{P(B)}$$

eg 1 :

To find the prob. of having a liver disease if patient is an alcoholic.

A - patient has liver disease $P(A) = 0.1$

B - patient is an alcoholic $P(B) = 0.05$

$P(B \mid A) = 0.07$

Acc. to bayes theorem ;

$$P(A \mid B) = (0.07 \times 0.1) / (0.05) = 0.14$$

$$P(A \mid B) = 14\%$$

eg 3 :

1% of people have certain genetic defect. 90% of tests for gene defect are detect the defect. (T.P). 9.6% of tests are false positives.

If person gets positive test result, what are the odds they actually have the genetic defect.

A = Chance of having faulty gene = 0.01
X = Positive test result

P(A|X) = Prob. of having the given gene a positive test result.

P(X|A) = Chance of a positive test result given that gene is faulty. = 90% = 0.9

P(X|~A) = 9.6% = 0.096

P(A|X) = 0.0865 = 8.65%

$$P(A|X) = \frac{P(X|A) \cdot P(A)}{P(X|A) \cdot P(A) + P(X|\sim A) \cdot P(\sim A)}$$

$$\therefore P(A|X) = \frac{(0.9 \times 0.01)}{(0.9 \times 0.01) + (0.096 \times 0.99)} = 0.0865 = \underline{8.65\%}$$

* Other forms of Bayes Theorem :

- Probability Ratio

The rule states that any event must be multiplied by this factor $PR(H,E) = P_E(H) / P(H)$, that gives the events probability conditional on E.

- Odds Ratio Rule :

It is similar to probability ratio but the likelihood ratio divides a tests true positive rate by it's false positive rate.

Formula : $OR(H, E) = P_H(E) / P_{\sim H}(E)$

- Bayesian Spam Filtering :

The event is the case in which the message is spam. The test for spam is that the message contains some flagged words like ("You have won"). The probability a message is spam given that it contains flagged words :

$$P(\text{spam} \mid \text{words}) = \frac{P(\text{words} \mid \text{spam}) \cdot P(\text{spam})}{P(\text{words})}$$

Conclusion :

Successfully implemented spam-ham SMS classification using Naive Bayes algorithm.