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sec - 4

AIML Assignment - 3

Illustrate naive bayes on the set to predict whether we can pet an animal or not. find (P(xi|yj)) for each xi in x and each yj in y
illustrate decision Tree on the dataset.

SNO	Animal	size of Animal	bodycolour	can we pet them
0.	DOG	Medium	black	yes
1.	Dog	Big	white	NO
2.	Rat	Small	white	Yes
3.	COW	Big	white	Yes
4.	COW	Small	Brown	NO
5.	COW	Big	Black	Yes
6.	Rat	Big	Brown	NO
7.	Dog	Small	Brown	Yes
8.	DOG	medium	Brown	Yes
9.	COW	medium	white	NO
10.	Dog	Small	Black	Yes
11.	Rat	medium	Black	NO
12.	Rat	Small	Brown	NO
13.	COW	Big	white	Yes

$$P(y|x) = \frac{P(x|y)P(y)}{P(x)} \rightarrow \text{naive bayes}$$

1. Prior possibilities: P(y)

prob of yes & NO, NO of yes = 8, NO of NO = 6, Total = 14

$$P(yes) = \frac{8}{14} = 0.5$$

$$P(NO) = \frac{6}{14} = 0.4$$

2. Conditional probabilities: P(xi|y)

for each Animal

yes:

P(Dog|yes) = 4/8 = 0.5

P(Rat|yes) = 2/8 = 0.2

P(cow|yes) = 2/8 = 0.2

NO:

P(Dog|NO) = 2/6 = 0.3

P(Rat|NO) = 2/6 = 0.3

P(cow|NO) = 2/6 = 0.3

Size of Animal

Yes: P[Dog, size, small|yes]×

P(Small|yes) = 2/8 = 0.2

P(medium|yes) = 3/8 = 0.3

P(Big|yes) = 3/8 = 0.3

NO:

P(small|NO) = 2/6 = 0.3

P(medium|NO) = 2/6 = 0.3

P(Big|NO) = 2/6 = 0.3

for Body Colour:

yes: P(Black|yes) = 2/8 = 0.2

P(Brown|yes) = 3/8 = 0.3

P(white|yes) = 3/8 = 0.3

NO: P(Black|NO) = 2/6 = 0.3

P(Brown|NO) = 2/6 = 0.3

P(white|NO) = 2/6 = 0.3

3. Apply naive bayes theorem:

To predict whether we can predict to pet an animal based on predictive.

for example:

P(yes|Dog, Medium, Brown) = P(yes) × P(Dog|yes) × P(medium|yes) × P(Brown|yes)

P(yes|Dog, Medium, Brown) = 0.5 × 0.5 × 0.3 × 0.3 = 0.0401

Similarly for NO:

P(NO|Dog, medium, Brown) = P(NO) × P(Dog|NO) × P(Medium|NO) × P(Brown|NO)

P(NO|Dog, Medium, Brown) = 0.4 × 0.3 × 0.3 × 0.3 = 0.0159

Decision Tree Entropy:

1. Calculate Entropy of dataset

for can we pet them:

$H(pet) = -P(yes)\log_2 P(yes) - P(NO)\log_2 P(NO)$

Substitute the values

$H(pet) = -0.5\log_2 0.5 - 0.4\log_2 0.4$

$H(pet) = 0.985$

2. Entropy after splitting by a feature

for Dog [6 instances]

$$H(pet|Dog) = -\frac{4}{6}\log_2\frac{4}{6} - \frac{2}{6}\log_2\frac{2}{6}$$
$$= 0.9$$

for rat [4 instances]

$$H(pet|Rat) = -\frac{2}{4}\log_2\frac{2}{4} - \frac{2}{4}\log_2\frac{2}{4}$$
$$= 1.0$$

for Cow [4 instances]

$$H(pet|cow) = -\frac{2}{4}\log_2\frac{2}{4} - \frac{2}{4}\log_2\frac{2}{4}$$
$$= 1.0$$

weighted Entropy & split:

$$H(pet|animals) = \frac{6}{14}\times 0.9 + \frac{4}{14}\times 1.0 + \frac{4}{14}\times 1.0$$
$$= 0.942$$

3. Information Gain for splitting on Animals

$$IG(Animals) = H(pet) - H(pet|Animals)$$
$$= 0.985 - 0.942$$
$$= 0.043$$