Intelligent Systems: Reasoning and Recognition
Home task 4

Riyane SID-LAKHDAR

April 30, 2016

1 Explain Baye's rule

Let E1 and E2 be two different events. Let suppose that we know the probability that the event E1 (respectively E2) happens. And let suppose that we know the probability that the E1 happens, knowing that the event E2 happened.

Then the Baye's rule allows to know the probability that the event E2 happens, knowing that the event E1 happened.

2 What is it

$$P(E2|E1) = \frac{P(E1|E2) * P(E2)}{E1} \tag{1}$$

3 How is it used

In this section, we will suppose that an object has one only feature (one dimension). This explanation can be generalized to n-dimension objects.

Let consider a space where each object could belong to a class. And let consider that there exist K different classes. To improve the quality if this classification, we can improve the probability that an object X belongs to a class C_k.

This probability may be written as:

$$
\begin{aligned}
P(\omega_k|X) &= \frac{(X|\omega_k) * P(\omega_k)}{P(X)} \\
&= \frac{h_k(X)}{h(X)}
\end{aligned}
\tag{2}
$$

Where:

- $h_k(X)$ is the number of occurrence of the feature X in the class k

- $h(X)$ is the number of occurrence of the feature X in all the classes

All the factors on the right of this equation may be determined by construction of the system (knowing the training samples). Thus we can chose our training samples to maximize this probability.

4 Under what circumstances will it give incorrect results

In order to use Baye's rule to build or to improve classifiers, we need to have the probability (likelihood) of each possible feature among each class. As this knowledge is not always known, it needs to be approximated in order to use this method. And this may make the results inaccurate, or even wrong.

5 Can Baye's rule be used with symbolic features

In the previous explanation, we have used integers to represent each of the objects. However, no order between the elements has been required. Thus symbolic objects may be classified by simply mapping each object to a unique index (hash map).