جامعة بيرزيت
BIRZEIT UNIVERSITY

Electrical and Computer Engineering

Spoken Language Processing (Fall 2017)

Name: Key ID:

Quiz (2)

In a simple speaker verification system, a speaker S is represented by a 4-component Gaussian Mixture Model given by:

$$P(y_t) = 0.2G_1(y_t) + 0.3G_2(y_t) + 0.1G_3(y_t) + 0.4G_4(y_t)$$

Where G_1, G_2, G_3, G_4, are all multivariate Gaussian PDFs and y_t is an acoustic vector. Let be $Y = \{y_1, y_2, y_3\}$ be a sequence of acoustic feature vectors which represents a sample of speech which is claimed to have been spoken by speaker S. The probability for each vector and each PDF is given in the following table:

	G_1	G_2	G_3	G_4
y_1	$P(y_1/G_1)=0.03$	$P(y_1/G_2)=0.07$	$P(y_1/G_3)=0.04$	$P(y_1/G_4)=0.12$
y_2	$P(y_2/G_1)=0.02$	$P(y_2/G_2)=0.06$	$P(y_2/G_3)=0.05$	$P(y_2/G_4)=0.09$
y_3	$P(y_3/G_1)=0.03$	$P(y_3/G_2)=0.06$	$P(y_3/G_3)=0.03$	$P(y_3/G_4)=0.11$

(a) Write down the class conditional probability of the data Y given the speaker S.

[3] $P(Y/S) = P(y_1 y_2 y_3/S) = P(y_1/S)P(y_2/S)P(y_3/S)$

(ii) Assuming the prior probability of speaker S is 0.1 and assuming that the system will accept a speaker if the posterior probability of speaker S given the data Y is greater than 0.5, will this speaker be accepted or rejected? Justify your answer.

(1) $P(S/Y) = \frac{P(Y/S)P(S)}{P(Y)}$

(1) $P(Y/S) = P(y_1/S)P(y_2/S)P(y_3/S)$

(1) $P(y_1/S) = 0.2G_1(y_1) + 0.3G_2(y_1) + 0.1G_3(y_1) + 0.4G_4(y_1)$

$= 0.2(0.03) + 0.3(0.07) + 0.1(0.04) + 0.4(0.12) = 0.079$

(1) $P(y_2/S) = 0.2(0.02) + 0.3(0.06) + 0.1(0.05) + 0.4(0.09) = 0.063$

(1) $P(y_3/S) = 0.2(0.03) + 0.3(0.06) + 0.1(0.03) + 0.4(0.11) = 0.071$

(1) $P(S/Y) = (0.079)(0.063)(0.071)(0.1) = 3.53 \times 10^{-5}$

(2) $P(S/Y) <$ Threshold (0.5) $\Rightarrow$ Rejected.