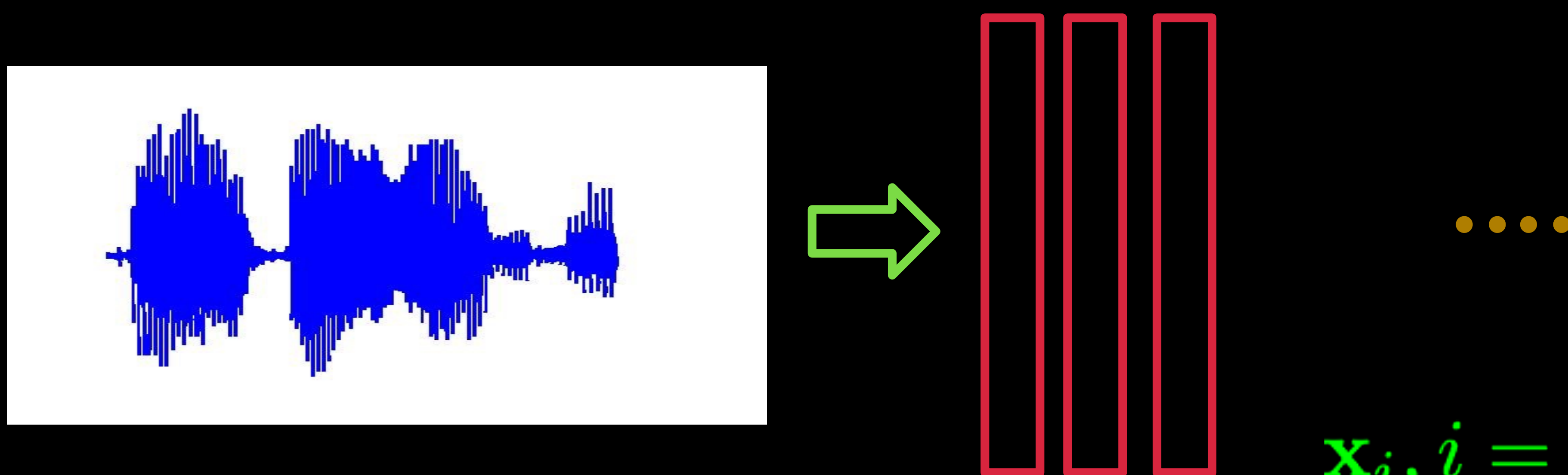
E9:261

22-02-2016

Recap …



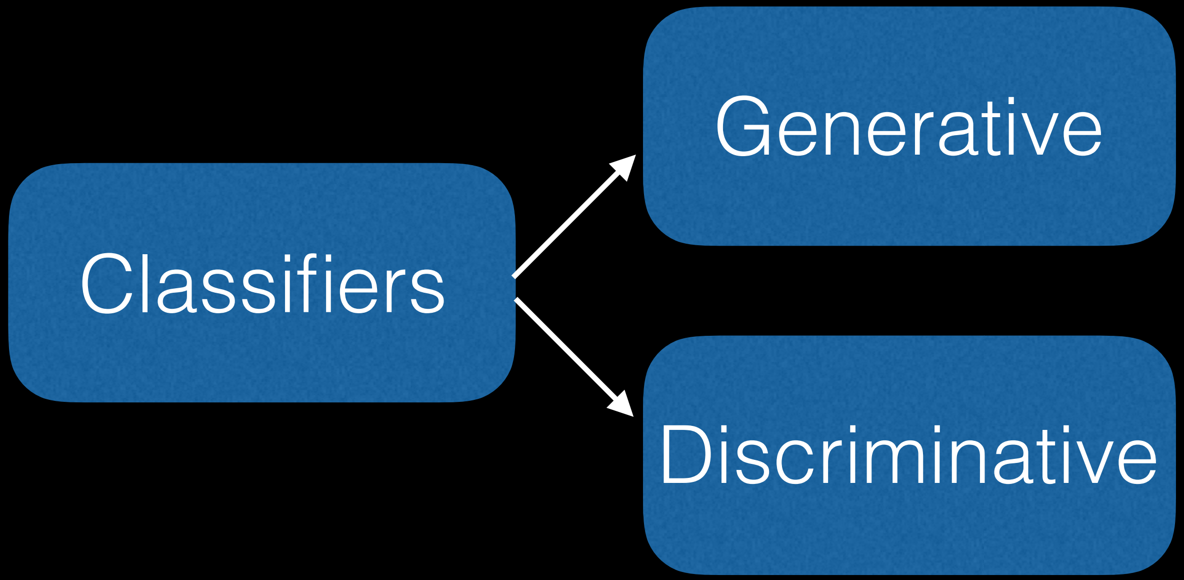
MFCC

$\mathbf{x}_i, i = 1, ..., T$

Speech is covered to a sequence of vectors - {Linear prediction parameters, MGCs, MFCC, Sub-band energies etc}

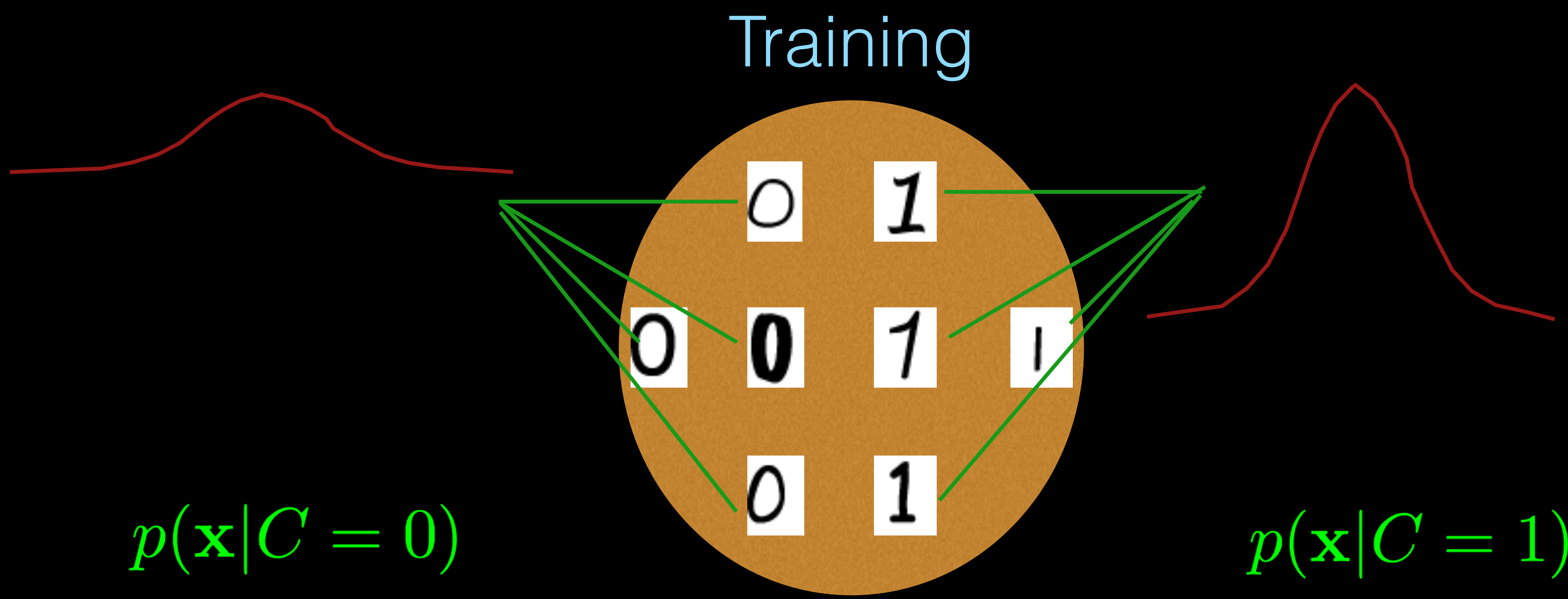
Recognition - Determine whether two recordings have the same content or not.

Pattern Recognition



Generative classifier

- Model the two classes separately using probability distributions -
  - Make each sample $\mathbf{X}_i$ (28x28) as a vector $\mathbf{x}_i$ of size 784.
  - Build class dependent probability $p(\mathbf{x}|C=0)$ & $p(\mathbf{x}|C=1)$

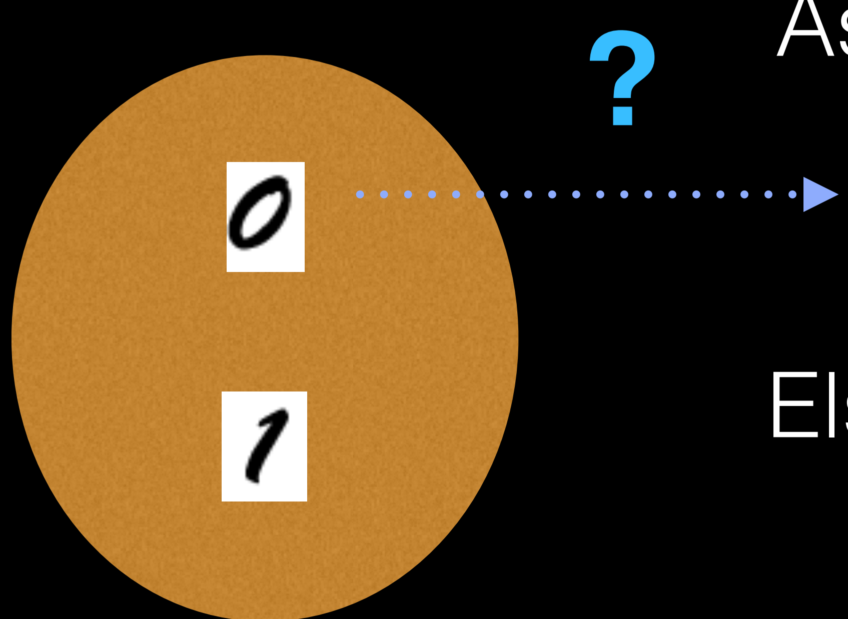


$p(\mathbf{x}|C=0)$ $p(\mathbf{x}|C=1)$

Generative classifier

- For the test sample
  - Make each sample $\mathbf{Y}$ (28x28) as a vector $\mathbf{y}$ of size 784.
  - Compute the probability of generating sample $\mathbf{y}$ for each class.

Test



Assign to class label 0 if

$$p(\mathbf{y}|C=0) > p(\mathbf{y}|C=1)$$

Else assign to class 1

Gaussian Distribution

$$p(\mathbf{x}|\theta) = \frac{1}{\sqrt{(2\pi)^D|\Sigma|}} exp\left\{-\frac{1}{2}(\mathbf{x}-\mu)^*\mathbf{\Sigma^{-1}}(\mathbf{x}-\mu)\right\}$$

- Parameters are mean and covariance matrix
- Determine the parameters with Maximum Likelihood Estimation (MLE) process.

$$L(\theta|\mathbf{x}) = p(\mathbf{x}|\theta)$$

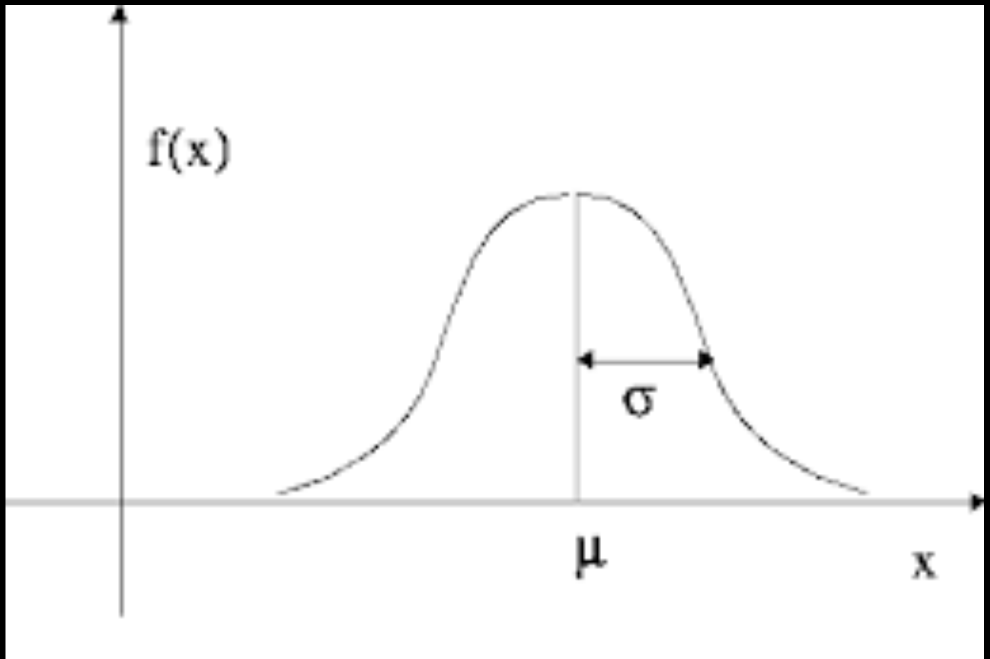


Figure 7. Gaussian (Normal) Probability Distribution Function

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Matrix Vector Differentiation Rules

Matrix vector differentiation rules

$$\frac{\partial\, x^T A x}{\partial x} = (A + A^T)\,x$$

If A is symmetric.

$$2Ax$$

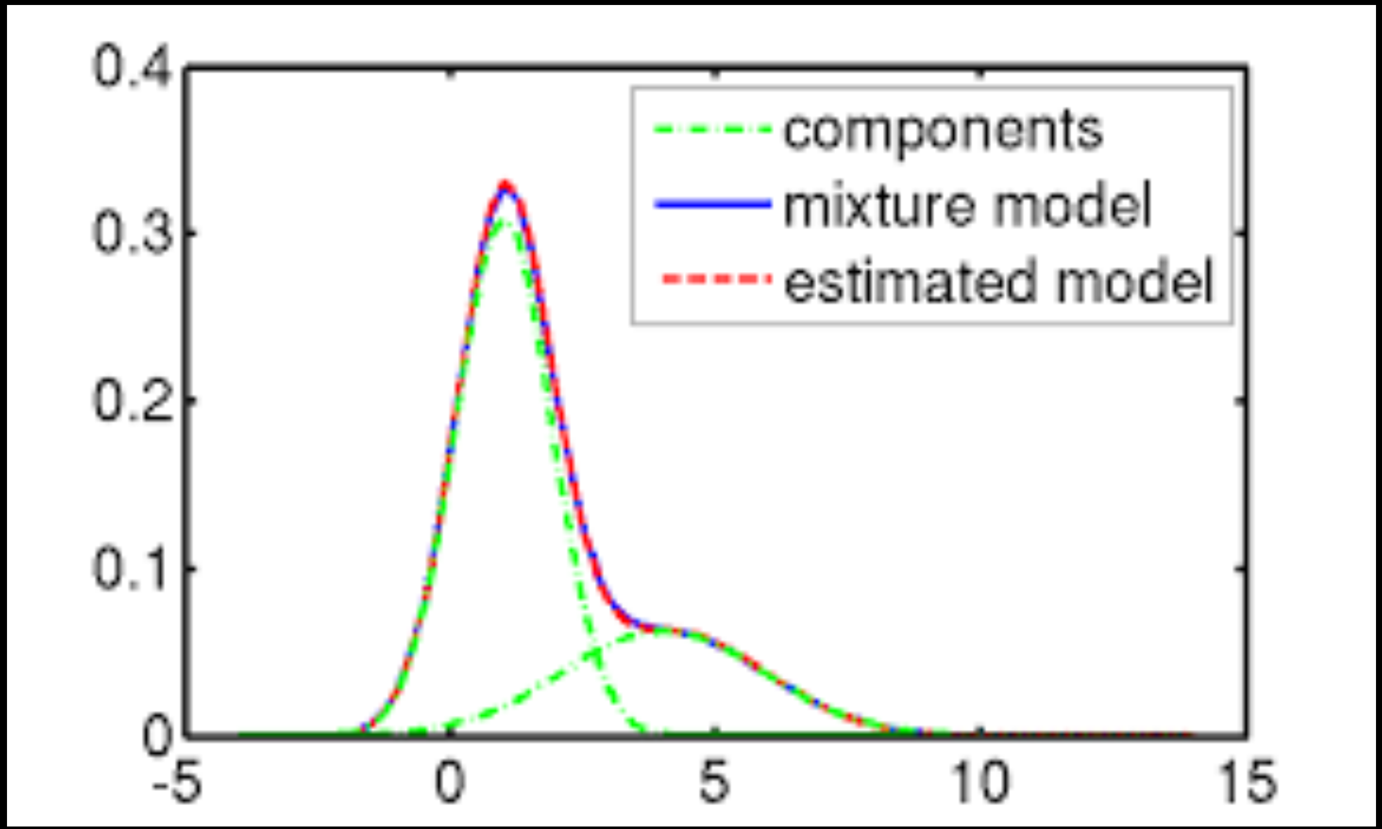
$$\frac{\partial |A|}{\partial a_{ij}} = \begin{cases} A_{ij} & \text{if } i = j \\ 2A_{ij} & \text{if } i \neq j \end{cases}$$ for symmetric A, A_{ij} = cofactor of A

$$\frac{\partial \log |A|}{\partial A} = \begin{cases} A_{ij}/|A| & \text{if } i = j \\ 2A_{ij}/|A| & \text{if } i \neq j \end{cases} = 2A^{-1} - \operatorname{diag}(A^{-1})$$

GMM

$$p(\mathbf{x}|\theta) = \sum_{i=1}^{M} \alpha_i p_i(\mathbf{x}|\theta_i)$$

- Parameters estimated using EM algorithm.



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