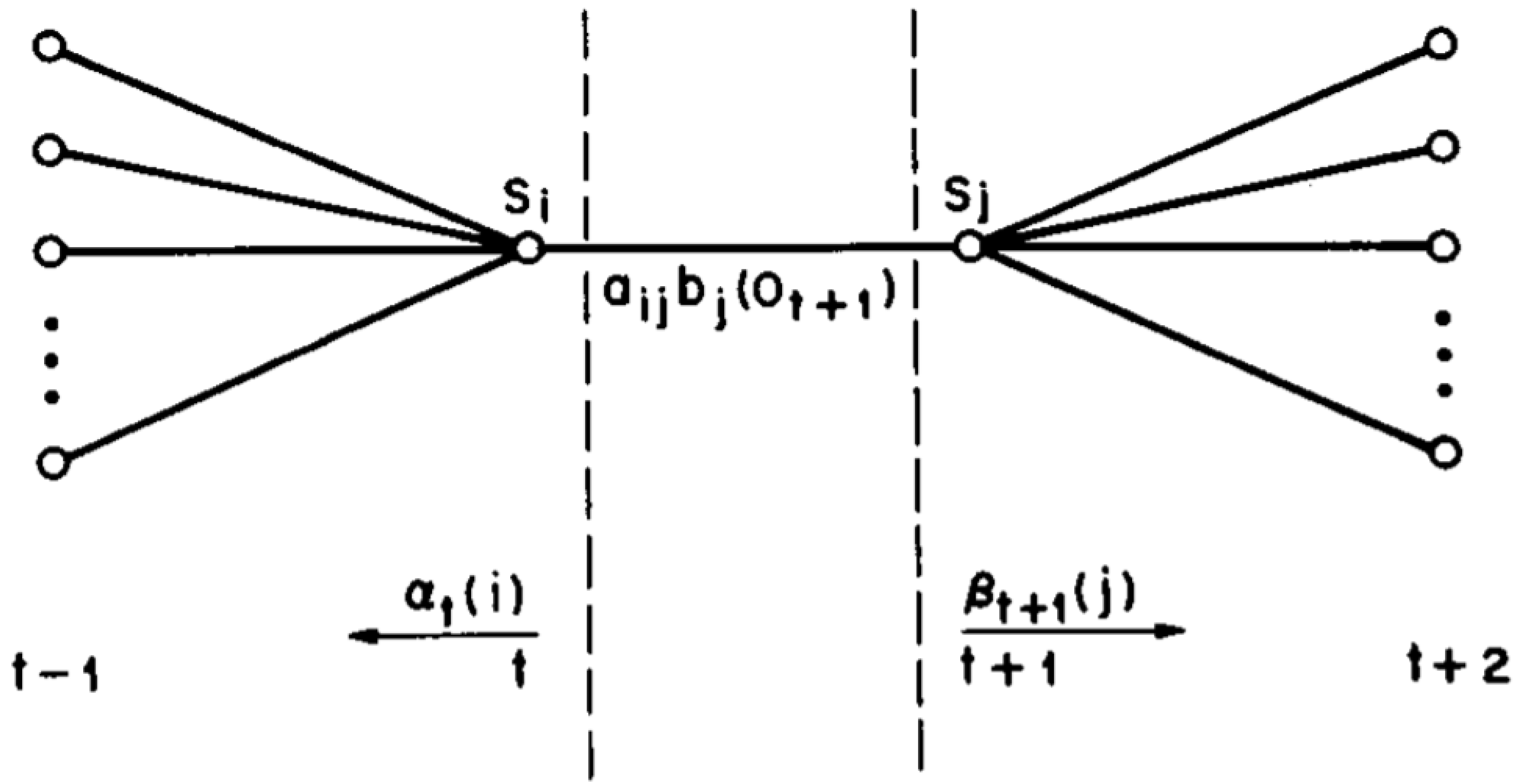


S_i
S_j
$a_{ij}b_j(O_{t+1})$
$\alpha_t(i)$
$\beta_{t+1}(j)$
$t-1$
t
$t+1$
$t+2$

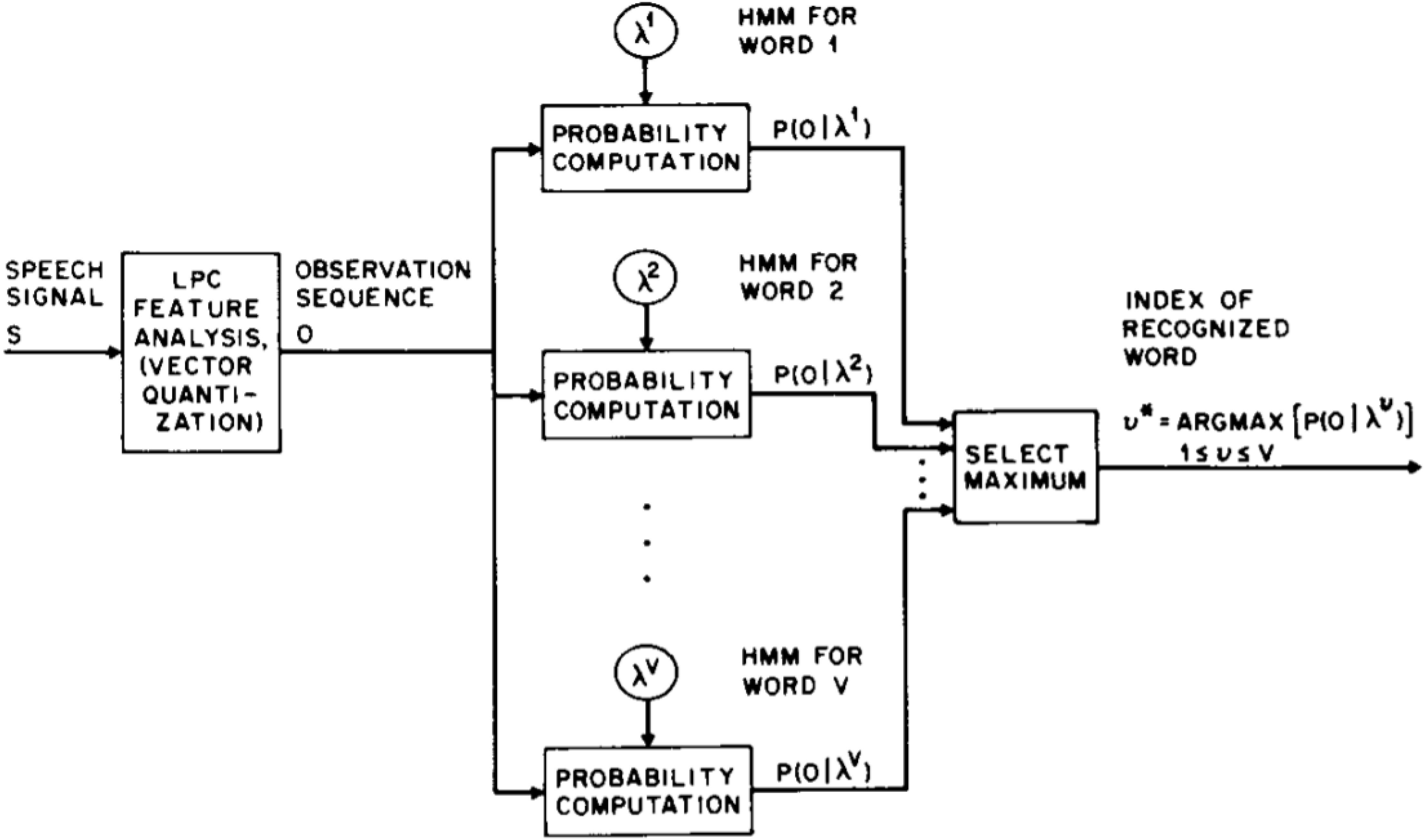
$$\bar{c}_{jk} = \frac{\sum_{t=1}^{T} \gamma_t(j, k)}{\sum_{t=1}^{T} \sum_{k=1}^{M} \gamma_t(j, k)}$$

$$\overline{\boldsymbol{U}}_{jk} = \frac{\sum_{t=1}^{T} \gamma_t(j, k) \cdot (\boldsymbol{O}_t - \boldsymbol{\mu}_{jk})(\boldsymbol{O}_t - \boldsymbol{\mu}_{jk})'}{\sum_{t=1}^{T} \gamma_t(j, k)}$$

$$\bar{\boldsymbol{\mu}}_{jk} = \frac{\sum_{t=1}^{T} \gamma_t(j, k) \cdot \boldsymbol{O}_t}{\sum_{t=1}^{T} \gamma_t(j, k)}$$

$$\gamma_t(j, k) = \left[\frac{\alpha_t(j)\,\beta_t(j)}{\sum_{j=1}^{N} \alpha_t(j)\,\beta_t(j)}\right]\left[\frac{c_{jk}\mathfrak{N}(\boldsymbol{O}_t, \boldsymbol{\mu}_{jk}, \boldsymbol{U}_{jk})}{\sum_{m=1}^{M} c_{jm}\mathfrak{N}(\boldsymbol{O}_t, \boldsymbol{\mu}_{jm}, \boldsymbol{U}_{jm})}\right].$$

(The term $\gamma_t(j, k)$ generalizes to $\gamma_t(j)$ in the case of a simple mixture, or a discrete density.)


HMM FOR WORD 1
HMM FOR WORD 2
HMM FOR WORD V
SPEECH SIGNAL S
LPC FEATURE ANALYSIS, (VECTOR QUANTI-ZATION)
OBSERVATION SEQUENCE O
PROBABILITY COMPUTATION
PROBABILITY COMPUTATION
PROBABILITY COMPUTATION
λ^1
λ^2
λ^V
$P(O|\lambda^1)$
$P(O|\lambda^2)$
$P(O|\lambda^V)$
SELECT MAXIMUM
INDEX OF RECOGNIZED WORD
$v^* = \underset{1 \le v \le V}{\text{ARGMAX}} [P(O|\lambda^v)]$

Probabilistic approach – statistical sequence recognition

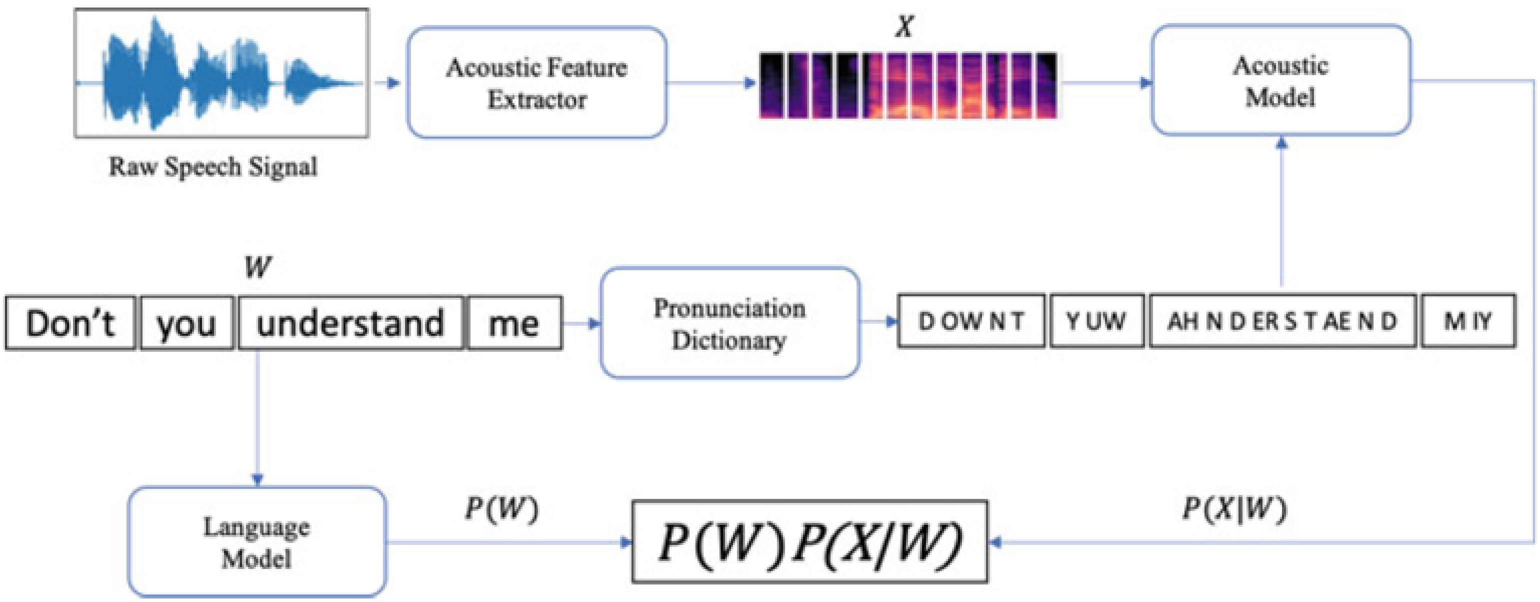
Using Bayes' Theorem

$$P(W|X) = \frac{P(X|W)P(W)}{P(X)}$$

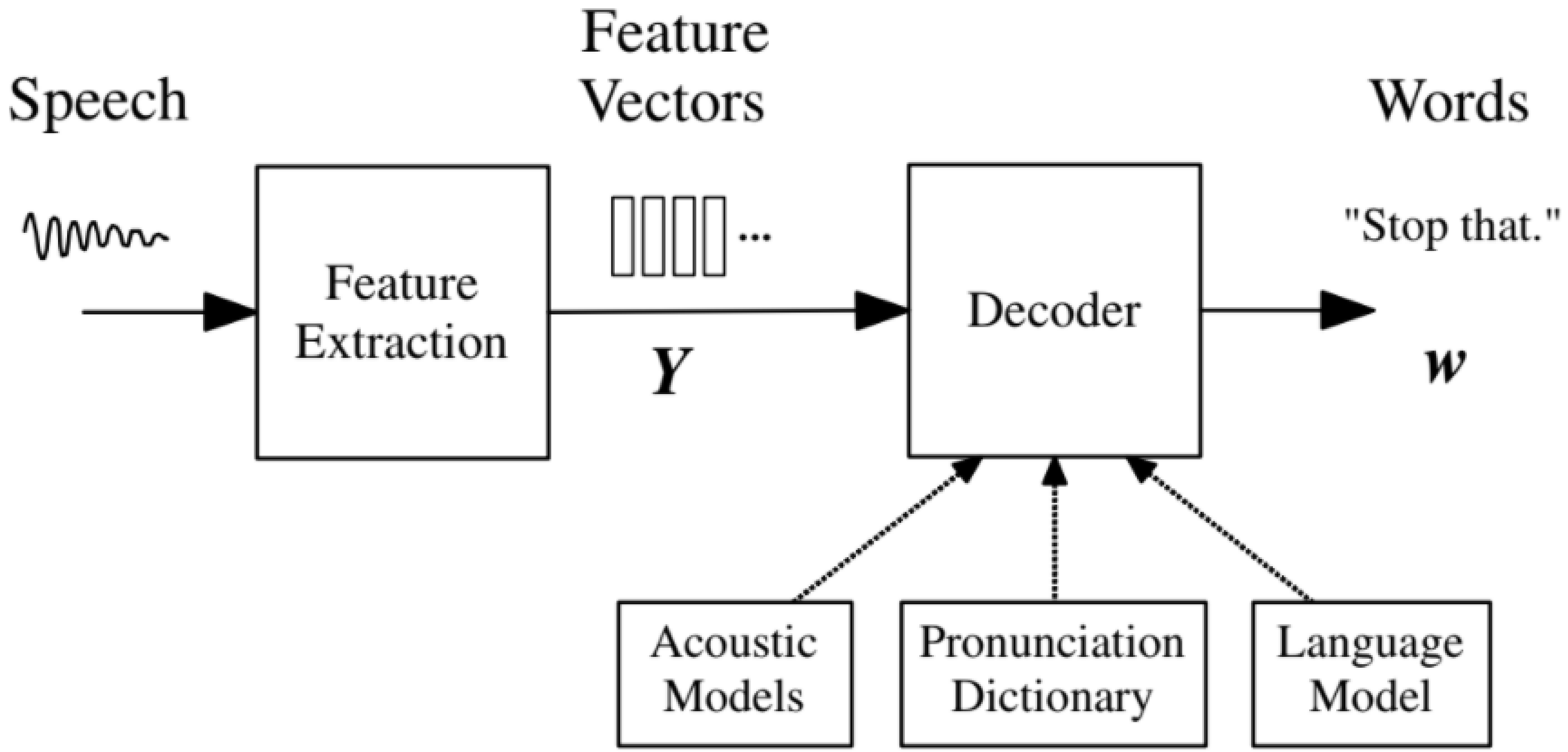
$$\boxed{W^* = \underset{W \in V^*}{\operatorname{argmax}} P(X|W)P(W)}$$

Acoustic Model

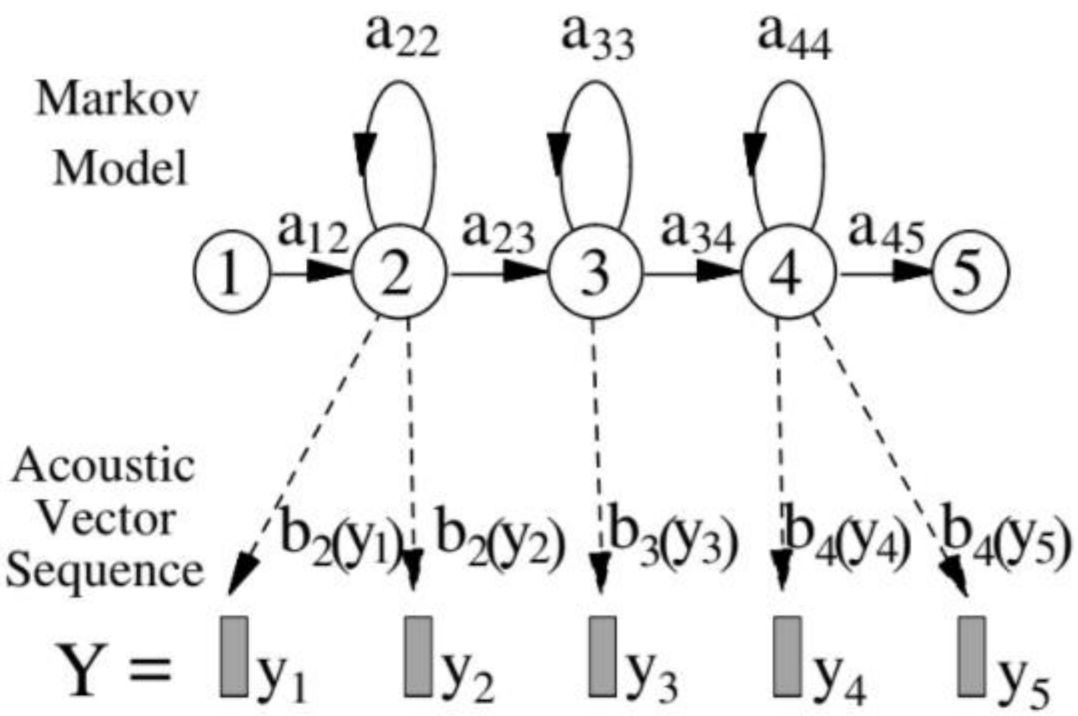
Language Model



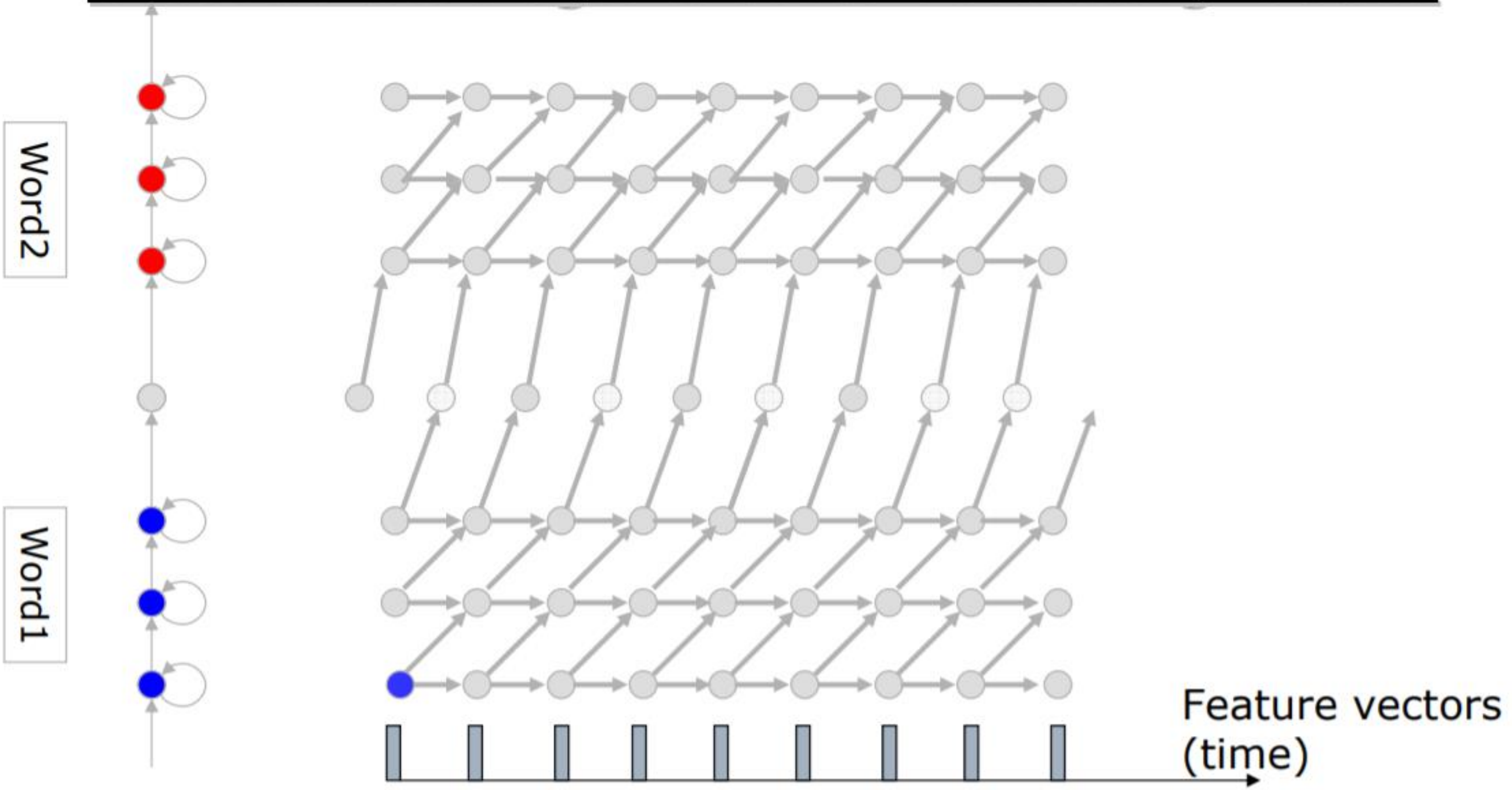
Architecture of HMM-based recognizer



HMM-based phone model



Viterbi through a Non-Emitting State



http://www.ee.iisc.ac.in/new/people/faculty/prasantg/downloads/Bhiksha_Tutorial_ConnectedWordModel.pdf