Massachusetts Institute of Technology
Department of Electrical Engineering & Computer Science

6.345 Automatic Speech Recognition
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Supplement Note on Q9 and Q10

Define the index function $\mathbf{1}_{\{x\}}(y)$ as follows:

$$\mathbf{1}_{\{x\}}(y) = \begin{cases} 1 & \text{if } x = y \\ 0 & \text{otherwise} \end{cases}$$

With the index function, the notation of $\bar{b}_j(k)$ can be expressed as:

$$\begin{aligned} \bar{b}_j(k) &= \frac{\sum_{t=1 \atop s.t.\ o_t = o_k}^{T} \gamma_t(j)}{\sum_{t=1}^{T} \gamma_t(j)} \\ &= \frac{\sum_{t=1}^{T} \gamma_t(j) \cdot \mathbf{1}_{\{o_k\}}(o_t)}{\sum_{t=1}^{T} \gamma_t(j)} \end{aligned}$$

Feel free to use the index function in your proof if it simplifies things. Still you can prove the equation without using the index function.