LBG Algorithm

LBG algorithm is like a K-means clustering algorithm which takes a set of input vectors $S = \{\mathbf{x}_i \in \mathbb{R}^d | i = 1, 2, ..., n\}$ as input and generates a representative subset of vectors $C = \{\mathbf{c}_j \in \mathbb{R}^d | j = 1, 2, ..., K\}$ with a user specified $K \ll n$ as output according to the similarity measure. For the application of Vector Quantization (VQ), d = 16, K = 256 or 512 are commonly used.

LBG Algorithm

- 1. Input training vectors $S = \{\mathbf{x}_i \in \mathbb{R}^d | i = 1, 2, \dots, n\}.$
 - 2. Initiate a codebook $C = \{ \mathbf{c}_j \in \mathbb{R}^d | j = 1, 2, \cdots, K \}.$
 - 3. Set $D_0 = 0$ and let k = 0.
 - 4. Classify the *n* training vectors into *K* clusters according to $\mathbf{x}_i \in S_q$ if $\|\mathbf{x}_i \mathbf{c}_q\|_p \leq \|\mathbf{x}_i \mathbf{c}_j\|_p$ for $j \neq q$.
 - 5. Update cluster centers \mathbf{c}_j , $j = 1, 2, \dots, K$ by $\mathbf{c}_j = \frac{1}{|S_j|} \sum_{\mathbf{x}_i \in S_j} \mathbf{x}_i$.
 - 6. Set $k \leftarrow k+1$ and compute the distortion $D_k = \sum_{j=1}^K \sum_{\mathbf{x}_i \in S_j} \|\mathbf{x}_i \mathbf{c}_j\|_p$.
 - 7. If $(D_{k-1} D_k)/D_k > \epsilon$ (a small number), repeat steps $4 \sim 6$.
 - 8. Output the codebook $C = \{ \mathbf{c}_j \in \mathbb{R}^d | j = 1, 2, \cdots, K \},\$

The convergence of LBG algorithm depends on the initial codebook C, the distortion D_k , and the threshold ϵ , in implementation, we need to provide a maximum number of iterations to guarantee the convergence.