Lloyd Max Quantizer

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For computing the reconstruction values and the decision boundaries of a Gaussian PDF, I have followed the below mentioned steps:

1. Initialize the decision boundaries considering uniform quantization i.e m[0], m[1], m[2]... m[L] at equal intervals. The values of m[0] and m[L] are fixed since they represent the maximum and minimum values the signal can take.   L = number of quantization levels
2. Based on the m[ ] values calculated, I am calculating the reconstruction values v[ ] based on the centroid formula.

$$v_{k,\,\mathrm{opt}} = \frac{\int_{m \in \mathcal{I}_k} m f_M(m)\,dm}{\underbrace{\int_{m \in \mathcal{I}_k} f_M(m)\,dm}_{\text{Probability } P_k \text{ (given)}}}$$

3. Then based on v[ ] values computed, I am calculating the m[ ] values by using this relation so that the decision boundaries are at the mid-point of the intermediate reconstruction values.

$$m_k - v_{k-1} = v_k - m_k$$
$$m_k = \frac{v_k + v_{k-1}}{2}$$

4. Afterwards I have calculated the mean deviation error using this relation -

$$D = \sum_{k=1}^{L} \int_{m \in \mathcal{I}_k} (m - v_k)^2 f_M(m)\,dm,\ f_M(m)$$

5. Then this repeats from step - 2 to 5 until either the difference between the previous error and present error becomes less than a threshold set or the number of iterations exceeds a particular max_iter

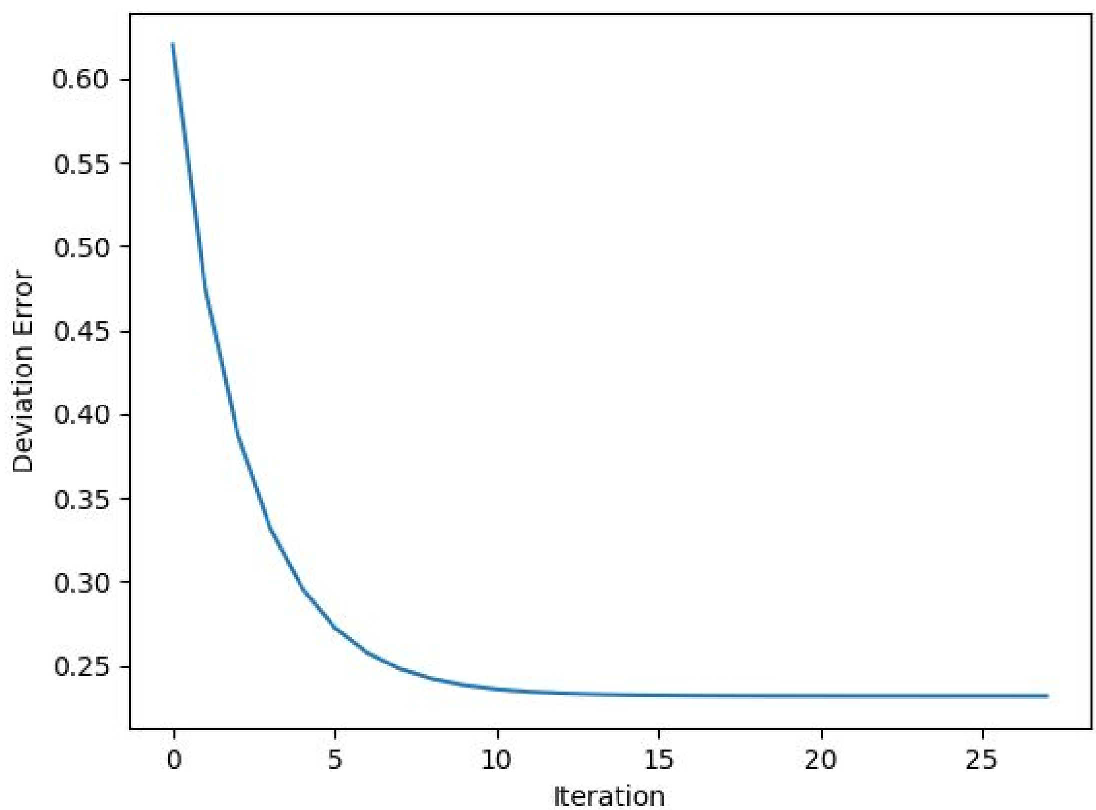
value(max_iter added so that it doesn't gets into an infinite loop and hang the pc)

6. For calculating the integral, I have used the quad function from the scipy.integrate library which takes the function (whose integral has to be found) as the first argument, integral limits and then any optional arguments which need to be passed

Demo example:

N_levels = 6, mean =0, variance = 4, max_value = 10, min_value = -10

Plot of mean deviation error with number of iteration



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