

Q) E step & M-Step :

Aus 2) Given: $\log P(x|\theta) \geq \sum_z q(z) \log \frac{P(z|x, \theta) P(x|\theta)}{q(z)}$

(a) Please provide a brief description on how to perform E step & M step in the above equation.

Now, it is given that -

$$\begin{aligned} \log \left(\sum_z q(z) \frac{P(x, z|\theta)}{q(z)} \right) &\geq \sum_z q(z) \log \frac{P(z|x, \theta) P(x|\theta)}{q(z)} \\ &\geq \sum_z q(z) \log \frac{P(x, z|\theta)}{q(z)} \quad \text{--- (1)} \end{aligned}$$

Now, in order to make the Jensen's equality ^{in (1)} hold tight i.e. hold for equality only -

$$\frac{P(x, z|\theta)}{q(z)} = \text{constant or}$$

$$P(x, z|\theta) \propto q(z) \text{ or } q(z) \propto P(x, z|\theta) \quad \text{--- (2)}$$

Since $q(z)$ is a ^{probability} ~~normal~~ distribution -

$$\therefore \sum_z q(z) = 1 \quad \text{--- (3)}$$