

INTRODUCE HIDDEN VAR
BY MARGINALIZATION

$$\mathcal{L}(\theta) = \log P(Y|\theta) =$$

$$= \log \sum_z P(Y, Z=z|\theta) =$$

$$= \log \sum_z Q(z) \frac{P(Y, Z=z|\theta)}{Q(z)}$$

TRUE FOR
EVERY
 $Q(z) \neq 0$

$$= \log \mathbb{E}_Q \left[\frac{P(Y, Z|\theta)}{Q(z)} \right]$$

$$\sum_z Q(z) f(z) = \mathbb{E}_Q[f(z)]$$

$$\geq \mathbb{E}_Q \left[\log \frac{P(Y, Z|\theta)}{Q(z)} \right]$$

APPLICATION
OF JENSEN
INEQUALITY
WITH \log
AND LINEAR
FUNCTION $\mathbb{E}_Q[\]$

$$= \underbrace{\mathbb{E}_Q[\log P(Y, Z|\theta)]}_{\text{EXPECTED COMPLETE LOG-LIKELIHOOD}} - \underbrace{\mathbb{E}_Q[\log Q(z)]}_{\text{ENTROPY}}$$

EXPECTED COMPLETE
LOG-LIKELIHOOD

ENTROPY