- INIT. VALUES FOR $\underline{\mu}, \underline{\underline{\Sigma}}, \underline{\pi}^{OLD}$ ← GOOD INIT K-MEANS
- (E) (EXPECTATION) $\gamma(z_{nk})$
- (M) (MAXIMIZATION) $\underline{\mu}, \underline{\underline{\Sigma}}, \underline{\pi}^{NEW}$

CONVERGENCE: — LOG LIKELIHOOD
— PARAMETER VALUES

EM ALGORITHM: GENERAL VIEW: FIND ML SOLUTION FOR MODELS WITH LATENT VARIABLES

$\underline{\underline{X}}, \underline{\underline{Z}}$ DATA (OBSERVED, LATENT)

$\underline{\theta}$ MODEL PARAMETERS

$$\ln p(\underline{\underline{X}}|\underline{\theta}) = \ln \left\{ \sum_{\underline{\underline{Z}}} p(\underline{\underline{X}}, \underline{\underline{Z}}|\underline{\theta}) \right\}$$

$(\underline{\underline{X}}, \underline{\underline{Z}})$ COMPLETE DATA SET

$(\underline{\underline{X}})$ INCOMPLETE —"—

KNOWLEDGE ABOUT $\underline{\underline{Z}}$ ← $p(\underline{\underline{Z}}|\underline{\underline{X}}, \underline{\theta})$ ← $\underline{\theta}^{OLD}$
↓ EXPECTATION
↓ MAXIMIZATION
↓ $\underline{\theta}^{NEW}$

$\underline{\theta}^{OLD}$
↓
(E) $p(\underline{\underline{Z}}|\underline{\underline{X}}, \underline{\theta}^{OLD})$
↓
(M) $\underline{\theta}^{NEW} = \arg\max_{\underline{\theta}} Q(\underline{\theta}, \underline{\theta}^{OLD})$

$\underline{\theta}^{OLD} \leftarrow \underline{\theta}^{NEW}$

$$Q(\underline{\theta}, \underline{\theta}^{OLD}) = \sum_{\underline{\underline{Z}}} p(\underline{\underline{Z}}|\underline{\underline{X}}, \underline{\theta}^{OLD}) \ln p(\underline{\underline{X}}, \underline{\underline{Z}}|\underline{\theta})$$

FINDING MAP SOLUTIONS:

$$Q(\underline{\theta}, \underline{\theta}^{OLD}) + \ln p(\underline{\theta})$$

$p(\underline{\theta})$
SOME PRIOR