

$$p(z|-)$$

$$p(z|\pi, \mu, x) \propto_z p(z, \pi, \mu, x) \propto_z \underbrace{p(x|z, \mu)}_{\text{Normal}} \underbrace{p(z|\pi)}_{\text{Bern.}} \quad (1)$$

$$= \prod_{i=1}^n N(x_i | \underbrace{\mu_{z_i}}_{\text{parameters}}, \Sigma^{-1}) \text{Bernoulli}(\underbrace{z_i}_{\text{c.v.}} | \pi) \quad \left[ \begin{array}{l} \text{This is} \\ \text{informal} \\ \text{and not} \\ \text{multiplic.} \end{array} \right]$$

$$= \prod_{i=1}^n \left\{ \underbrace{\left[ \pi N(x_i | \mu_1, \Sigma^{-1}) \right]}_{\alpha_{i1}}^{z_i} \left[ (1-\pi) N(x_i | \mu_0, \Sigma^{-1}) \right]^{1-z_i} \right\} \quad \begin{array}{l} \text{due to} \\ \text{the} \\ \text{dep of} \\ z_i \end{array}$$

$$= \prod_{i=1}^n \alpha_{i1}^{z_i} \alpha_{i0}^{1-z_i}$$

$$\propto_z \prod_{i=1}^n \text{Bernoulli}(z_i | \frac{\alpha_{i1}}{\alpha_{i0} + \alpha_{i1}}) \propto P$$