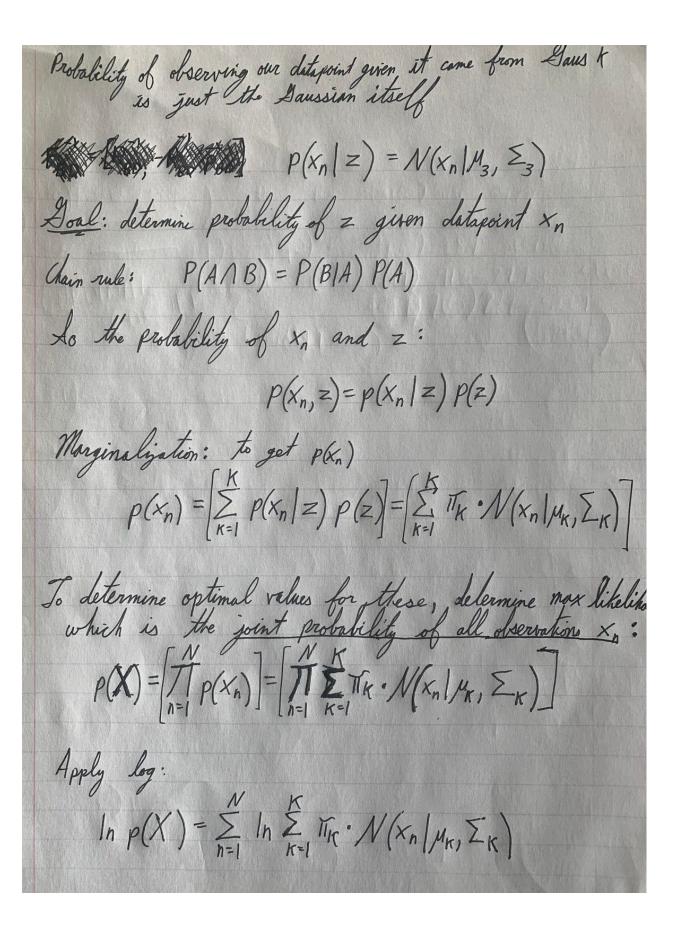
Diven datapoint x_n , what is the prob. that it came from Daus k? $P(Z_{Nh}=1 \mid x_n)$ The probability of observing a point that comes from Jacus k: $T_k = p(z_k=1)$ z = set of all possible latent variables for point x_n $z = \{z_1, \dots, z_k\}$

The probability of observing our datapoint given it came from \mathbb{R}^{k} $P(x_{n}|z) = \prod_{k=1}^{K} N(x_{n}|y_{k}, \sum_{k})^{z_{k}}$



... Which is the joint probability of all observations & latent variables. $\ln p(X, Z|\theta^*) = \sum_{n=1}^{N} \sum_{k=1}^{K} z_{nk} [\ln T_{K} + \ln N(x_n|\mu_K, \Sigma_k)]$ Estimate parameters by maximining Q with respect to parameters Replace Inp(X, Z 10") in above equation: $Q(\theta, \theta) = \sum_{n=1}^{N} \sum_{k=1}^{K} \gamma(z_{nk}) \left[\ln T_k + \ln N(x_n | M_k, \Xi_k) \right]$ Step 3: "Maximization Step," Find the revised parameters, O, using: where $Q(\theta,\theta)$ is taken from above Step 2. Also, include a Lagrange multiplier to take into account that IT values sum up to 1: $Q(\theta,\theta) = \sum_{n=1}^{N} \sum_{k=1}^{K} \gamma(z_{nk}) \left[\ln T_k + \ln N(x_n | \mu_k, \Sigma_k) \right] - \lambda \left(\sum_{k=1}^{K} T_k - 1 \right)$ Derivative of Q: $\frac{dQ(\theta,\theta)}{dT_{k}} = \sum_{n=1}^{N} \frac{\chi(z_{nk})}{T_{k}} - \lambda = 0$ $\sum_{n=1}^{N} \gamma(z_{nK}) = \prod_{k} \lambda \implies \sum_{k=1}^{K} \sum_{n=1}^{N} \gamma(z_{nk}) = \sum_{k=1}^{K} \prod_{k} \lambda$

Since $\sum_{k=1}^{K} T_k = 1$, and the sum of probabilities Y over K will also give us L, then $\lambda = N$ $T_k = \sum_{n=1}^{N} \frac{Y(z_{nK})}{X} = \sum_{n=1}^{N} \frac{Y(z_{nK})}{X}$ Then differentiate Q with respect to μ and Σ , equate the derivative to O, and solve for parameters with \log -likelihood equation: $\mu_k^* = \frac{\sum_{n=1}^{N} \frac{Y(z_{nK})}{X}}{\sum_{n=1}^{N} \frac{Y(z_{nK})}{X}}$ $\sum_{k=1}^{N} \frac{\sum_{n=1}^{N} \frac{Y(z_{nK})}{X}}{X}$ $\sum_{k=1}^{N} \frac{\sum_{n=1}^{N} \frac{Y(z_{nK})}{X}}{X}$