Algorithm 2: CAVI for a Gaussian mixture model

Input: Data $x_{1:n}$, number of components K, prior variance of component means σ^2

Output: Variational densities $q(\mu_k; m_k, s_k^2)$ (Gaussian) and $q(z_i; \varphi_i)$ (K-categorical)

Initialize: Variational parameters $\mathbf{m} = m_{1:K}$, $\mathbf{s}^2 = s_{1:K}^2$, and $\boldsymbol{\varphi} = \varphi_{1:n}$

while *the ELBO has not converged* **do**

  for $i \in \{1, \ldots, n\}$ **do**

    Set $\varphi_{ik} \propto \exp\{\mathbb{E}[\mu_k; m_k, s_k^2] x_i - \mathbb{E}[\mu_k^2; m_k, s_k^2]/2\}$

  end

  for $k \in \{1, \ldots, K\}$ **do**

    Set $m_k \longleftarrow \dfrac{\sum_i \varphi_{ik} x_i}{1/\sigma^2 + \sum_i \varphi_{ik}}$

    Set $s_k^2 \longleftarrow \dfrac{1}{1/\sigma^2 + \sum_i \varphi_{ik}}$

  end

  Compute ELBO$(\mathbf{m}, \mathbf{s}^2, \boldsymbol{\varphi})$

end

return $q(\mathbf{m}, \mathbf{s}^2, \boldsymbol{\varphi})$