# Advanced Probabilistic Machine Learning and Applications

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## 1 Tutorial 12: Variational Inference

### Exercise 1: implementing Gaussian Mixture Model with VI

In this tutorial we will implement the CAVI algorithm for the GMM model and replicate the figure of Lecture 12 notes.

(a) Draw synthetic dataset of GMM with $K = 3$ and $N = 1000$ datapoints.

(b) Derive the ELBO for this model.

(c) Implement the CAVI updates for this model using what learned in the Lecture.

(d) Run the algorithm and plot the results at convergence.

(e) Plot the behavior of the ELBO over iteration time. Comment.

(f) Plot the state of the variational result for the mixture mean parameters at the iteration times where the ELBO changes significantly. Comment.

(g) Calculate accuracy in labeling the datapoints by cluster.