

# Advanced Probabilistic Machine Learning and Applications

Caterina De Bacco and Alessandro Lonardi

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## 1 Tutorial 9: 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 9 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 labelling the datapoints by cluster.