

# Amortized Mixture and Multilevel Models

*Paul Bürkner*

TU Dortmund University.

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## **Abstract**

Probabilistic mixture and multilevel models are central building blocks in Bayesian data analysis. However, they remain challenging to estimate and evaluate, especially when the involved likelihoods or priors are analytically intractable. Recent developments in generative deep learning and simulation-based inference have shown promising results in scaling up Bayesian inference through amortization. Against this background, we have developed specialized neural inference frameworks for estimating Bayesian mixture and multilevel models. The involved neural architectures are closely mirroring the probabilistic symmetries and conditional (in-)dependencies assumed by these models. This not only speeds up neural network training, but also enables amortized inference for new datasets of varying number of groups and sample sizes.

**Keywords:** Amortized Bayesian Inference; Neural Posterior Estimation; Probabilistic Factorization.