



## Bachelor/Master Thesis:

# Gaussian Mixture Library for Probabilistic AI: GMTorch

#### Topic

Gaussian Mixtures (GMs) are powerful for modeling complex, multimodal distributions and are widely used in clustering, density estimation, and generative modeling. Their probabilistic nature allows for soft assignments, enabling nuanced interpretations. Building a custom GM library on top of PyTORCH is crucial to leverage its autograd system for efficient gradient computation, especially when extending GMs with neural components or integrating them into deep architectures. PyTorch's GPU acceleration and modular design further enable scalable, differentiable implementations, making it ideal for research and experimentation. A dedicated library ensures flexibility, reproducibility, and easier integration with modern deep learning workflows.

#### Path

Our goal is to have a minimal GM library that has the core functionalities that mostly arises in probabilistic AI.

#### Prerequisite

There are no hard constraints but the more programming and math you know the more you can have fun while doing the project.

### What I offer

- A teammate/supervisor who is actually present.
- Possibility to be a co-author in a research level publication.
- A BSc/MSc thesis project that will be used in production level software for an enterprise level project.
- I can probably provide you with an office.
- Nice private IT infrastructure to implement whatever wild ideas you have in mind.

Contact: Ali Darijani

ali.darijani@iosb.fraunhofer.de ali.darijani@kit.edu