

A Comparative Study of Probabilistic Programming Frameworks: Pyro vs TensorFlow Probability

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R244 Mini Project

• Pyro



- Pyro
- TensorFlow Probability



- Pyro
- TensorFlow Probability
- Similarities

| Aspect | | |
|----------------------------------|--|--|
| Probabilistic Programming | | |
| Bayesian Modeling | | |
| Autodiff Support | | |
| Flexible Model Design | | |
| Monte Carlo Methods | | |
| Variational Inference | | |
| Distributions | | |
| Integration with Neural Networks | | |
| Open Source | | |
| Parallel Computation | | |



- Pyro
- TensorFlow Probability
- Similarities
- Differences

| Aspect | Руго | TensorFlow Probability (TFP) |
|-----------------------------|--|--|
| Backend | PyTorch | TensorFlow |
| Execution Style | dynamic computation graph | static computation graphs but supports eager execution |
| Inference Algorithms | emphasizes variational inference and MCMC methods | offers variational inference and MCMC with a wider variety of pre-built algorithms Hamiltonian Monte Carlo (HMC). |
| Performance on Large Models | may incur overhead for large-scale production environments | Better suited for large-scale production tasks with TensorFlow's optimizations |
| Real-Time Applications | suits for real-time and interactive probabilistic modeling tasks | stronger for production environments with tools like TensorFlow Serving |



Task 1 - Performance Comparison

- Model: Bayesian Neural Network (BNN)
- Algorithm: Variational Inference (VI) for parameter estimation.
- Dataset: CIFAR-10



Task 2 - Computation Trade-offs

- Model: Gaussian Process Regression
- Algorithm: Hamiltonian Monte Carlo (HMC)
- Dataset: UCI Machine Learning Repository's Diabetes Dataset ???



Goal

- usability, flexibility, and performance
- strengths and limitations of each framework
- computational trade-offs
- learning curves and application domains
- evaluate quantitatively and qualitatively



Project Plan and Timeline

Day 1: Dataset preparation and environment setup.

Day 2: Model and algorithm implementation in Pyro and TFP.

Day 3: Run experiments, collect metrics, and analyze results.

Day 4: Summarize findings, create visualizations

Day 5: Write the report.

