

## USRA PROJECT LIST 2025

**Project Title:** Flexible, efficient approximations for high-dimensional distributed Bayesian inference

Bayesian inference is a tool that is widely used in many fields of science and engineering to model reality while quantifying uncertainty. In order to perform Bayesian inference in practice with modern, cutting-edge models, we require computational methods that can draw from complex, high-dimensional probability distributions. One of the most successful state-of-the-art techniques for sampling from recent years is based on annealing, where draws from a simple, tractable distribution (the reference distribution) are sequentially perturbed towards a complex target distribution of interest. In order to make the process efficient, the reference distribution should be as similar to the target distribution as possible.

This summer research project will involve developing novel reference distributions for use in annealing methods. The project will have two phases. The first phase will involve developing reference distributions that are tractable to learn and simulate from based on Gaussian graphical models and probabilistic circuits. In the second phase, these will be implemented in the Pigeons open source software package ([pigeons.run/dev/](https://pigeons.run/dev/)), which enables practitioners to harness distributed computing for performing Bayesian computation at scale. As an optional third phase, theoretical convergence of the novel reference distributions will be analyzed.

The student research assistant will have the opportunity to gain experience in annealing methods, Monte Carlo methods, variational methods, optimization, and distributed computing. Proficiency with either Python or Julia required. Strong mathematical and coding skills are preferred. Experience (from course work or otherwise) with Monte Carlo methods, variational inference, and optimization is an asset.

**Please contact Trevor Campbell at [trevor@stat.ubc.ca](mailto:trevor@stat.ubc.ca) if interested with the following:**

- current transcript (showing course averages)
- CV