**STA 663 Final Project**

**Infinite Latent Feature Models and the Indian Buffet Process**

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1. Summary

In this paper, we explore the Indian Buffet Process. It is a Bayesian Non-Parametric approach to unsupervised learning when there are potentially infinite numbers of features. In unsupervised learning, the goal is to describe hidden structure from unlabeled data groups. In other words, we would like to group the data into categories, such that the categories are learned from the data itself. One way is to use a standard clustering algorithm like k-means or Gaussian mixture modeling. The problem is that both these methods assume a fixed number of groups that are determined by the user. Unfortunately, most real world data do not have a fixed number of groups. Non-parametric Bayesian methods allow us to model such data by allowing the number of groups to grow with the addition of more data. One such non-parametric method is the Chinese Restaurant Process, where we allocate a data point to a group with some probability while also allowing a data point to form a new group. The Indian Buffet Process is an extension of the Chinese Restaurant Process in which we allow data points to belong to multiple groups. For the purpose of this paper, we shall implement the algorithm described in the paper “Infinite Latent Feature Models and the Indian Buffet Process” by Griffiths and Ghahramani (2005). We will simulate an image dataset similar to that used in Griffiths and Ghahramani (2005) to test our code. Once we implement the algorithm, we shall attempt to optimize it in regards to computational efficiency.

1. Introduction
2. Implementation
   1. Algorithm for Gibbs Sampling and Metropolis-Hasting
      1. Parameters
      2. Priors
      3. Full Conditional Posteriors
      4. Metropolis-Hastings
3. Profiling and Optimization
   1. Cython
   2. Parallelization and CUDA
4. Unit Testing
5. Application and Results