A Monte Carlo Markov Chain Technique to Reinforcement Learning

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This project will analyze how a Markov chain Monte Carlo technique can be implemented in reinforcement learning. This underlying Bayesian technique will enable an algorithm to make decisions based off of state changes and probability ratios. I am fascinated by algorithms being able to learn based on the actions taken. This project is inspired by my summer REU project. Although that project was categorized as statistics, I argue that the Bayesian procedure that we developed is a reinforcement learning algorithm. I, however, do not want to steal or copy any of that work and will instead take a broader look into how a Bayesian procedure aided by a Markov chain Monte Carlo can be used in a reinforcement algorithm.

My goal with this theoretical project is to look at the math behind the algorithms and the potential applications this reinforcement learning approach has. Below are some academic sources I have gathered. I would also like to apply this project to a clustering problem. The Bayesian framework would help determine the location and number of clusters and error rates. The output would be two distribution, one being the location and one being the number of clusters. Coded in python, this algorithm theoretically could take any data and would output the distribution of number and location of clusters as well as the error rates.

Initial research has brought up that MCMC technique can be computationally time-consuming and time expensive. However, some approaches such as in [4] have shown that using a simple Gibbs sampler produced results that contained lower error rates compare to no Bayesian techniques. Bayesian clustering algorithms also already exist such as in [1], although this paper is relatively old and confusing it provides evidence that approaching a clustering problem with Bayesian statistics is possible.

References

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