CS 561 Assignment 1

Due on 4th Sept (Tuesday) 5:00 PM

Exercise 1: The objective of this exercise is to understand the Metropolis-Hastings algorithm, a Markov chain Monte Carlo (MCMC) method for sampling.

Consider the following distribution

$$P(x) = \frac{\exp(-x^4)\ (2 + \sin(5x) + \sin(-2x^2))}{\int_{-\infty}^{\infty} \exp(-x'^4)\ \left(2 + \sin(5x') + \sin\left(-2x'^2\right)\right)dx'}$$

Assume that the integration is difficult to solve and you know that

$$P(x) \propto \exp(-x^4)\ (2 + \sin(5x) + \sin(-2x^2))$$

The distribution is shown in Figure 1. Generate samples from this distribution using Metropolis-Hastings algorithm with normal distribution as proposal distribution.

- Generate the candidate using normal distribution with the current state as mean of the distribution i.e. $x^*|x_n \sim Normal(x_n, \sigma^2)$.

- Set $x_0 = -1$, generate 1500 samples for three different values of σ ($low = .05$, $medium = 1$, and $high = 50$) . Plot the histogram of the generated samples and compare with actual distribution for each of the σ values, and also plot the generated sample versus iteration (the actual Markov chain-the sequence of generated values) for each of the σ values.

- Submit your code and a report (hard copy not more than one page –both sides printed) that should have the plots and the conclusions drawn from the plots.

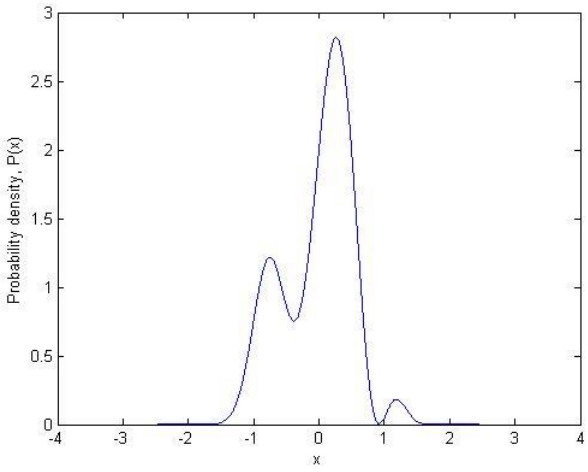

Figure 1. The distribution from which samples are required to be drawn