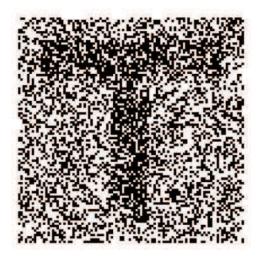# Homework 5

June 19, 2018

1. The goal is to denoise the follow image (data4.mat/data4.txt).

   Assume that the image prior is

   $$\pi(x) = \frac{1}{Z_T} \exp^{\frac{1}{T} \sum\limits_{<i,j>} x_i x_j} .$$

   where T is a fixed temperature, and $<i,j>$ denotes that i and j are neighbor to each other. The $i = (i_1, i_2)$ and $j = (j_1, j_2)$ are neighbor to each other if

   $$|i_1 - j_1| + |i_2 - j_2| = 1.$$

   Assume that the image above is from an image with flipping noise 0.375. (The probability of each pixel from -1 to 1 or from 1 to -1 is 0.375).

   (a) From Bayesian point of view, the original image y is the image which has the largest probability to produce the observed image x. Can you write down the probability of the original image y given the observed image x?

(b) Design a Metropolis-Hastings algorithm to sample images from the distribution you obtained above. (You can plot the image after each iteration to see the sequence of images sampled by the Markov chain. You should also try different temperatures T, eg. T=0.01, 0.05, 0.1, 0.3, 1, 3, 5, 10.)

(c) Comment on your experiments above.

2. Can you figure out the words below? A secret (and good) reward will be unlocked from the solution.

o rmaeqwzeqd rui wugelfuc zlfjuqgdcuna bzfyucg huqgfcfuh ajcuq uyfuhdqgui wauy rqfuoeaz uo jfcudpui wueafuqgfup-dacqu rfudruqgfuozeccui waumaejfuhdzzubfueunzwcup auqg-fucqeqdcqdoezuo ynwqdrmuneaqur uyeqqfaug hubejziui wuj udruqgfupdrezufsey