# Programming Assignment 2

## Question 1

Outline a Gibbs sampling algorithm (in pseudocode) that iterates over the pixels in the image and samples each yij given its Markov blanket. Use the simple approach of sweeping across the image in row-major fashion on every iteration of the algorithm. Thus, an "iteration" will generate a complete new sample of y. Allow for a burn-in of B iterations, followed by draws of S samples.You may assume  and  are fixed constants.

### Solution

```
Initialize starting values of y_i,j for i = 1, j =1, M,N, ita, beta;
for B do (while not at convergence):
pick an order of the M × N variables;
    for each variable y_i,j do:
        sample y_i,j based on P(y_i,j | y_Nbr(i,j));
        update y_i,j to Y ;
    end
end
for S do (while at convergence):
pick an order of the M × N variables;
    for each variable y_i,j do:
        sample y_i,j based on P(y_i,j | y_Nbr(i,j));
        update y_i,j to Y ;
    end
end
```

## Question 2

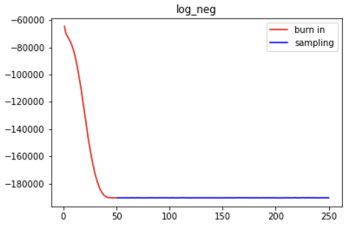
1. Do all three seem to be converging to the same general region of the posterior, or are some obviously suboptimal?

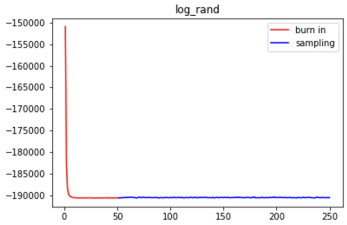
2. Does the burn-in seem to be adequate in length?

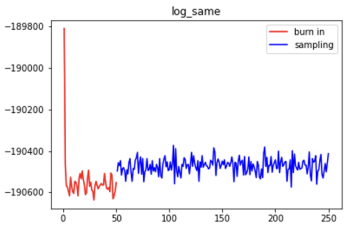
3. Is there substantial fluctuation from iteration to iteration, indicating that the chain is mixing well, or does it become stuck at particular energies for several iterations at a time?

# Programming Assignment 2

## Solution




| Section | Log_neg | Log_rand | Log_same |
|---|---|---|---|
| 1 | Converges to the region between -180000 and -190000 | Converges to the region between -190000 and -192000 | Converges to the region between -190400 and -190700 |
| 2 | The assigned length of burn-in is reasonable | The assigned length of burn-in is reasonable, but the value converged approximately after 20th iteration | Can obviously observe the difference between burn-in and sample, therefore, the length is reasonable |
| 3 | No significant flactuations here | No significant flactuations | The substantial fluctuation from iteration to iteration is observed (the chain is mixing well) |

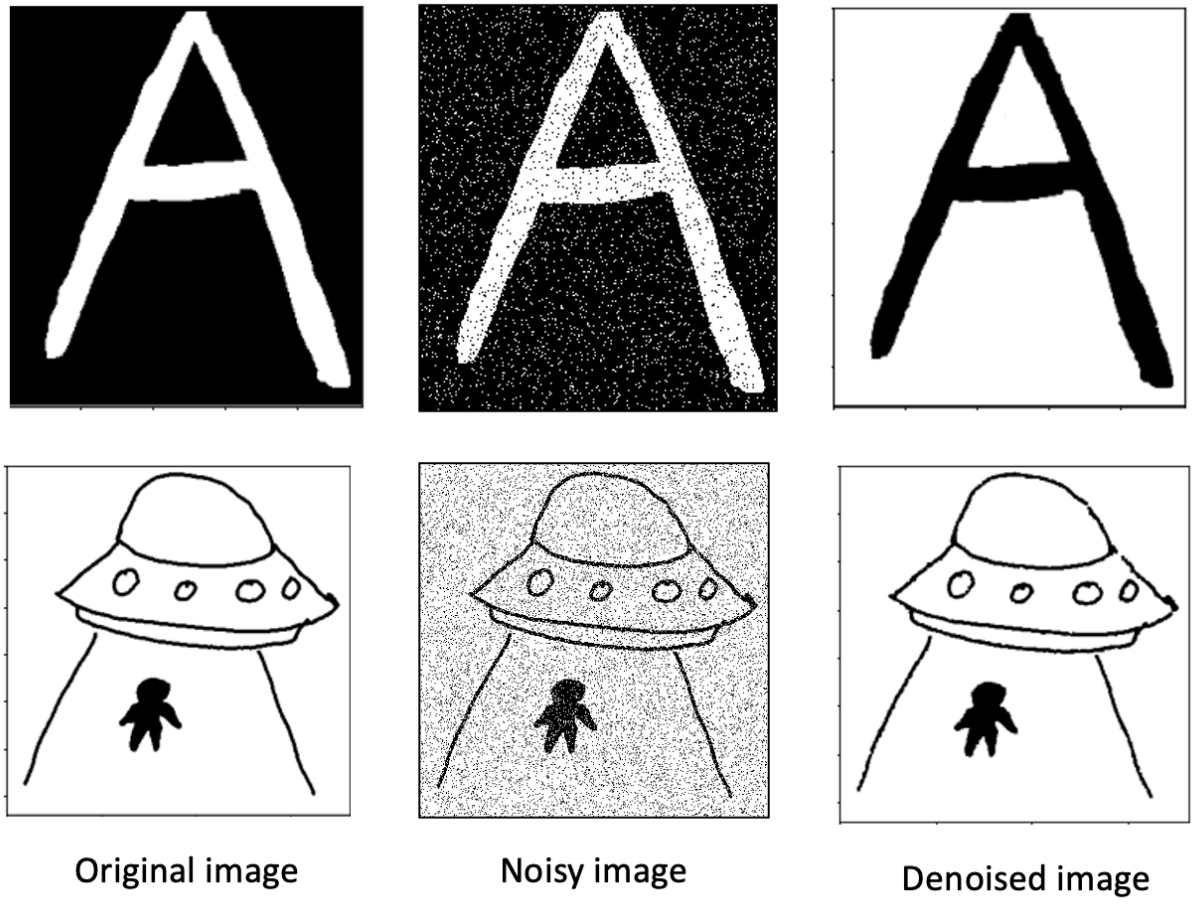
1. If generalize, then all three converge to the same general region.
2. Burn-in seems adequate in length, but the *log_rand* burn-in length could be decreased.
3. The substantial fluctuation from iteration to iteration can be observed for *log_same*

# Question 3

1. Prepare a figure for each the the two images, showing the original, the noisy version, and the restoration side by side.
2. Report the restoration error for each image.

# Programming Assignment 2

## Solution




```
restoration error for image a : 0.992262
restoration error for image b : 0.004810
```

# Problem 4

How many hours did you spend on this assignment?

## Solution

15 to 20 hours