

Homework VII

Deadline: 2018-1-3

1. (20 pts.) Reproduce the numerical example on pg. 36 of Lecture 12. That is, compare gradient descent, Newton's method and BFGS for minimizing the function

$$f(\mathbf{x}) = 100(x_2 + x_1^2)^2 + (1 - x_1^2).$$

Report the number of iterations for each algorithm to achieve the accuracy $\|\mathbf{x}_k - \mathbf{x}_*\|_2 \leq 10^{-6}$, where \mathbf{x}_* is the true minimizer of $f(\mathbf{x})$.

2. (20 pts.) Code Lloyd's algorithm to cluster the **two circles** data as shown on pg. 8 of Lecture 13. Plot the data and your clustering result. Moreover, plot $E(\mathbf{c})$ and verify that it decreases monotonically. Two tips:

- You can generate a circle with radius **r** perturbed by gaussian noise with mean 0 and standard variance **sigma** as follows

```
theta = 2*pi*rand(n,1);  
X = [r*cos(theta)+sigma*randn(1000,1) r*sin(theta)+sigma*randn(1000,1)];
```

Here, **n** is the number of points sampled on each circle. The example presented in Lecture 13 has **n**=1000, **sigma** = 0.15, and **r**=2, 3 respectively.

- You are free to choose the two initial centers.