Lab Assignment 4b: Optimization for Machine Learning

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Write python codes of descent methods with inexact line search technique for the following function:

(1) $f : \mathbb{R}^2 \to \mathbb{R}$ is defined by $f(x) = 0.5(100(x_1 - x_2^2)^2 + (r - x_1)^2)$ with and $x^0 = (2r, -2r)$ where r is the last digit of your roll number. If last digit of your roll number is 0 then choose $r = 1.75$. Find number of iterations, function evaluations and gradient evaluations.

(2) Solve the above problem with descent direction at $x^k = -B\nabla f(x^k)$ where $B = \begin{bmatrix} 2r & \sqrt{r} \\ \sqrt{r} & r \end{bmatrix}$. Find number of iterations, function evaluations and gradient evaluations. Does this method take less number of iterations?

(3) Solve the above problem with descent direction at $d^k = -{B^k}^{-1}\nabla f(x^k)$ where $B^0 = I_2$ and $B^{k+1} = B^k + \frac{s^k {s^k}^T}{{s^k}^T \delta^k} - \frac{B^k s^k {s^k}^T B^k}{{s^k}^T B^k s^k}$ where $\delta^k = x^{k+1} - x^k$ and $s^k = \nabla f(x^{k+1}) - \nabla f(x^k)$. Find number of iterations, function evaluations and gradient evaluations. Which method takes less number of iteration among three.?