Lab Exam

Optimization in ML

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Write python codes for the following problems.

1. Consider the function
$$f(x) = \sum_{i=1}^{9} \left(100(x_{i+1} - x_i^2)^2 + (1 - x_i^2)\right)$$
where is last two digits of your roll number. Suppose descent direction at x^k is descent direction is found by solving
$$\min_d \ \nabla f(x^k)^T d + \frac{1}{2} D_h(x^k + d, x^k)$$
where $h(x) = x^T Q x$, Q is given in excell file Q_matrix. Write a python code for mirror descent method with Armijo type line search using $x^0 = (0.5, 0.5, \ldots, 0.5)^T$. Use stopping criteria $\|\nabla f(x)\| < 10^{-3}$ or $\alpha_k < 10^{-5}$ or 500 iterations. (6)

2. In '$datasetlab\_1$', price of a product based on $x = (diameter, weight, red, green, blue)$ is given for sample 200. Write a code for proximal gradient method
$$\min \frac{1}{2}\|Ax - y\|^2 + \|x\|_1$$
with $x^0 = (0, 0, 0, 0, 0)^T$, $\alpha_k = \frac{1}{1+k}$. Use maximum 500 iterations as stopping criteria. Predict the price for $(R/10, 10R, R + 50, 2R, 2)$, where R is last digit of your roll number. (7)

3. Write both primal and dual of the SVM code for the data set $insulin\_2$. Replace 0 in outcome column by -1. Predict outcome for $(0, 100 + R, 55 + R, 25 + R/10, 0, 5R/8, R/10, A,)$ where R is last two digits of your roll no and A is your age. (7)