THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

Machine Learning II
Homework #5
Due: *Oct-12-2020*

Homework 5:

- **Show ALL Work, Neatly and in Order.**
- **No** credit for Answers Without Work.
- Submit a single pdf file includes all of your solutions.
- **DO NOT** submit individual files or images.
- For coding questions, submit **ONE** .py file and include your comments.

E.1:

Consider the following function:

$F(x) = [1 + (x_1 + x_2 - 5)^2][1 + (3x_1 - 2x_2)^2]$

i. Perform one iteration of Newton's method, starting from the initial guess $\begin{bmatrix}10 & 10\end{bmatrix}^T$

ii. Repeat part (i), starting from the initial guess $\begin{bmatrix}2 & 2\end{bmatrix}^T$

iii. Find the minimum of the function, and compare with your results from the previous two parts.

E.2:

For the following functions find the first and second directional derivatives from the point $\begin{bmatrix}1 & 1\end{bmatrix}^T$ in the direction $\begin{bmatrix}-1 & 1\end{bmatrix}^T$.

i. $F(x) = \frac{7}{2}x_1^2 - 6x_1x_2 - x_2^2$

ii. $F(x) = 5x_1^2 - 6x_1x_2 + 5x_2^2 + 4x_1 + 4x_2$

iii. $F(x) = \frac{9}{2}x_1^2 - 2x_1x_2 + 3x_2^2 + 2x_1 - x_2$

iv. $F(x) = \frac{-1}{2}(7x_1^2 + 12x_1x_2 - 2x_2^2)$

E.3:

For the functions of Exercise E2:

i. Find the stationary points.

ii. Test the stationary points to find minima, maxima or saddle points

iii. Provide rough sketches of the contour plots, using the eigenvalues