

# Homework 6

## Question 1

Put the following function in the general form of quadratic functions:  $Q(x) = (1/2)x^T Ax + b^T x + c$ :

$$Q(x) = 2x_1^2 + 3x_2^2 + 3x_1x_2 + 0.5x_1 + 0.5x_2$$

## Question 2

Let  $Q(x) = (1/2)x^T Ax + b^T x + c$ , for  $A = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ ,  $b = 0$  and  $c = 0$ :

Plot the surface and the 2D contour lines of  $Q(x)$  in the same figure (side by side) - in the range  $[-4, 4]$  in both the  $x$  and  $y$  axes.

## Question 3

Let  $F(x)$  be as follows:

$$F(x, y) = (x^2 + y - 11)^2 + (x + y^2 - 7)^2$$

Find a minimum of the previous function starting from point  $(4, -4)$  using the following methods in the `minimize` function (of `scipy.optimize` module):

1. Powell's method
2. Conjugate Gradient
3. BFGS

Plot the 2D contour of the function and the path starting from the given initial point to the minimum for range  $[-5, 5]$  in both  $x$  and  $y$  axes. For the Conjugate Gradient and BFGS methods, send the minimize function a callable to the gradient of the given function. Print the found minima, number of iterations and number of function evaluations for each method.