Algorithms for optimisation
Problem Set # 1
Due date: 29/01/2020

1. In conjugate gradient descent, what is the normalised descent direction at the first iteration for the function $f(x,y) = x^2 + xy + y^2 + 5$ when initialised at $(x,y) = (1,1)$? What is the resulting point after two steps of the conjugate gradient method?

First order methods:

2. Take the Rosenbrock function : $f = (1-x_1)^2 + 5(x_2 - x_1^2)^2$, with an initial guess of $(x1,x2) = (-1.5,-1.5)$. Find the optimum of this function using
   (a) Steepest descent
   (b) Gradient decent with line search
   (c) Conjugate gradient (Polak-Ribier)

Note: Include your code along with the results. Annotate the code describing each step of implementation. Compare the performance of the methods, by reporting

- the number of steps (iteration) taken by your code to reach the optimal point within a certain error (change the error and see how this number changes)
- time to solution
- Plot the steps and compare the paths taken by each method