OPTIMIZATION. HOMEWORK 7

OSCAR DALMAU

(1) Implement the following Non Linear Conjugate Gradient methods: Fletcher-Reeves (FR), Fletcher-Reeves Polak-Ribiere (FRPR) and Hestenes-Stiefel (HF). Apply the previous implementations to the following functions and compare the results with respect to: number of iterations, norm of the gradient $\|\nabla f(\boldsymbol{x}_k)\|$ and the error $|f(\boldsymbol{x}_k) - f(\boldsymbol{x}^*)|$. Use two initial points: the initial point provided below and another randomly selected.

- Rosembrock function, for $n = 100$

$$\begin{aligned} f(\boldsymbol{x}) &= \sum_{i=1}^{n-1} \left[100(x_{i+1} - x_i^2)^2 + (1 - x_i)^2\right] \\ \boldsymbol{x}^0 &= [-1.2, 1, 1, \cdots, 1, -1.2, 1]^T \\ \boldsymbol{x}^* &= [1, 1, \cdots, 1, 1]^T \\ f(\boldsymbol{x}^*) &= 0 \end{aligned}$$

- Wood function

$$\begin{aligned} f(\boldsymbol{x}) &= 100(x_1^2 - x_2)^2 + (x_1 - 1)^2 + (x_3 - 1)^2 + 90(x_3^2 - x_4)^2 \\ &\quad +10.1[(x_2 - 1)^2 + (x_4 - 1)^2] + 19.8(x_2 - 1)(x_4 - 1) \\ \boldsymbol{x}^0 &= [-3, -1, -3, -1]^T \\ \boldsymbol{x}^* &= [1, 1, 1, 1]^T \\ f(\boldsymbol{x}^*) &= 0 \end{aligned}$$