Homework 1
CPO-2018

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May 16, 2018

Due Friday 25/05/2018.
Send it via e-mail with subject HW1-CPO-2018

For each function f in the list below, program a python function
```
def BBname(x):
```
that for a vector x it returns the value of the function $f(x)$, its gradient
$\nabla f(x) := (\frac{\partial f(x)}{\partial x_1}, \frac{\partial f(x)}{\partial x_2}, \ldots, \frac{\partial f(x)}{\partial x_n})$, and its hessian matrix

$$\nabla^2 f(x) := \begin{bmatrix} \frac{\partial^2 f(x)}{\partial x_1^2} & \frac{\partial^2 f(x)}{\partial x_1 \partial x_2} & \cdots & \frac{\partial^2 f(x)}{\partial x_1 \partial x_n} \\ \frac{\partial^2 f(x)}{\partial x_2 \partial x_1} & \frac{\partial^2 f(x)}{\partial x_2^2} & \cdots & \frac{\partial^2 f(x)}{\partial x_2 \partial x_n} \\ \vdots & \vdots & \ddots & \vdots \end{bmatrix}$$

1. $f(x) = \sum_{i=1}^{n} i x_i^2 + \frac{1}{100}(\sum_{i=1}^{n} x_i)^2$

2. $f(x) = \sum_{i=1}^{n-1}(x_i - 1)^2 + (\sum_{i=1}^{n} x_i^2 - 0.25)^2$

3. $f(x) = \sum_{i=1}^{n/2} 100(x_{2i} - x_{2i-1}^3)^2 + (1 - x_{2i-1})^2$

4. $f(x) = \sum_{i=1}^{n/2}(1.5 - x_{2i-1}(1 - x_{2i}))^2 + (2.25 - x_{2i-1}(1 - x_{2i}^2))^2 + (2.625 - x_{2i-1}(1 - x_{2i}^3))^2$

5. $f(x) = \sum_{i=1}^{n} q_i^4 - 20q_i^2 - 0.1q_i$, where

$$q_i = \sum_{j=i}^{\min\{n, i+20\}} x_j$$