UNIVERSITE DE GENEVE
Faculté des sciences

Section de Mathématiques

Optimization with Applications I
TP 1

These exercises are meant to familiarize yourself with the development environment around python. Please install something like PyCharm and then solve the following.

Exercise 1 (First function)**.** Implement a function that given a value $x \in [1, \infty)$ returns $\sqrt{x-1}$. Plot this function using the library matplotlib.

Exercise 2 (Numerical derivative)**.** Implement a function *numerical_derivative* that gets as input a function $f : \mathbb{R} \to \mathbb{R}$, a point $x_0 \in \mathbb{R}$ and the value $\epsilon > 0$ and returns the left a right difference quotients

$$\frac{f(x_0+\epsilon)-f(x_0)}{\epsilon}, \quad \frac{f(x_0-\epsilon)-f(x_0)}{-\epsilon}.$$

Test this with the function from Exercise 1 and compare to the actual value.

Exercise 3 (Numerical gradient)**.** Write a function *numerical_gradient* that is given a multivariate function $f : \mathbb{R}^n \to \mathbb{R}$, a point $x_0 \in \mathbb{R}^n$ and the value $\epsilon > 0$ and returns the approximation to the gradient. You can use your function from Exercise 2.

IMPORTANT : Every function and exercise must be tested. Plug in some values for which you know the correct answers and compare the output of your function.