**MCL758 Optimization** **04th March 2024**

# Project 1: Gradient Descent Algorithm with Armijo's Rule

The projects requires you to write a Python code that performs steepest gradient descent, using Armijo's rule for the step size. The code should take the following as an input from the user.

(a) A function $f : \mathbb{R}^2 \to \mathbb{R}$ that is to be minimized (assume input function to be smooth with Lipschitz gradient), and

(b) $\epsilon$, for the stopping criteria $\|\nabla f(x)\| \leq \epsilon$.

Let the Armijo parameter $s = 1$. Perform analysis with respect to the Armijo's parameters $\sigma$, and $\beta$, i.e., run the code for $N$ pair (at least 5) of values of $(\sigma, \beta)$, where $\sigma \in [10^{-5}, 10^{-2}]$ and $\beta \in [1/10, 1/2]$. For each of the above 5 pairs, plot the progression of the descent steps on the contour plot of $f(x)$, as elucidated in the figure below.

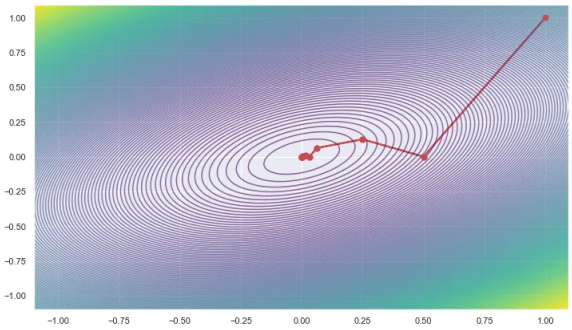


Figure 1.1: Steepest descent Steps with Armijo's rule

**Submission guidelines:** Details to be updated soon. Broadly, you will be required to submit the `.ipynb` file (IPython Notebook) that determines the minimum value, and prints the value of $x^*$ and the contour plot (along with the descent step) for each of the $N$ pair of parameters $(\sigma, \beta)$.

**Submission deadline:** 22nd March 2024.

**Total marks:** 5 points