ECE 490: Introduction to Optimization **Spring 2017**

Project II

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1.

Let $f(x_1, x_2, x_3) = w_1 \log x_1 + w_2 \log x_2 + w_3 \log x_3 - \dfrac{1}{(1 - x_1 - x_2 - x_3)^2}$ over the domain $D = \{x \in \mathbb{R}^3 : x_1 > 0, x_2 > 0, x_3 > 0, x_1 + x_2 + x_3 < 1\}$.

Write a python function that will take as input the weight vector w, an initial point $x^{(0)}$, and the parameters α, β, σ, and ϵ. The output should be the resulting x and $f(x)$ from running Armijo's rule and steepest descent until $\|\nabla f(x_k)\| \leq \epsilon$.

The parameters for Armijo's rule and the value ϵ of should be selected by you.

Use your function to numerically maximize $f(x_1, x_2, x_3)$ for the following choices for the constants w and starting points $x^{(0)}$:

(a) $w_1 = 1$, $w_2 = 1$, $w_3 = 1$. $x^{(0)} = \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$.

(b) $w_1 = 1$, $w_2 = 2$, $w_3 = 3$. $x^{(0)} = \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$.

(c) w and $x^{(0)}$ of your choosing.

(d) Use **scipy.optimize** to solve the above problem. Compare your results with parts (a)-(c).

Note: Because of the constraint set, the choice of α in Armijo's rule should be small enough such that $x_k \in D$ at iteration k.

2.

Repeat for $g(x_1, x_2, x_3) = w_1 \log x_1 + w_2 \log x_2 + w_3 \log x_3 - \dfrac{1}{(1 - x_1 - x_2)^2} - \dfrac{1}{(1 - x_1 - x_3)^2}$ over the domain $D = \{x \in \mathbb{R}^3 : x_1 > 0, x_2 > 0, x_3 > 0, x_1 + x_2 < 1, x_1 + x_3 < 1\}$.