Exercise 1  Show that the steepest descent direction

$$- \frac{\nabla f(x_k)}{\|\nabla f(x_k)\|_2}$$  \hspace{1cm} (1)

is the solution of the constrained problem:

$$\min_d \nabla f(x_k)^t d$$  \hspace{1cm} s.t.  \hspace{1cm} \|d\|_2^2 = 1.$$  \hspace{1cm} (2)

Exercise 2  Consider the following unconstrained problem:

$$\max_x f(x) = 2x_1x_2 + 2x_2 - x_1^2 - 2x_2^2.$$  \hspace{1cm} (3)

Find its solution using the steepest ascent method starting from the point

$$x^{(0)} = (x_1^{(0)}, x_2^{(0)}) = (0, 0).$$