CS730 Assignment #3

1. Show that the conjugate direction choice:

   $$d_i = -\nabla f(x_i) + \alpha_i d_{i-1}, \tag{1}$$

   for $\min\limits_{x \in R^n} f(x)$, where $f : R^n \longrightarrow R$ is a differentiable function on R^n, satisfies condition (2) of OLM: "Parallel Gradient Distribution in Unconstrained Optimization", SICON 33, 1995, 1916-1925 (PGD):

   $$-\nabla f(x_i)' d_i \geq \sigma_1(\|\nabla f(x_i)\|), \tag{2}$$

   for some forcing function σ_1, provided that the coefficient α_i of the "memory" or "momentum" term d_{i-1} satisfies the condition:

   $$-\sigma_3(\|\nabla f(x_i)\|) \geq \alpha_i \nabla f(x_i)' d_{i-1}, \tag{3}$$

   where σ_3 is a forcing function. What is $\sigma_1(\|\nabla f(x_i)\|)$?

2. If either stepsizes (i) (minimize f along d_i) or stepsize (ii) (find first stationary point of f along d_i) of Example 2.2 of PGD is used, what condition, if any, is needed on α_i? What is $\sigma_1(\|\nabla f(x_i)\|)$?

Note: As a consequence of the above result, the conjugate direction (1) under assumption (3) can be used with *any* of the stepsizes of Example 2.2 of PGD.