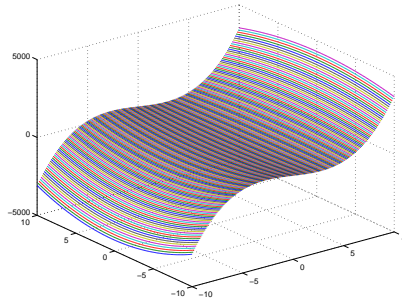


620-361 Operations Research Techniques and Algorithms

Practice Class 2

1 Consider the unconstrained nonlinear program:

$$\min_{x \in \mathbb{R}^2} f(x) = \frac{4}{3}x_1^3 - x_1x_2^2 - 8x_2 + 3x_2^2.$$



(a) Show that $x = (1, 2)^T$ is a stationary point of f .

(b) Does the second-order sufficiency condition hold for the stationary point $x = (1, 2)^T$? Is $x = (1, 2)^T$ a local minimum of f ? Briefly justify your answer.

(c) Find the direction of steepest descent for f at the point $x^0 = (2, 0)^T$. The steepest descent algorithm uses a stepsize t^* to calculate x^1 , of the form $t^* = \arg \min_{t \geq 0} q(t)$. Write down the function $q(t)$ for this problem (note that you only have to write down the function $q(t)$, you are not required to find its minimum, or to simplify your expression for $q(t)$).

(d) Find the Newton direction for f at $x^0 = (2, 0)^T$. Is the Newton direction a descent direction? Justify your answer.

(e) Show that a step of length $t_0 = 1$ along the Newton direction d at x^0 satisfies the Armijo-Goldstein condition, with the linesearch parameter $\sigma = \frac{1}{9}$.