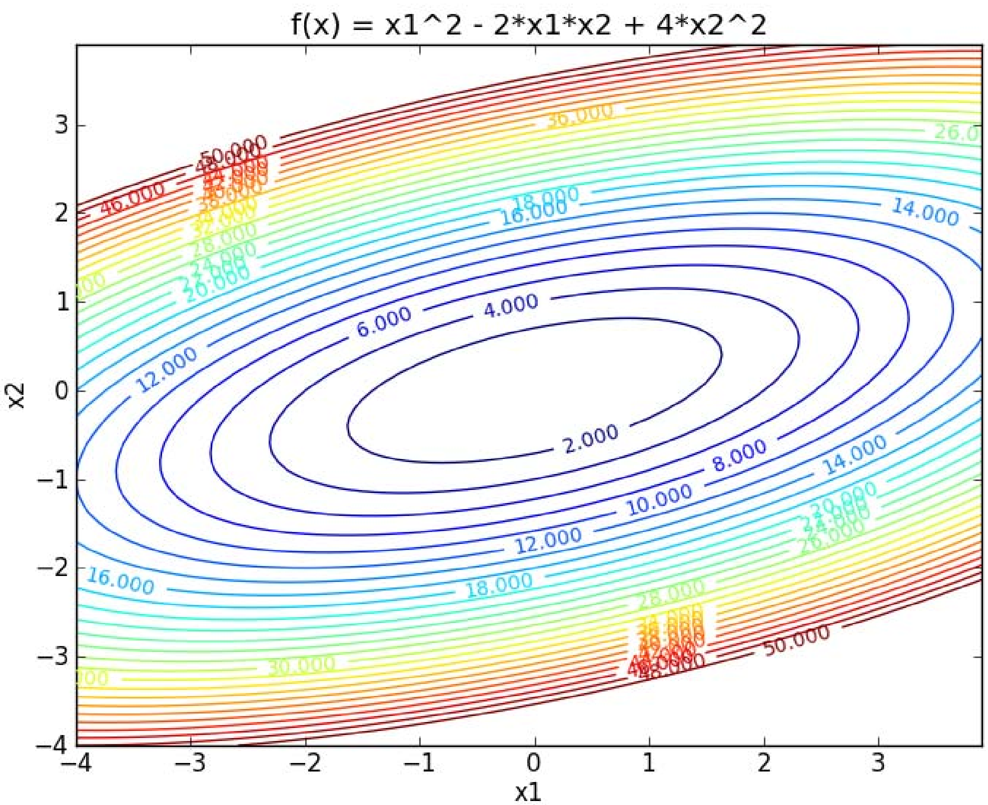
K-T Conditions, LaGrange Multipliers

1. (10) Solve the following problem using K-T conditions:

$$f = x_1^2 - 2x_1x_2 + 4x_2^2$$

$$0.1667x_1 - x_2 = 2$$

Plot the equality constraint on your paper and show the optimum point. Does your calculated optimum agree with a graphical optimum?



2. (10) Change the constraint to be,

$$0.1667x_1 - x_2 = 2.1$$

Solve again for the optimum. Does the Lagrange multiplier from part 1 accurately predict the change in the objective for a change in the constraint right hand side? Compare the actual change to the predicted change.

3. For the problem:

$$Min\ \ f(x) = x_1^2 + x_2$$

$$g_1(x) = x_1^2 + x_2^2 - 9 = 0$$
$$g_2(x) = x_1 + x_2^2 - 1 \le 0$$
$$g_3(x) = x_1 + x_2 - 1 \le 0$$

A contour plot of this problem looks like:

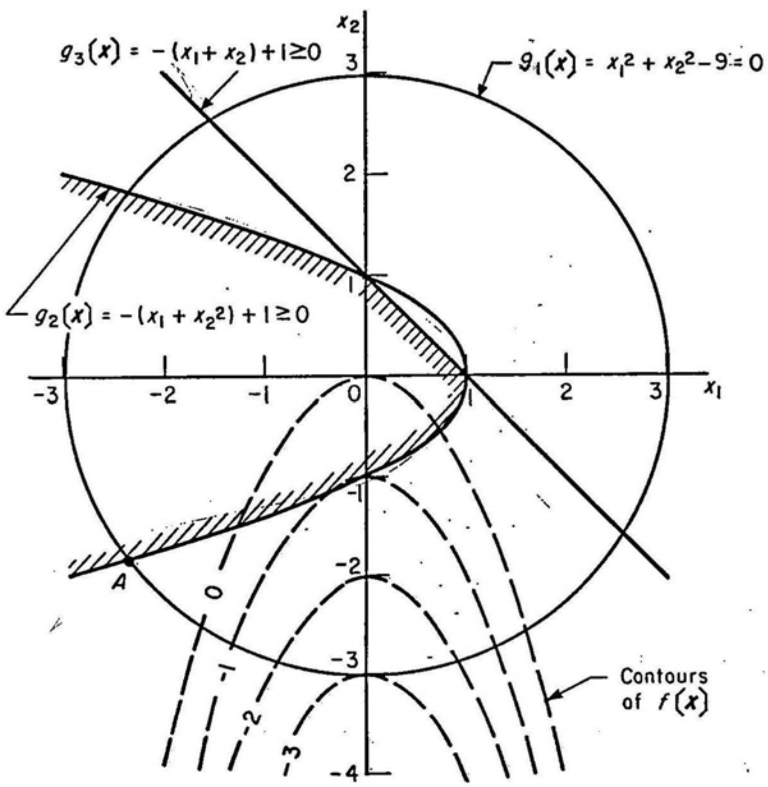


Figure taken from Himmelblau, David (1972). *Applied nonlinear programming*. New York: McGraw-Hill.

Using the K-T equations (constraints should be considered satisfied within acceptable round-off):

a. (10) Verify that the point $[-2.3723, -1.8364]$ is a local optimum

b. (10) Verify that the point $[-2.5000, -1.6583]$ is <u>not</u> a local optimum

c. (15) Drop the equality constraint from the problem. Using the contour plot to see where the optimum lies, solve for the optimum using the K-T conditions.