Exercises

Unconstrained Optimization

Consider the following function

$$f(x) = x^2 + 3x - 5$$

What is the smallest value of *f* for all *x*? This is an *unconstrained* optimization problem. Plot this function and from the plot estimate what the minimum and maximum values for the function in the range x in [-6,4].

Using the decision tree in the Chapter E04 introduction find a suitable routine to find the minimum and maximum. Is the solution what you expect from your original estimate? Add the solution to the plot with suitable text.

Constrained Optimization

Consider the following function

$$f(x) = \sin(3y - x^2 + 1) + \cos(2y^2 - 2x)$$

Subject to the following *constraints*:

$$-2 < x < 1, \quad -1 < y < 1$$

Make a contour plot of the function and constraints, and estimate the minimum and maximum. Using the decision tree in the Chapter E04 introduction, find a suitable routine to solve this problem. How does the starting point vary the solution? Do you always get the correct one?

Using Gradients

The derivatives of $f(x)$ are:

$$\partial f/\partial x = 2(\sin(2y^2 - 2x) - x\cos(3y - x^2 + 1))$$
$$\partial f/\partial y = 3\cos(3y - x^2 + 1) - 4y(\sin(2y^2 - 2x))$$

Now solve the problem again using an appropriate routine. Is there a performance advantage? How does the time to solution vary with the starting point?

Pay attention to any error messages.