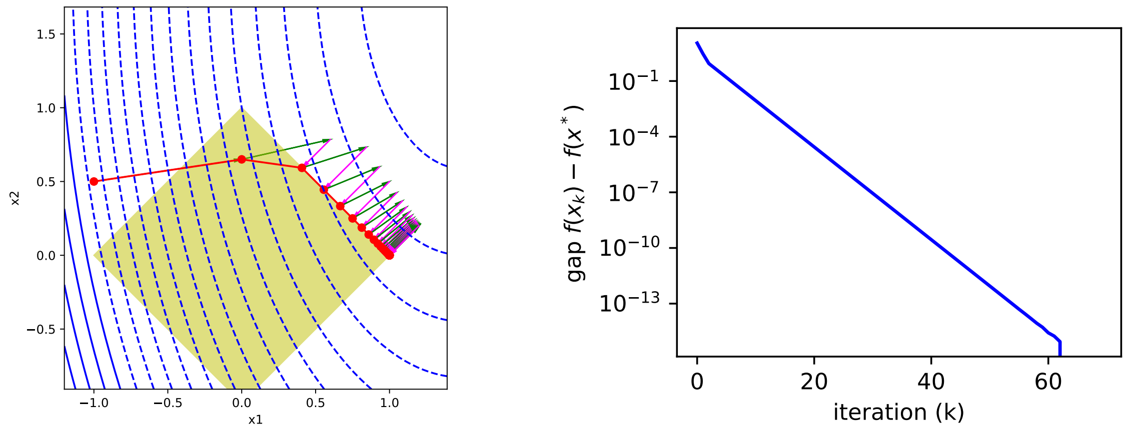
1



(a) trajectory with initial point (-1,0.5)

(b) gap with initial point (-1,0.5)

Figure 1: trajectories and gaps for Problem 1

I choose the same stepsize as slides, which is 0.1 and above are the trajectories and gaps. The solution is $\boldsymbol{w}^* = (1, 0)$, which is what we have seen in class and the number of iterations is 69. The optimal value is 4.5.

2

(a).

The Lagrange function is

$$\mathcal{L} = e^{x_1} + e^{2x_2} + e^{2x_3} + \lambda(x_1 + x_2 + x_3 - 1)$$

By setting the partial derivatives to zero we get

$$\begin{cases} \frac{\partial \mathcal{L}}{\partial x_1} = e^{x_1} + \lambda = 0 \\ \frac{\partial \mathcal{L}}{\partial x_2} = 2e^{2x_2} + \lambda = 0 \\ \frac{\partial \mathcal{L}}{\partial x_3} = 2e^{2x_3} + \lambda = 0 \\ \frac{\partial \mathcal{L}}{\partial \lambda} = x_1 + x_2 + x_3 - 1 = 0 \end{cases}$$

By solving the upper three equations we get

$$\begin{cases} x_1 = ln(-\lambda) \\ x_2 = \frac{1}{2} ln(-\frac{\lambda}{2}) \\ x_3 = \frac{1}{2} ln(-\frac{\lambda}{2}) \end{cases}$$

Then by solving the last equation we calculate that

$$\lambda^* = -\sqrt{2e}$$

Finally the optimal solution along with the multiplier is

$$\begin{cases} x_1^* = \frac{1}{2}(1+ln2) \\ x_2^* = \frac{1}{4}(1-ln2) \\ x_3^* = \frac{1}{4}(1-ln2) \\ \lambda^* = -\sqrt{2e} \end{cases}$$

The optimal value is

$$f^* = 2\sqrt{2e}$$

(b)

I choose stepsize=0.1 again and it takes me 52 iterations to get the result.
The optimal solution is $(x_1^*, x_2^*, x_3^*) = (0.8466, 0.0767, 0.0767)$ and the optimal value is $f^* = 4.6633$, which is indeed the result we have calculated above using the Lanrange multiplier method.