EX2 programming
Numerical Optimization with Python

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Link to Github

Quadratic programming example:

$$\min x^2 + y^2 + (z+1)^2$$

Subject to: $x + y + z = 1$

$$x \geq 0$$

$$y \geq 0$$

$$z \geq 0$$

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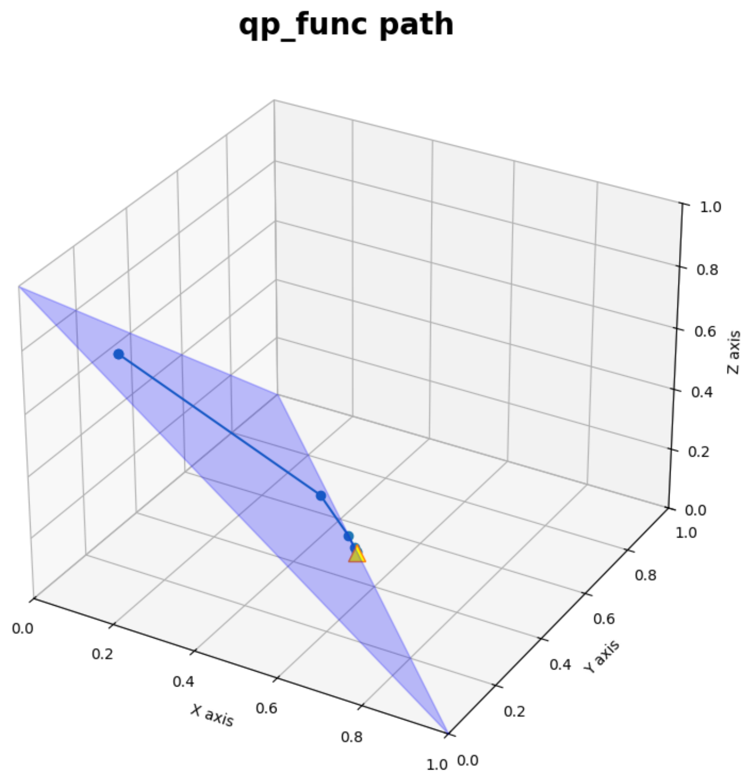
Final Results for the Quadratic Programming Example:
Objective value for the function is: 1.5000003444929044 and the X: [4.99612800e-01 5.00387155e-01 4.46798454e-08]
in-equality contraints:
#1 contraint: 0.4996128000155961
#2 contraint: 0.5003871553045577
#3 contraint: 4.467984544411096e-08
equality contraints:
#1 contraint: -7.771561172376096e-16
iteration: 0, f_value: 2.9399999999999995
iteration: 1, f_value: 2.940000374350371
iteration: 2, f_value: 1.584595957160603
iteration: 3, f_value: 1.5060041706374827
iteration: 4, f_value: 1.5004904137096498
iteration: 5, f_value: 1.500027199855154
iteration: 6, f_value: 1.5000055241090695
iteration: 7, f_value: 1.5000003444929044
```

Objective at the final candidate ≈ 1.5

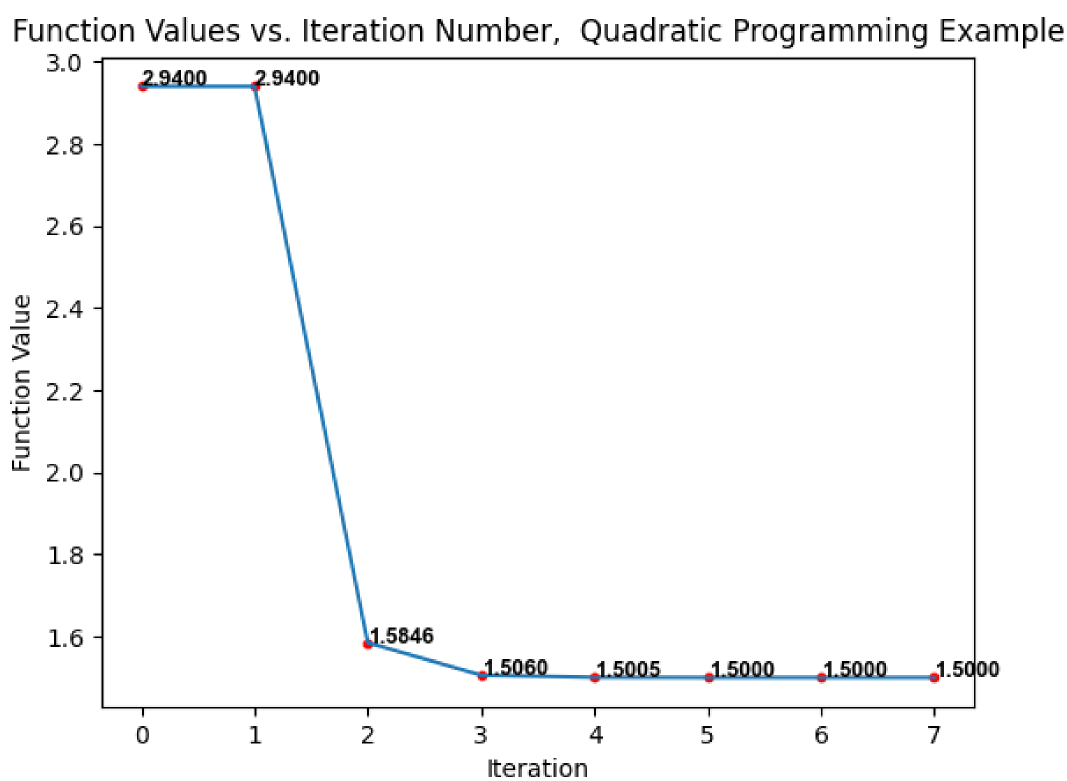
3 inequality constraints are satisiffied, ineqality constraint is sattisfied at the finale candidate (under very small tolerance):

$$x = 0.4996 \geq 0$$
$$y = 0.5 \geq 0$$
$$z = 4.468 \cdot 10^{-8} \geq 0$$
$$x + y + z - 1 = 0.4996 + 0.4996 + 4.468 \cdot 10^{-8} - 1 = -7.77 \cdot 10^{-16} \approx 0$$

Feasible region and the path taken by the algorithm :



Objective value vs. outer iteration number :



Linear programming example:

$$\max[x + y]$$

Subject to:

$$-x - y + 1 \leq 0$$
$$y - 1 \leq 0$$
$$x - 2 \leq 0$$
$$-y \leq 0$$

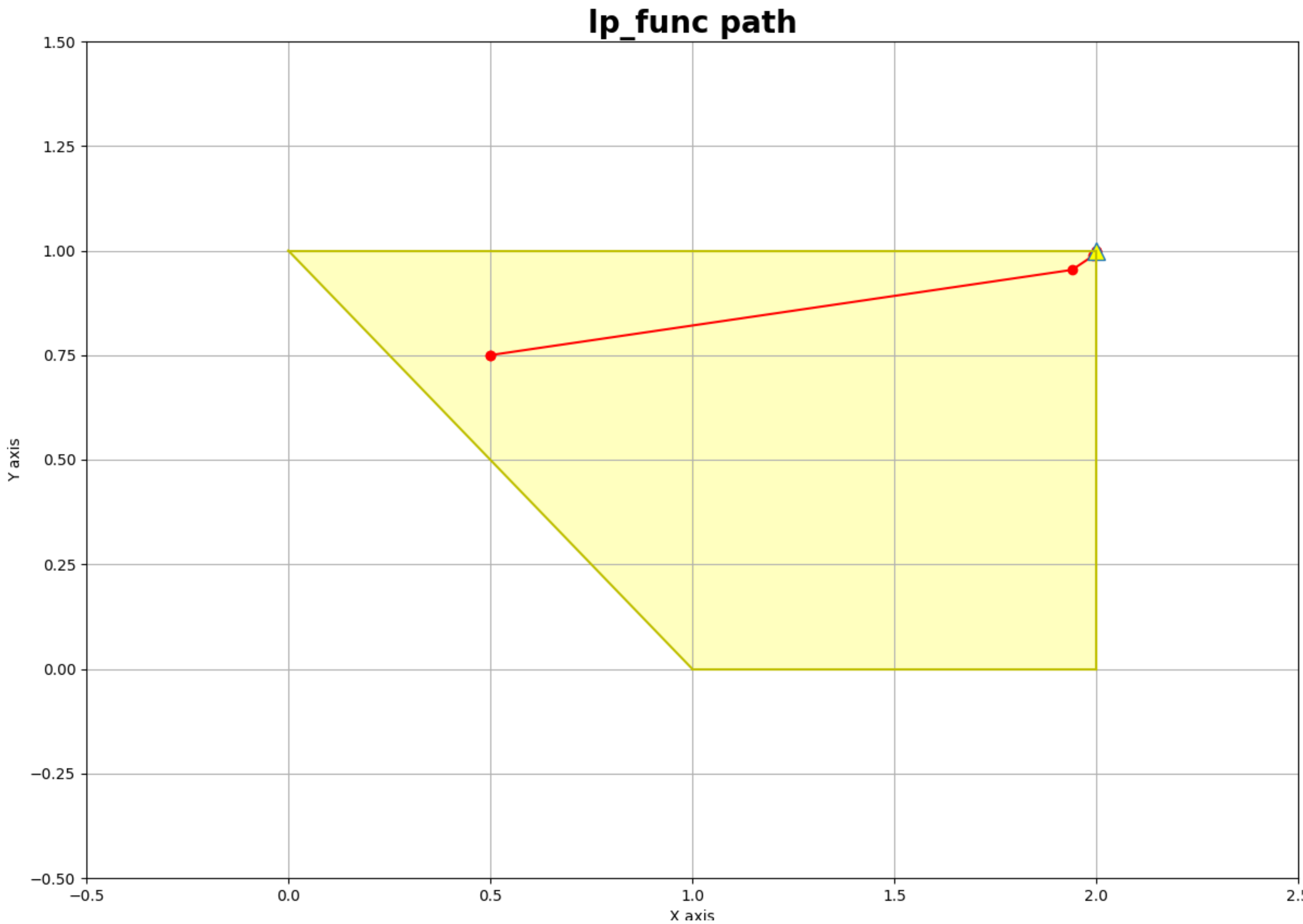
```
Final Results for the Linear Programming Example:
The final candidate is: [1.999999 0.999999] and the objective value is: -2.9999979912589096
in-equality constraints:
#1 constraint: -1.9999979912589096
#2 constraint: -1.0045278747705666e-06
#3 constraint: -1.0042132156939942e-06
#4 constraint: -0.9999989954721252
iteration: 0, f_value: -1.25
iteration: 1, f_value: -1.249999734845835
iteration: 2, f_value: -2.8940589640916925
iteration: 3, f_value: -2.980789224664023
iteration: 4, f_value: -2.99801816543288
iteration: 5, f_value: -2.9997992537270775
iteration: 6, f_value: -2.999979911291327
iteration: 7, f_value: -2.9999979912589096
```

Objective at the final candidate ≈ -3

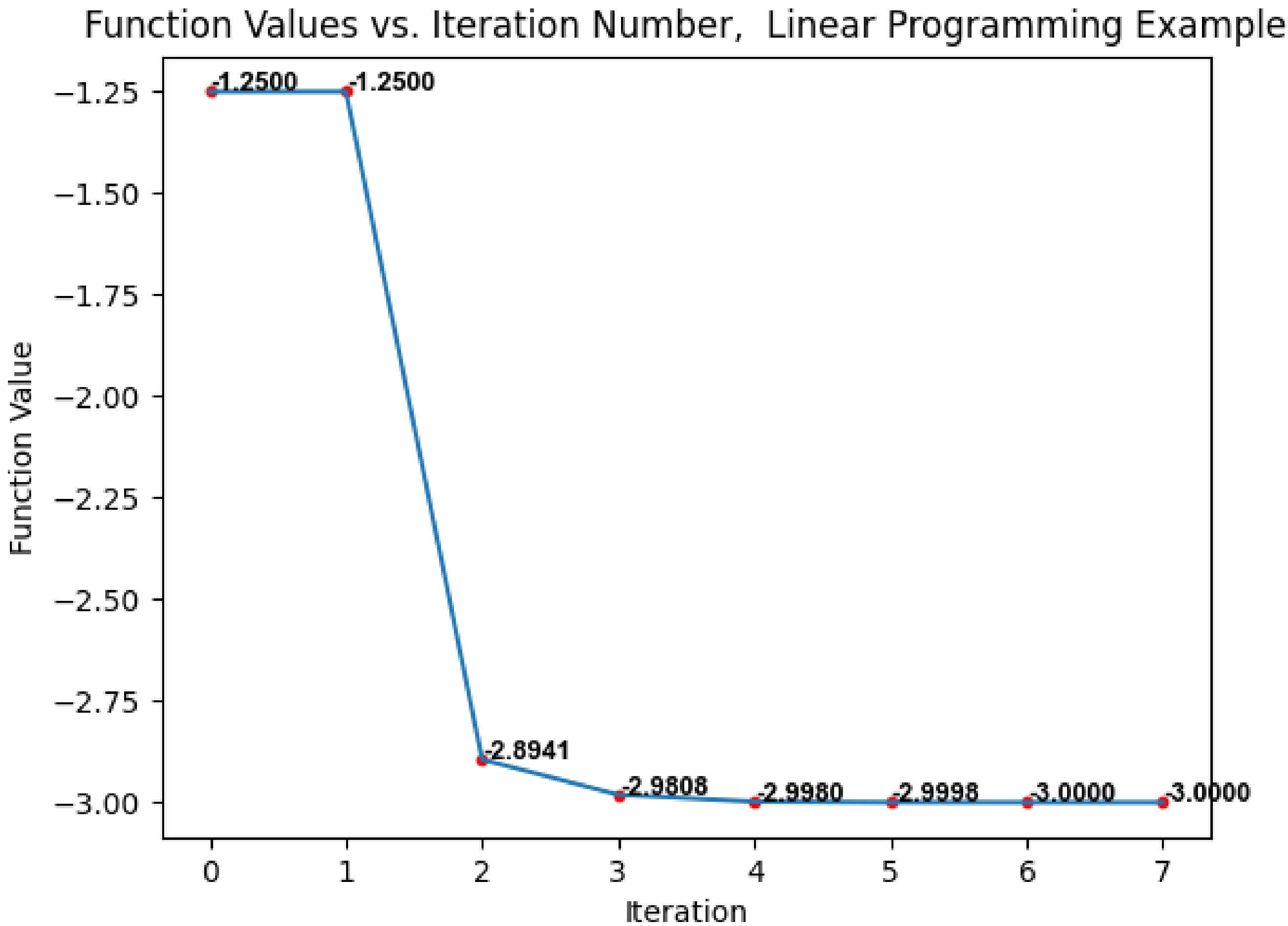
4 inequality constraints are satisiffied at the finale candidate:

$$-x - y + 1 - 1 = -1.9999\ldots -0.9999 \ldots + 1 \approx -2 - 1 + 1 = -2 \leq 0$$
$$y - 1 = 0.9999 \ldots - 1 \approx -10^{-6} \leq 0$$
$$x - 2 = 1.999 \ldots - 2 \approx -10^{-6} \leq 0$$
$$-y = -0.9999 \ldots \approx -1 \leq 0$$

Feasible region and the path taken by the algorithm :



Objective value vs. outer iteration number :



Function Values vs. Iteration Number, Linear Programming Example
Function Value
Iteration
−1.25
−1.50
−1.75
−2.00
−2.25
−2.50
−2.75
−3.00
0
1
2
3
4
5
6
7
-1.2500
-1.2500
-2.8941
-2.9808
-2.9980
-2.9998
-3.0000
-3.0000