Report – HW2

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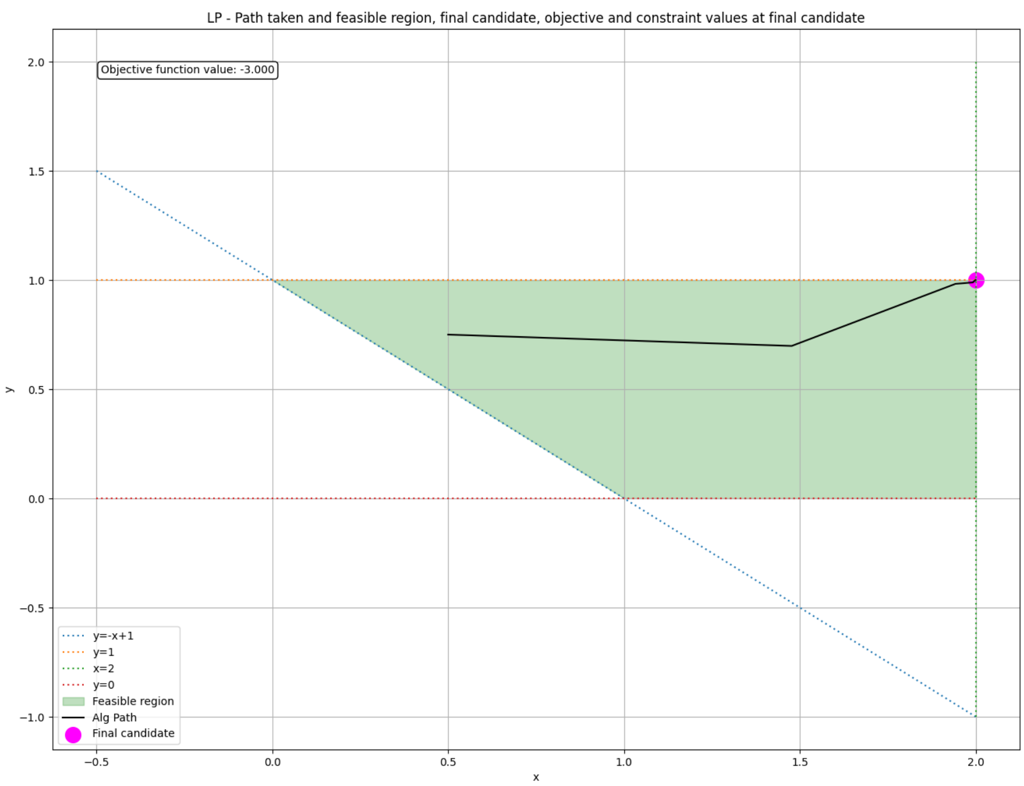
Linear Programming:

$$\max[x + y]$$

$$\text{Subject to: } y \geq -x + 1$$
$$y \leq 1$$
$$x \leq 2$$
$$y \geq 0$$

Please note that in the implementation (code) the objective function, currently Max[x+y] is flipped to minimize –(x+y) → Min[-x-y]. With respect to the given constraints, values x, y that maximize x + y are equivalent to the values x, y that minimize -x-y.

Plot of Path taken by the algorithm, feasible region, as well as the objective function values at the final candidate point.

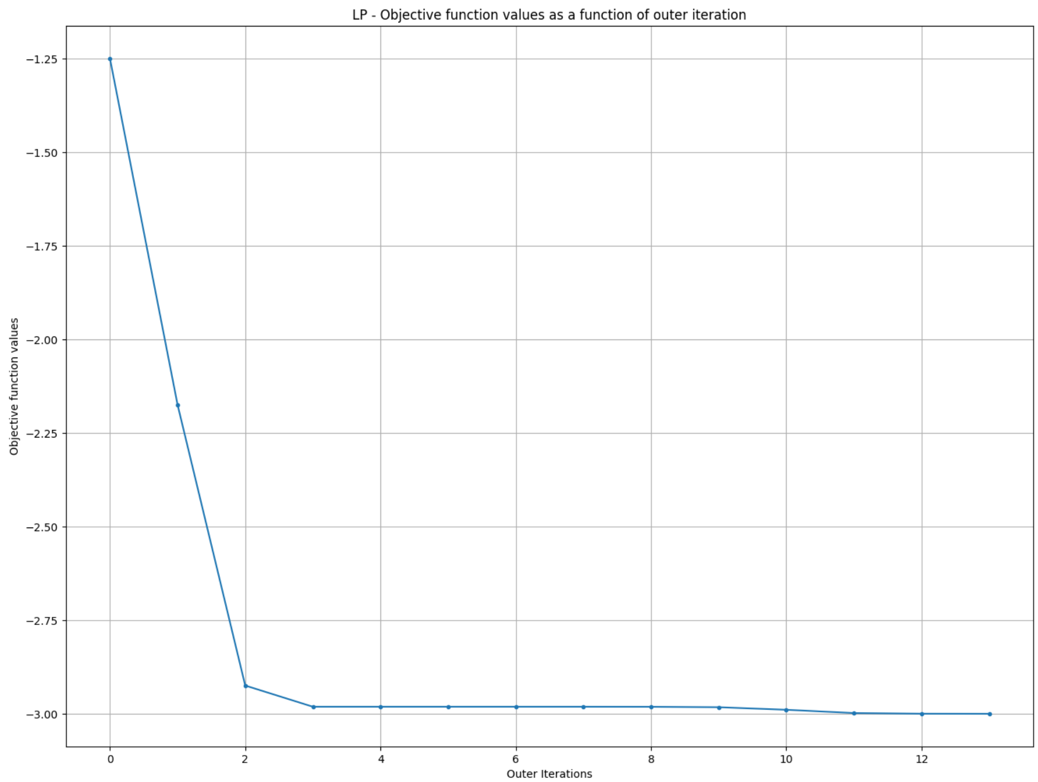


The **final candidate** is point: [1.99998904 0.99998904]

Objective function value at final candidate: -2.999978070093433, this is, the **original objective function** Max[x+y] = 2.999978070093433.

Constraints

-x – y + 1 <= 0 →-1. 9999780700934329 <= 0. Constraint is satisfied.
y – 1 <= 0 →-1.0964974135774241e-05 <= 0. Constraint is satisfied.
x – 2 <= 0 →-1.0964932431578589e-05 <= 0. Constraint is satisfied.
-y <= 0 → -0.9999890350258642 <= 0. Constraint is satisfied.



It can be observed that the objective function value reaches ~ -3, under the minimize -x-y objective. Hence, reaches ~3 in the original Max[x+y] objective.

To sum, it can be observed the objective function value decreases with the iterations, it virtually reaches (not quite, but less than 0.0001 distance) the optimal solution. This indicates the minimization process is successful and the termination criteria seems to be sufficient.

The feasible region, as well as its boundaries given by the constraints can be observed above. The constraints are satisfied, and we can see the path the algorithm took, as well as the final candidate point.

Quadratic Programming:

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

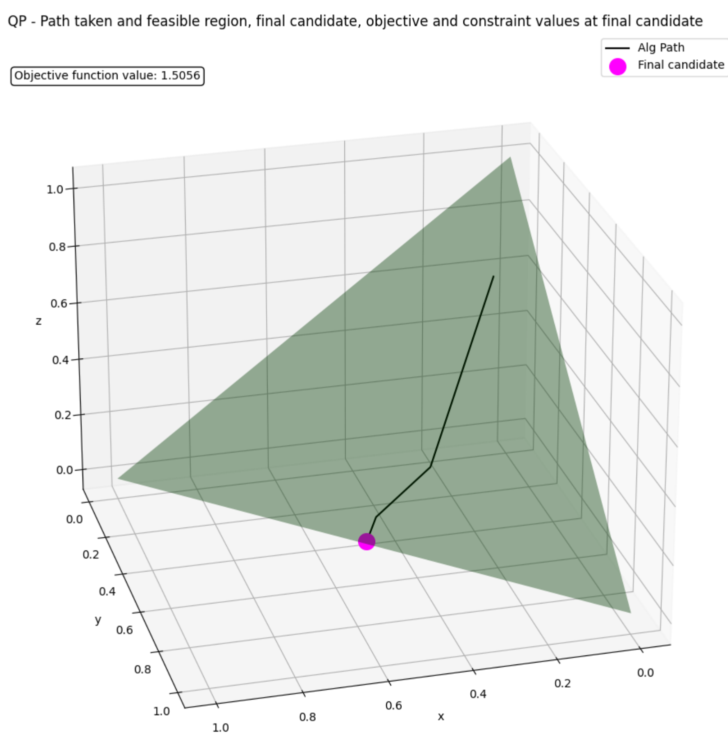
Subject to: $x + y + z = 1$

$$x \geq 0$$

$$y \geq 0$$

$$z \geq 0$$

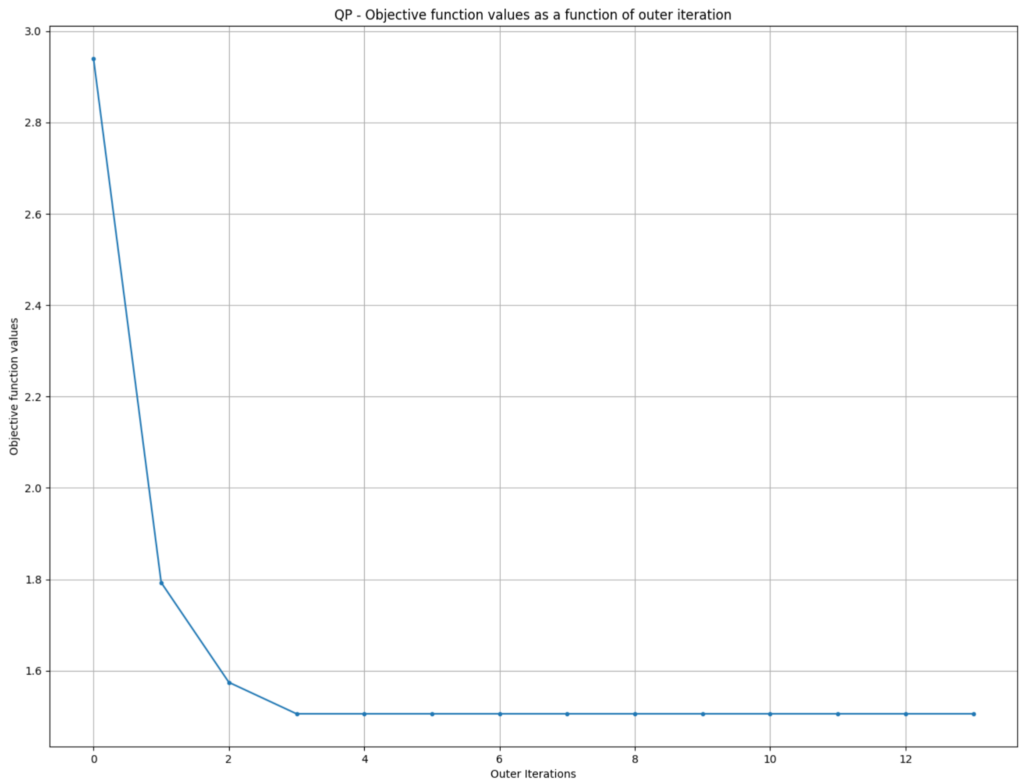
Plot of Path taken by the algorithm, feasible region, as well as the objective function values at the final candidate point, and inequality constraint values.



The **final candidate** is point: [0.49724485 0.4972451 0.00551005]

Objective function value at final candidate: 1.5055555865330512

Constraints
-x <= 0 → -0.49724485 <= 0. Constraint is satisfied.
-y <= 0 → -0.4972451 <= 0. Constraint is satisfied.
-z <= 0 → -0.00551005 <= 0. Constraint is satisfied.
x + y + z = 1 → 0.49724485 + 0.4972451 + 0.00551005 = 1. Constraint is satisfied.
*The above is equal more precisely to 1.0 when using the real values without rounding ([0.4972448527172547, 0.497245101653972, 0.005510045628773407]).



It can be observed that the objective function value reaches ~1.5.

To sum, it can be observed the objective function value decreases with the iterations, it virtually reaches (not quite, but less than 0.001 distance) the optimal solution. This indicates the minimization process is successful and the termination criteria seems to be sufficient.

The feasible region, as well as its boundaries given by the constraints can be observed above. The constraints are satisfied, and we can see the path the algorithm took, as well as the final candidate point.

Github Link:
https://github.com/omri9195/Optimization_Python_HW2