Advanced Automation and Control

Optimization Part

Surname..... Name.....

Wednesday 8th July, 2020

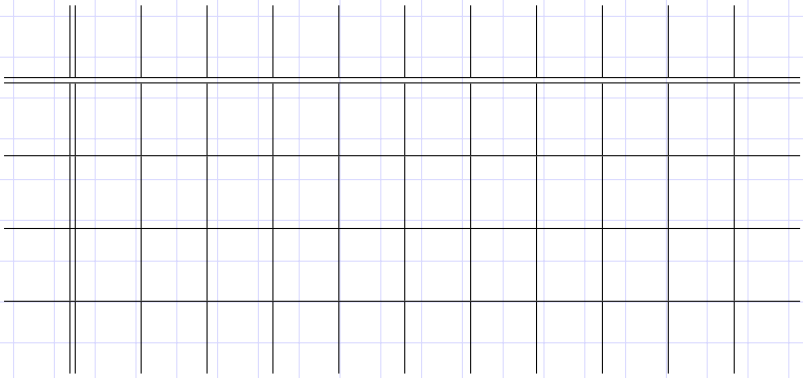
Exercise 1

1. Rewrite the optimization problem in **standard form**. Depict the tree associated to the MILP.

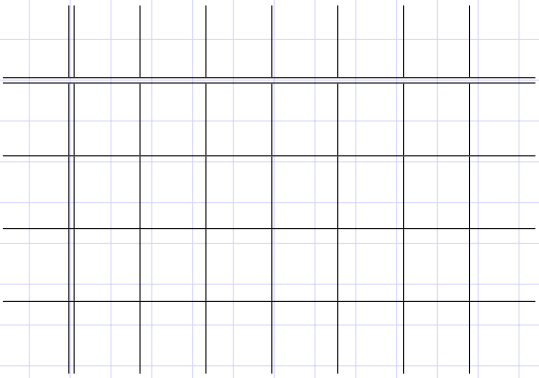
2. Write down the relaxed problem at node 0 **and** the optimization problem for Phase 1.

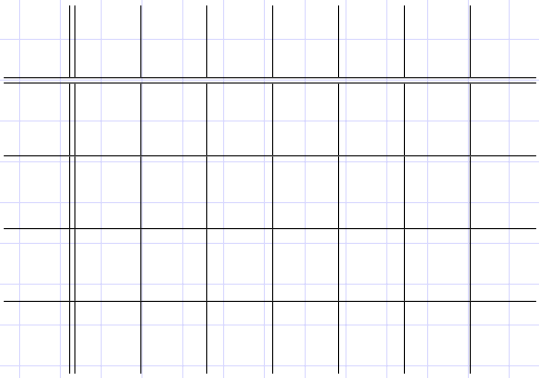
3. Simplex algorithm at node 0

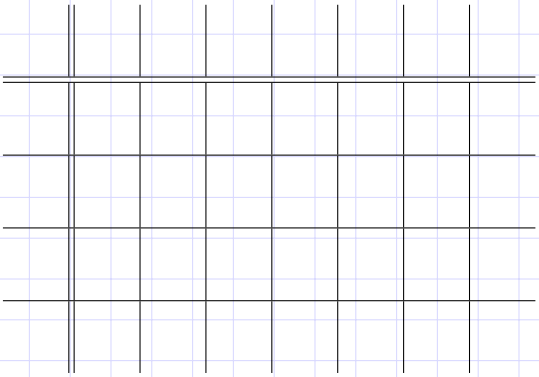
(a) Solve Phase 1

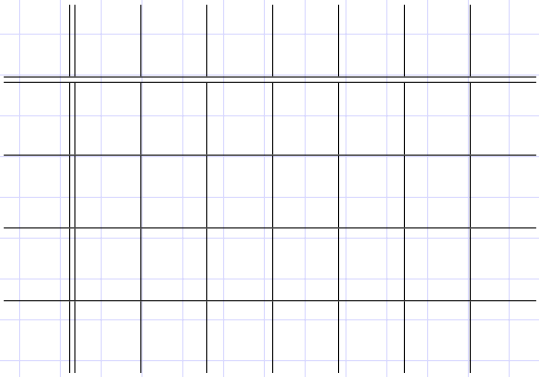


(b) Simplex algorithm **Phase 2** (complete from left to right and from up to down)









(c) The optimal cost is

(d) The optimal solution is $x =$

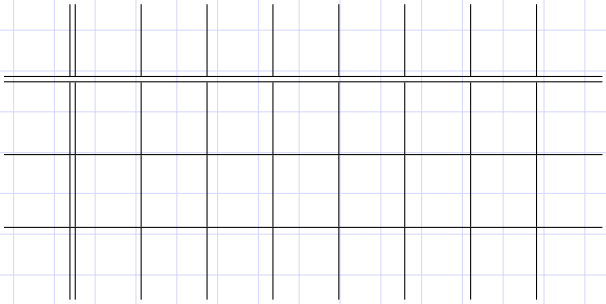
(e) Is this solution feasible for the original MILP (Yes or No and Why)?

(f) Is this solution optimal for the original MILP (Yes or No and Why)?

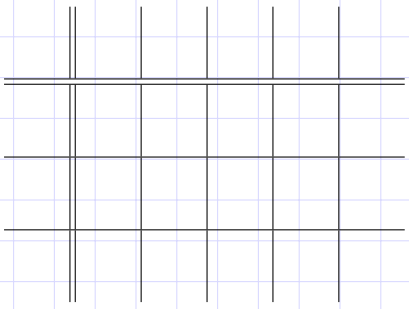
4. Write down the relaxed problem at node 1 **and** the optimization problem for Phase 1.

5. Simplex algorithm at node 1

(a) Solve Phase 1



(b) Simplex algorithm **Phase 2** (complete from left to right and from up to down)



(c) The optimal cost is

(d) The optimal solution is $x =$

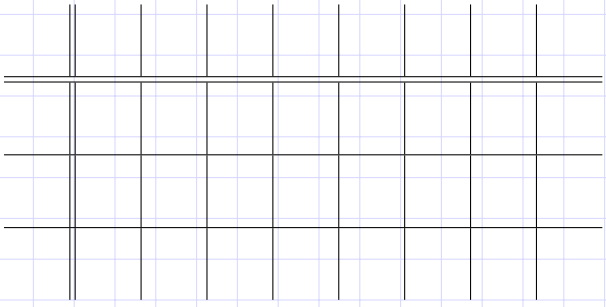
(e) Is this solution feasible for the original MILP (Yes or No and Why)?

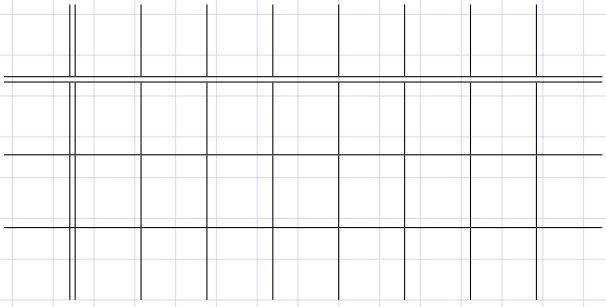
(f) Is this solution optimal for the original MILP (Yes or No and Why)?

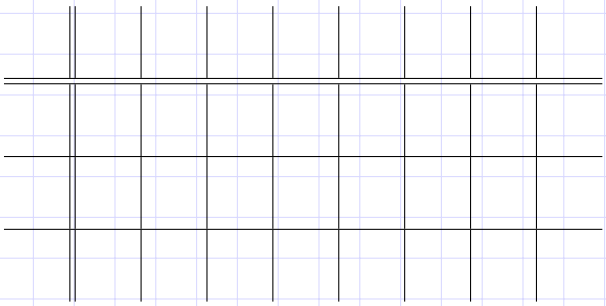
6. Write down the relaxed problem at node 2 **and** the optimization problem for Phase 1.

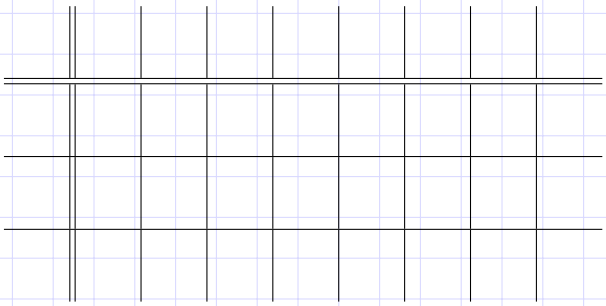
7. Simplex algorithm at node 2

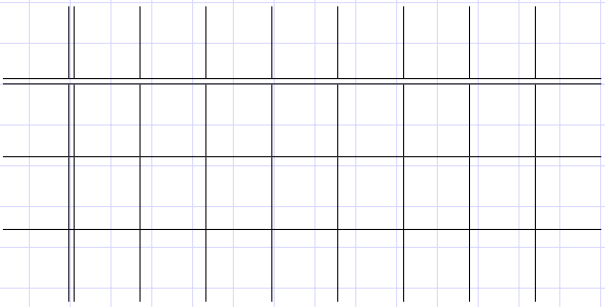
(a) Solve Phase 1



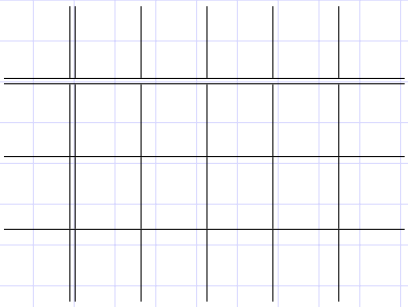


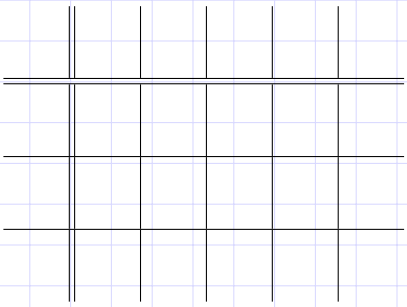


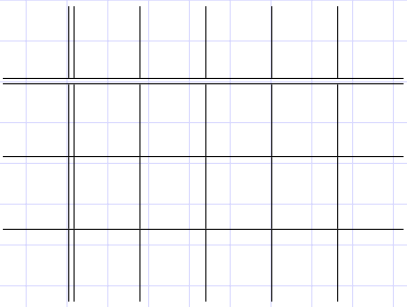


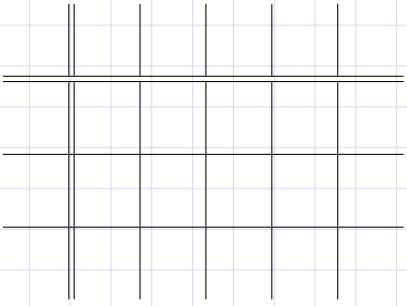


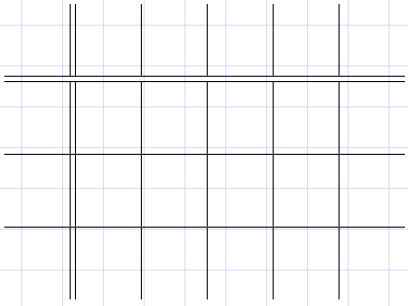
(b) Simplex algorithm **Phase 2** (complete from left to right and from up to down)











(c) The optimal cost is

(d) The optimal solution is $x =$

(e) Is this solution feasible for the original MILP (Yes or No and Why)?

(f) Is this solution optimal for the original MILP (Yes or No and Why)?

(g) After examining nodes 0, 1 and 2, did we find the optimal solution (Yes, No, Why)?

If Yes:

i. the optimal cost for the MILP is

ii. the optimal solution for the MILP is $x =$

Exercise 2

1. Indicate the initial set of chosen optimization variables and their meaning. Do not include here the auxiliary variables required to resolve bilinearities or "if" conditions.

2. Please report all the steps required to obtain the MILP formulation of the problem

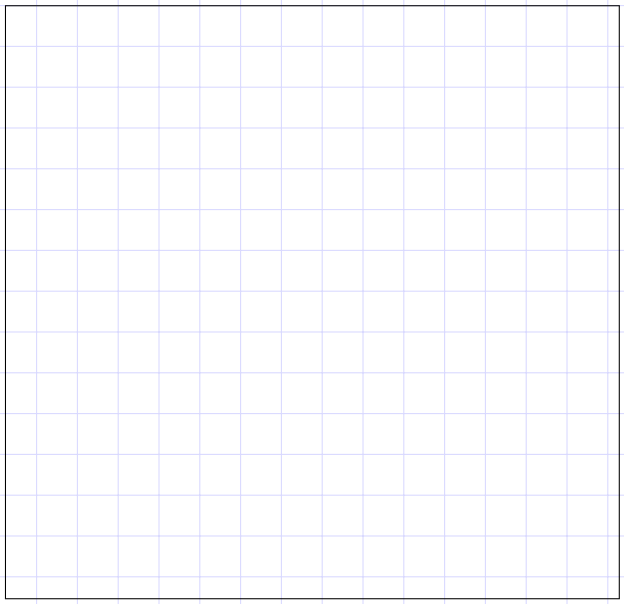
3. Write down the final set of optimization variables (after having resolved bilinearities etc.) and their meaning

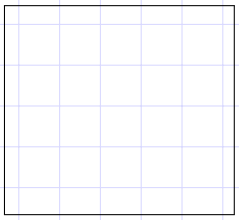
4. Write down the final **linear** objective function

5. Write down all the constraints

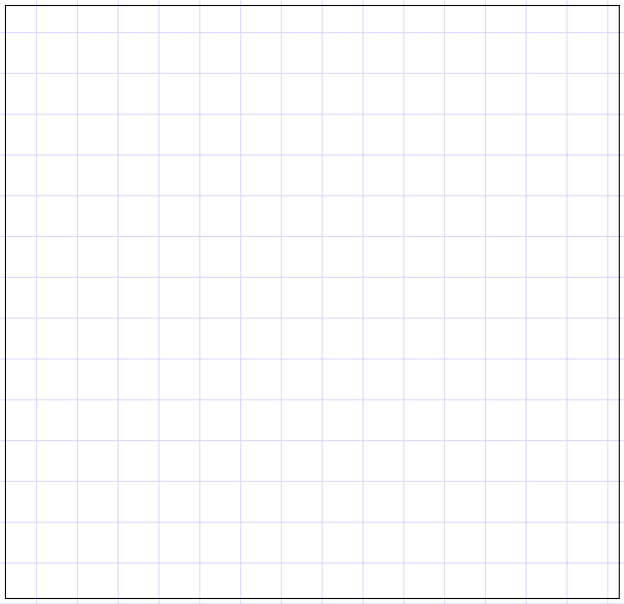
Exercise 3

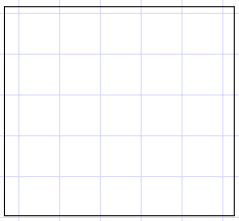
1. Depict the cost function (IN THE BOX) and indicate if it is convex for $x \geq 0$ (IN THE SMALL BOX and motivate the answer OUT OF THE BOX).





2. Depict the feasibility domain of the problem (IN THE BOX). Is $x = -3$ part of it (ANSWER YES/NO IN THE SMALL BOX and motivate the answer OUT OF THE BOX)?





3. Indicate if the optimisation problem is convex (motivate the answer).

Exercise 4