

Advanced Automation and Control

Optimization Part

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

Thursday 27th January, 2022

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.

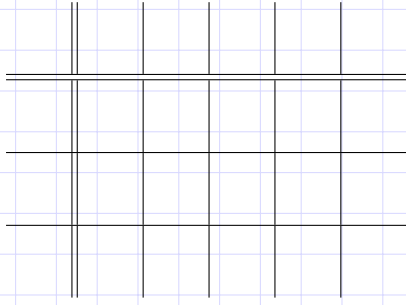


5. Simplex algorithm at node 1

(a) Solve Phase 1

A grid for a Simplex tableau. It consists of 8 vertical lines and 3 horizontal lines. The first vertical line is double-lined on both sides, representing the objective function row. The remaining 7 vertical lines are single-lined. The top horizontal line is double-lined, representing the objective function row. The remaining 2 horizontal lines are single-lined, representing constraint rows. This layout creates a 3x7 grid of cells for coefficients and RHS values.

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



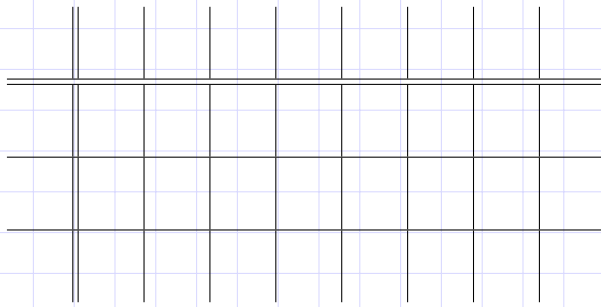
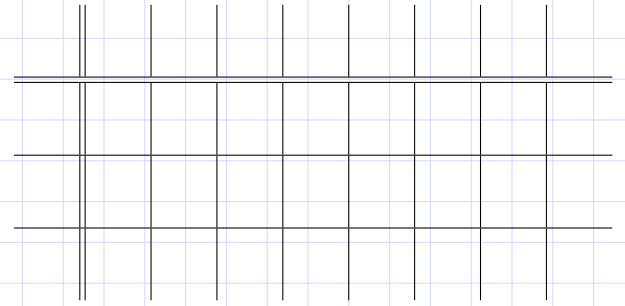
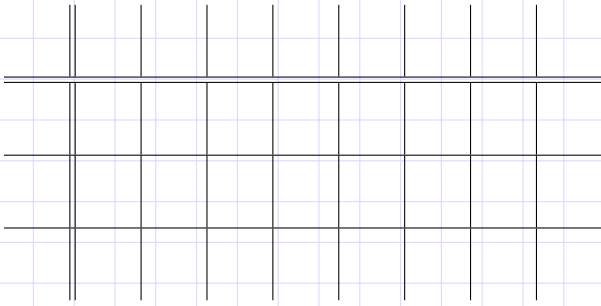
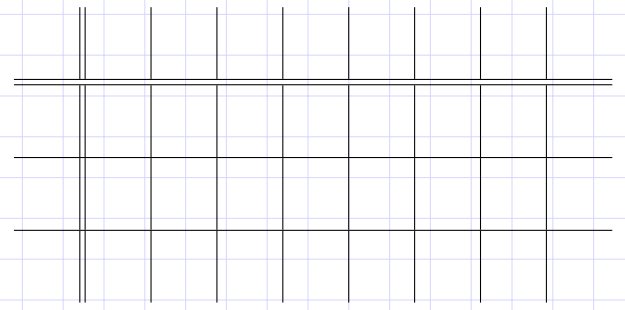
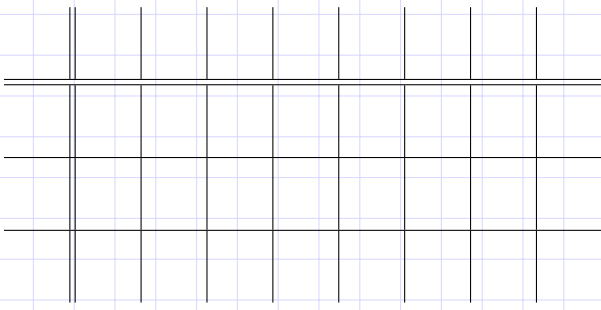
- (c) The optimal cost is
- (d) The optimal solution is $x =$
- (e) Is this solution feasible for the original MILP (Yes or No and Why)?
- (f) Is this solution optimal for the original MILP (Yes or No and Why)?

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

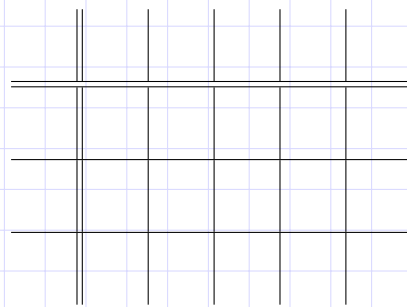
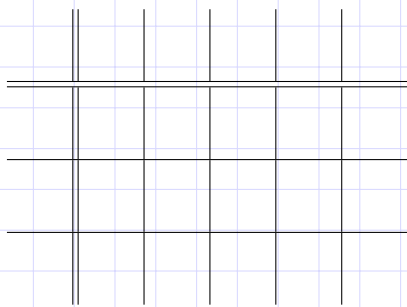


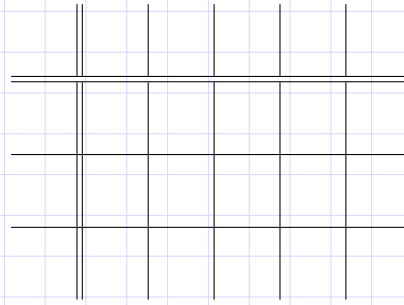
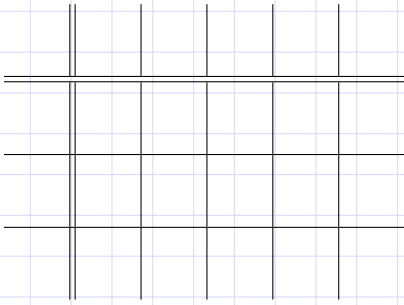
7. Simplex algorithm at node 2

- (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

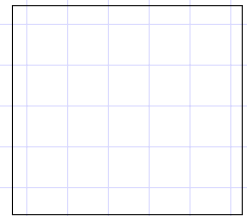
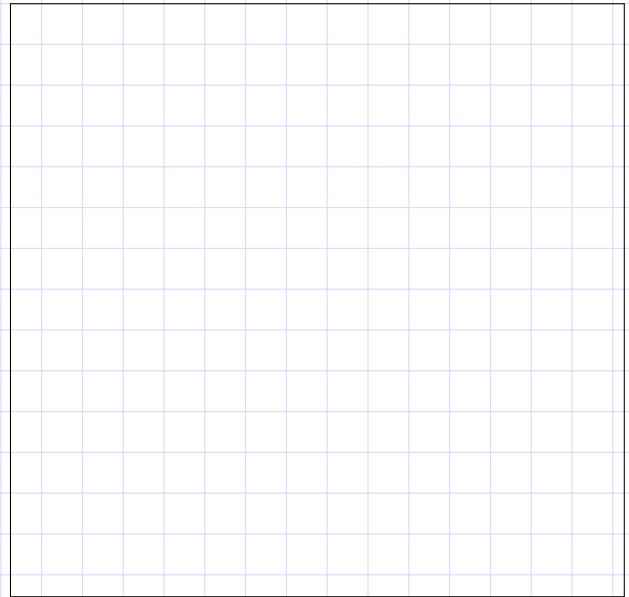
3. Write down the final set of optimization variables (after having resolved bilinearities etc.) and their meaning

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

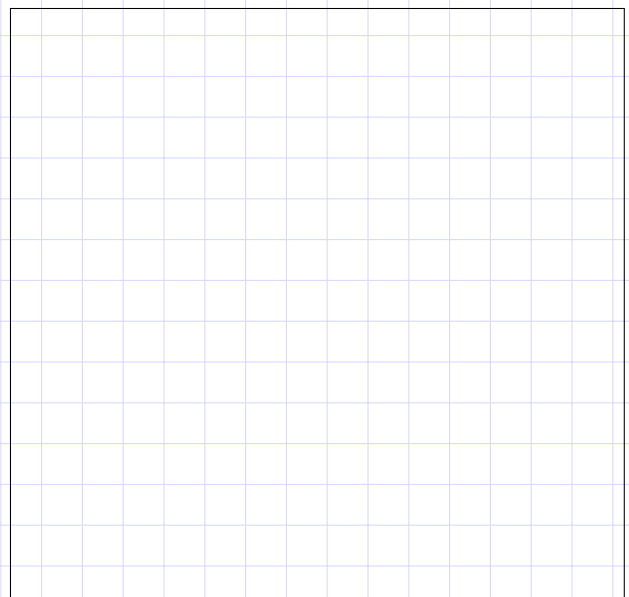
5. Write down all the constraints

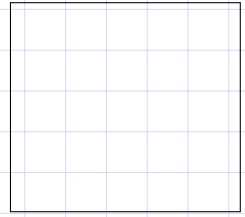
Exercise 3

1. Depict the cost function (IN THE BOX) and indicate if it is convex (IN THE SMALL BOX) and motivate the answer OUT OF THE BOX).



2. Depict the feasibility domain of the problem (IN THE BOX). Is the domain convex? (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

