isec Engenharia
Department of Computer and Systems Engineering

Optimization and Decision Support Methodologies
2nd Assessment Test

Date: January 14, 2021 Duration: 1h 30m

Note: Present all the calculations you carry out, as well as any comments, justifications or conclusions you deem appropriate.

1. Consider the following Goal Programming problem:

$$\text{Minimize } z = \left\{ d_4^-, d_1^-, d_3^- + d_3^+ \right\}$$

subject to

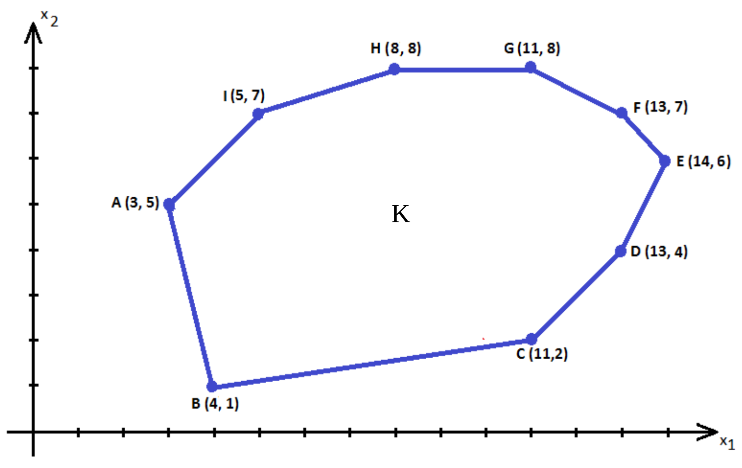
$$x_1 + d_1^- - d_1^+ = 2 \quad (1)$$
$$2x_1 + x_2 + d_2^- = 10 \quad (2)$$
$$x_2 + d_3^- - d_3^+ = 1 \quad (3)$$
$$x_1 - x_2 + d_4^- - d_4^+ = 1 \quad (4)$$
$$-x_1 + x_2 + d_5^- = 3 \quad (5)$$
$$x_1 \geq 0,\ \ x_2 \geq 0,\ \ d_i^- \geq 0,\ \ d_i^+ \geq 0 \ \ (i = 1,2,3,4,5)$$

[0.50 points] **a)** Without solving the problem, indicate, justifying, whether points A or B could be possible solutions to this problem: A: x = (1,-1) | B: x = (3.1)

[4.00 points] **b)** Solve the problem by the graphical method.

2. Consider the following Multi-objective Linear Programming problem:

Max $z_1 = -3x_1 + 3x_2$
Min $z_2 = 3x_1 + 7x_2$
subject to $x = (x1, x2)^T \in K$



[3.00 points] Determine the set of (strictly and/or weakly) efficient solutions using the graphical representation of this problem in the space of decision variables.

[1.00 points] **3.** Consider the MATLAB code of the function developed in the practical classes, which implements the post-optimization study in the case of introducing a new decision variable in the problem:

```
1  function [n,m,A,c,b,x,xB,cB,SBA,zjcj,z]=Posopt_xnew(n,m,c,A,b,x,xB,cB,SBA,zjcj,z)
2   disp('------------------------------------------------------------')
3   disp('Post-optimization study --> Introduction of a new variable ')
4   disp('------------------------------------------------------------')
5   P_New=input('Coefficients of the new variable in the constraints [;]:');
6   c_New=input('Coefficient of the new variable in the objective function:');
7   % Calculates column of the new variable in the optimal tableau - X_New
8   B_1=A(:,n+1:n+m);
9   X_New=B_1*P_New;
10  % Updates variables
11  n=n+1; % Number of decision variables
12  A=[A X_New];
13  c=[c c_New];
14  x=[x n+m];
15  ZnewCnew=cB'*X_New-c_New;
16  zjcj=[zjcj ZnewCnew];
17  SBA=[SBA;0]; % New variable enters the solution with zero value
18  % Show updated Simplex tableau
19  Present_Simplex_tableau(n,m,c,xB,cB,A,b,zjcj,z,0,0,0,0)
20  % Test zj-cj value corresponding to new variable
21  if ZnewCnew >= 0
22     fprintf('As the whole zj-cj row continues >=0, the tableau is optimal\n')
23     fprintf('The basis remains optimal and the solution too, with x%d equal to zero\n',n+m)
24  else
25     fprintf('As a negative value appeared in the line zj-cj the tableau is no longer optimal\n')
26     fprintf('--> You have to apply the Simplex method, putting x%d in the base\n',n+m)
27     disp('Press a key to continue...')
28     pause
29     [n,m,A,c,b,x,xB,cB,SBA,zjcj,z]=MSimplex(n,m,A,c,b,x,xB,cB,SBA,zjcj);
30     Present_final_results(n,m,SBA,z,0)
31  end
32 end
```

<u>Without changing the previous code</u>, complete it, so that the appearance of an optimal alternative solution is detected after the introduction of the new variable. If it appears, the function should calculate it and present it to the user.

In your answer, present only the fragment of new code that you write, indicating between which lines of code previously presented, it should be inserted.

<u>NOTE</u>: Assume that the MSimplex function is already prepared for all particular cases of the Simplex method.