[Fecha]

MOAD

Practical work

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[NOMBRE DE LA EMPRESA]

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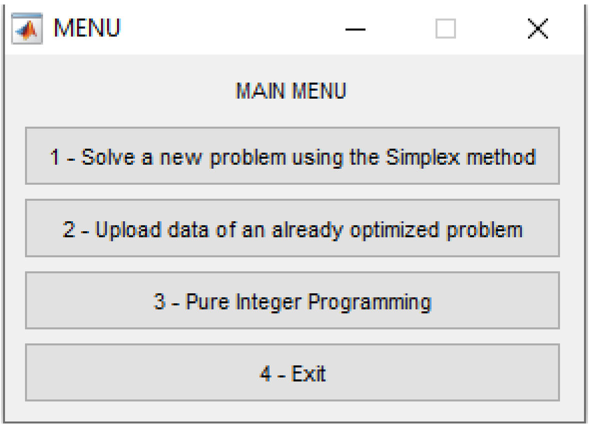
Main program

The main program is called Main_PO.m.

When executing we can see the menu popping:



All the example files are saved in the folder.

Example 1

Exercise 1 from the practical sheet 2

Maximize $z = 3x1 + 4x2$

subject to

$$2x1 + 3x2 \leq 6$$

$$4x1 + 5x2 \leq 8$$

$$x1 \geq 0,\ x2 \geq 0$$

$$x1,\ x2 \text{ integers}$$

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Entering the data

```
 ------------------------------------------------------------
  Solving a problem by the dual method of Simplex
 ------------------------------------------------------------
  It is assumed that:
  -> Objective function is in the maximization form
  -> All constraints are of type ">="
  -> All variables are >=0
 ------------------------------------------------------------

 -------------------- Data of the problem --------------------
 Number of variables: 2
 Number of constraints: 2

 Coefficients of the variables in the objective function
 Insert vector c[]:[3 4]

 Coefficients of the variables in the constraints
 Insert matrix A[;]:[2 3;4 5]

 Independent terms of the constraints
 Insert vector b[]:[6 8]
```

Optimal solution

```
Iteration #0:

              3.0      4.0      0.0      0.0
              x1       x2       x3       x4       b
-----------------------------------------------------------------
x3   0.0      2.0      3.0      1.0      0.0      6.0
x4   0.0      4.0      5.0      0.0      1.0      8.0
-----------------------------------------------------------------
zj-cj         -3.0     -4.0     0.0      0.0      0.0

Variable that will enter the basis -> x2
Variable that will leave the basis -> x4


Iteration #1:

              3.0      4.0      0.0      0.0
              x1       x2       x3       x4       b
-----------------------------------------------------------------
x3   0.0      -0.4     0.0      1.0      -0.6     1.2
x2   4.0      0.8      1.0      0.0      0.2      1.6
-----------------------------------------------------------------
zj-cj         0.2      0.0      0.0      0.8      6.4


=> Optimal tableau because there are no negative values in column b
```

```
Optimal solution:
-------------------------------
    x1* = 0.00
    x2* = 1.60
    x3* = 1.20
    x4* = 0.00

Optimal value of z:
-------------------------------
    z*=6.40
```

PILP solution

```
There are original variables with a fractional value
---> A cutting constraint must be introduced
and the new problem solved by the dual Simplex method

xnew =

     5

Iteration #1:

              3.0       4.0       0.0       0.0       0.0
              x1        x2        x3        x4        x5        b
---------------------------------------------------------------------------
x3   0.0      -0.4      0.0       1.0       -0.6      0.0       1.2
x2   4.0      0.8       1.0       0.0       0.2       0.0       1.6
x5   0.0      -0.8      -0.0      -0.0      -0.2      1.0       -0.6
---------------------------------------------------------------------------
zj-cj         0.2       0.0       0.0       0.8       0.0       6.4

Variable that will enter the basis -> x1
Variable that will leave the basis -> x5
```

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```
Iteration #2:

                3.0       4.0       0.0       0.0       0.0
                x1        x2        x3        x4        x5        b
---------------------------------------------------------------------------
x3   0.0        0.0       0.0       1.0       -0.5      -0.5      1.5
x2   4.0        0.0       1.0       0.0       0.0       1.0       1.0
x1   3.0        1.0       0.0       0.0       0.3       -1.3      0.8
---------------------------------------------------------------------------
zj-cj           0.0       0.0       0.0       0.8       0.3       6.3


=> Optimal tableau because there are no negative values in column b

Optimal solution:
-------------------------------
    x1* = 0.75
    x2* = 1.00
    x3* = 1.50
    x4* = 0.00
    x5* = 0.00

Optimal value of z:
-------------------------------
    z*=6.25
There are original variables with a fractional value
---> A cutting constraint must be introduced
and the new problem solved by the dual Simplex method

xnew =

     6

Iteration #1:

                3.0       4.0       0.0       0.0       0.0       0.0
                x1        x2        x3        x4        x5        x6        b
------------------------------------------------------------------------------------
x3   0.0        0.0       0.0       1.0       -0.5      -0.5      0.0       1.5
x2   4.0        0.0       1.0       0.0       0.0       1.0       0.0       1.0
x1   3.0        1.0       0.0       0.0       0.3       -1.3      0.0       0.8
x6   0.0        -0.0      -0.0      -0.0      -0.3      -0.8      1.0       -0.8
------------------------------------------------------------------------------------
zj-cj           0.0       0.0       0.0       0.8       0.3       0.0       6.3

Variable that will enter the basis -> x5
Variable that will leave the basis -> x6
```

Iteration #2:

		3.0	4.0	0.0	0.0	0.0	0.0	
		x1	x2	x3	x4	x5	x6	b
x3	0.0	0.0	0.0	1.0	-0.3	0.0	-0.7	2.0
x2	4.0	0.0	1.0	0.0	-0.3	0.0	1.3	0.0
x1	3.0	1.0	0.0	0.0	0.7	0.0	-1.7	2.0
x5	0.0	0.0	0.0	0.0	0.3	1.0	-1.3	1.0
zj-cj		0.0	0.0	0.0	0.7	0.0	0.3	6.0

=> Optimal tableau because there are no negative values in column b

Optimal solution:

```
-------------------------------
    x1* = 2.00
    x2* = 0.00
    x3* = 2.00
    x4* = 0.00
    x5* = 1.00
    x6* = 0.00
```

Optimal value of z:

```
-------------------------------
    z*=6.00
```

Example 2

Exercise 2 from the practical sheet 2

Maximize $z = 6x1 + 5x2$

subject to

$x1 + 2x2 \leq 10$

$3x1 + x2 \leq 12$

$x1 \geq 0,\ x2 \geq 0$

x1, x2 integers

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Entering the data

```
----------------------------------------------------------
 Solving a problem by the dual method of Simplex
----------------------------------------------------------
 It is assumed that:
 -> Objective function is in the maximization form
 -> All constraints are of type ">="
 -> All variables are >=0
----------------------------------------------------------

-------------------- Data of the problem --------------------
Number of variables: 2
Number of constraints: 2

Coefficients of the variables in the objective function
Insert vector c[]:[6 5]

Coefficients of the variables in the constraints
Insert matrix A[;]:[1 2;3 1]

Independent terms of the constraints
Insert vector b[]:[10 12]
```

Optimal solution

```
Iteration #0:

                  6.0        5.0        0.0        0.0
                  x1         x2         x3         x4         b
-----------------------------------------------------------------
x3   0.0          1.0        2.0        1.0        0.0        10.0
x4   0.0          3.0        1.0        0.0        1.0        12.0
-----------------------------------------------------------------
zj-cj             -6.0       -5.0       0.0        0.0        0.0

Variable that will enter the basis -> x1
Variable that will leave the basis -> x4


Iteration #1:

                  6.0        5.0        0.0        0.0
                  x1         x2         x3         x4         b
-----------------------------------------------------------------
x3   0.0          0.0        1.7        1.0        -0.3       6.0
x1   6.0          1.0        0.3        0.0        0.3        4.0
-----------------------------------------------------------------
zj-cj             0.0        -3.0       0.0        2.0        24.0

Variable that will enter the basis -> x2
Variable that will leave the basis -> x3


Iteration #2:

                  6.0        5.0        0.0        0.0
                  x1         x2         x3         x4         b
-----------------------------------------------------------------
x2   5.0          0.0        1.0        0.6        -0.2       3.6
x1   6.0          1.0        0.0        -0.2       0.4        2.8
-----------------------------------------------------------------
zj-cj             0.0        0.0        1.8        1.4        34.8


=> Optimal tableau because there are no negative values in column b

Optimal solution:
--------------------------------
    x1* = 2.80
    x2* = 3.60
    x3* = 0.00
    x4* = 0.00

Optimal value of z:
--------------------------------
    z*=34.80
```

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PILP solution

```
There are original variables with a fractional value
---> A cutting constraint must be introduced
and the new problem solved by the dual Simplex method

xnew =

     5

Iteration #1:

               6.0       5.0       0.0       0.0       0.0
               x1        x2        x3        x4        x5        b
----------------------------------------------------------------------------
x2   5.0       0.0       1.0       0.6       -0.2      0.0       3.6
x1   6.0       1.0       0.0       -0.2      0.4       0.0       2.8
x5   0.0       -0.0      -0.0      -0.8      -0.4      1.0       -0.8
----------------------------------------------------------------------------
zj-cj          0.0       0.0       1.8       1.4       0.0       34.8

Variable that will enter the basis -> x3
Variable that will leave the basis -> x5


Iteration #2:

               6.0       5.0       0.0       0.0       0.0
               x1        x2        x3        x4        x5        b
----------------------------------------------------------------------------
x2   5.0       0.0       1.0       0.0       -0.5      0.8       3.0
x1   6.0       1.0       0.0       0.0       0.5       -0.2      3.0
x3   0.0       0.0       0.0       1.0       0.5       -1.3      1.0
----------------------------------------------------------------------------
zj-cj          0.0       0.0       0.0       0.5       2.3       33.0


=> Optimal tableau because there are no negative values in column b

Optimal solution:
-------------------------------
    x1* = 3.00
    x2* = 3.00
    x3* = 1.00
    x4* = 0.00
    x5* = 0.00

Optimal value of z:
-------------------------------
    z*=33.00
```

Example 3

Exercise 3 from the practical sheet 2

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Maximize **z** = 2x1 + x2

subject to

2x1 + 5x2≤ 17

3x1 + 2x2≤ 10

x1≥ 0, x2 ≥ 0

x1, x2 integers

Entering the data

```
-----------------------------------------------------------
 Solving a problem by the Simplex method
-----------------------------------------------------------
 It is assumed that:
 -> Objective function is in the maximization form
 -> All constraints are of type ">="
 -> All variables are >=0
-----------------------------------------------------------

-------------------- Data of the problem --------------------
Number of variables: 2
Number of constraints: 2

Coefficients of the variables in the objective function
Insert vector c[]:[2 1]

Coefficients of the variables in the constraints
Insert matrix A[;]:[2 5;3 2]

Independent terms of the constraints
Insert vector b[]:[17 10]
```

Optimal solution

```
Iteration #0:

                 2.0       1.0       0.0       0.0
                 x1        x2        x3        x4        b
-----------------------------------------------------------------
x3   0.0         2.0       5.0       1.0       0.0       17.0
x4   0.0         3.0       2.0       0.0       1.0       10.0
-----------------------------------------------------------------
zj-cj            -2.0      -1.0      0.0       0.0       0.0

Variable that will enter the basis -> x1
Variable that will leave the basis -> x4


Iteration #1:

                 2.0       1.0       0.0       0.0
                 x1        x2        x3        x4        b
-----------------------------------------------------------------
x3   0.0         0.0       3.7       1.0       -0.7      10.3
x1   2.0         1.0       0.7       0.0       0.3       3.3
-----------------------------------------------------------------
zj-cj            0.0       0.3       0.0       0.7       6.7


=> Optimal tableau because there are no negative values in column b

Optimal solution:
--------------------------------
    x1* = 3.33
    x2* = 0.00
    x3* = 10.33
    x4* = 0.00

Optimal value of z:
--------------------------------
    z*=6.67
```

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PILP solution

```
There are original variables with a fractional value
---> A cutting constraint must be introduced
and the new problem solved by the dual Simplex method

xnew =

     5

Iteration #1:

               2.0       1.0       0.0       0.0       0.0
               x1        x2        x3        x4        x5        b
---------------------------------------------------------------------------
x3   0.0       0.0       3.7       1.0       -0.7      0.0       10.3
x1   2.0       1.0       0.7       0.0       0.3       0.0       3.3
x5   0.0       -0.0      -0.7      -0.0      -0.3      1.0       -0.3
---------------------------------------------------------------------------
zj-cj          0.0       0.3       0.0       0.7       0.0       6.7

Variable that will enter the basis -> x2
Variable that will leave the basis -> x5


Iteration #2:

               2.0       1.0       0.0       0.0       0.0
               x1        x2        x3        x4        x5        b
---------------------------------------------------------------------------
x3   0.0       0.0       0.0       1.0       -2.5      5.5       8.5
x1   2.0       1.0       0.0       0.0       0.0       1.0       3.0
x2   1.0       0.0       1.0       0.0       0.5       -1.5      0.5
---------------------------------------------------------------------------
zj-cj          0.0       0.0       0.0       0.5       0.5       6.5


=> Optimal tableau because there are no negative values in column b
```

```
Optimal solution:
-------------------------------
    x1* = 3.00
    x2* = 0.50
    x3* = 8.50
    x4* = 0.00
    x5* = 0.00

Optimal value of z:
-------------------------------
    z*=6.50
There are original variables with a fractional value
---> A cutting constraint must be introduced
and the new problem solved by the dual Simplex method

xnew =

     6

Iteration #1:

              2.0       1.0       0.0       0.0       0.0       0.0
              x1        x2        x3        x4        x5        x6        b
------------------------------------------------------------------------------------
x3   0.0      0.0       0.0       1.0       -2.5      5.5       0.0       8.5
x1   2.0      1.0       0.0       0.0       0.0       1.0       0.0       3.0
x2   1.0      0.0       1.0       0.0       0.5       -1.5      0.0       0.5
x6   0.0      -0.0      -0.0      -0.0      -0.0      -1.0      1.0       -1.0
------------------------------------------------------------------------------------
zj-cj         0.0       0.0       0.0       0.5       0.5       0.0       6.5

Variable that will enter the basis -> x5
Variable that will leave the basis -> x6
```

```
Iteration #2:

                2.0        1.0        0.0        0.0        0.0        0.0
                x1         x2         x3         x4         x5         x6         b
-------------------------------------------------------------------------------------
x3   0.0        0.0        0.0        1.0        -2.5       0.0        5.5        3.0
x1   2.0        1.0        0.0        0.0        0.0        0.0        1.0        2.0
x2   1.0        0.0        1.0        0.0        0.5        0.0        -1.5       2.0
x5   0.0        0.0        0.0        0.0        0.0        1.0        -1.0       1.0
-------------------------------------------------------------------------------------
zj-cj           0.0        0.0        0.0        0.5        0.0        0.5        6.0


=> Optimal tableau because there are no negative values in column b

Optimal solution:
-------------------------------
    x1* = 2.00
    x2* = 2.00
    x3* = 3.00
    x4* = 0.00
    x5* = 1.00
    x6* = 0.00

Optimal value of z:
-------------------------------
    z*=6.00
There are original variables with a fractional value
---> A cutting constraint must be introduced
and the new problem solved by the dual Simplex method

xnew =

     7

Iteration #1:

                2.0       1.0       0.0       0.0       0.0       0.0       0.0
                x1        x2        x3        x4        x5        x6        x7        b
---------------------------------------------------------------------------------------------
x3   0.0        0.0       0.0       1.0       -2.5      0.0       5.5       0.0       3.0
x1   2.0        1.0       0.0       0.0       0.0       0.0       1.0       0.0       2.0
x2   1.0        0.0       1.0       0.0       0.5       0.0       -1.5      0.0       2.0
x5   0.0        0.0       0.0       0.0       0.0       1.0       -1.0      0.0       1.0
x7   0.0        -0.0      -0.0      -0.0      -0.0      -0.0      -1.0      1.0       -1.0
---------------------------------------------------------------------------------------------
zj-cj           0.0       0.0       0.0       0.5       0.0       0.5       0.0       6.0

Variable that will enter the basis -> x6
Variable that will leave the basis -> x7
```

Example 4

Exercise 5 from the practical sheet 2

Maximize $z = x1 + 3x2$

subject to

$-x1 + 2x2 \leq 2$

$5x1 + 2x2 \leq 10$

$x1 \leq 1$

$x1 \geq 0,\ x2 \geq 0$

x1, x2 integers

Entering the data

```
-----------------------------------------------------------
 Solving a problem by the Simplex method
-----------------------------------------------------------
 It is assumed that:
 -> Objective function is in the maximization form
 -> All constraints are of type ">="
 -> All variables are >=0
-----------------------------------------------------------

-------------------- Data of the problem --------------------
Number of variables: 2
Number of constraints: 3

Coefficients of the variables in the objective function
Insert vector c[]:[1 3]

Coefficients of the variables in the constraints
Insert matrix A[;]:[-1 2;5 2;1 0]

Independent terms of the constraints
Insert vector b[]:[2 10 1]
```

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Optimal solution

```
Iteration #0:

               1.0       3.0       0.0       0.0       0.0
               x1        x2        x3        x4        x5        b
--------------------------------------------------------------------------
x3  0.0        -1.0      2.0       1.0       0.0       0.0       2.0
x4  0.0        5.0       2.0       0.0       1.0       0.0       10.0
x5  0.0        1.0       0.0       0.0       0.0       1.0       1.0
--------------------------------------------------------------------------
zj-cj          -1.0      -3.0      0.0       0.0       0.0       0.0

Variable that will enter the basis -> x2
Variable that will leave the basis -> x3


Iteration #1:

               1.0       3.0       0.0       0.0       0.0
               x1        x2        x3        x4        x5        b
--------------------------------------------------------------------------
x2  3.0        -0.5      1.0       0.5       0.0       0.0       1.0
x4  0.0        6.0       0.0       -1.0      1.0       0.0       8.0
x5  0.0        1.0       0.0       0.0       0.0       1.0       1.0
--------------------------------------------------------------------------
zj-cj          -2.5      0.0       1.5       0.0       0.0       3.0

Variable that will enter the basis -> x1
Variable that will leave the basis -> x5


Iteration #2:

               1.0       3.0       0.0       0.0       0.0
               x1        x2        x3        x4        x5        b
--------------------------------------------------------------------------
x2  3.0        0.0       1.0       0.5       0.0       0.5       1.5
x4  0.0        0.0       0.0       -1.0      1.0       -6.0      2.0
x1  1.0        1.0       0.0       0.0       0.0       1.0       1.0
--------------------------------------------------------------------------
zj-cj          0.0       0.0       1.5       0.0       2.5       5.5
```

```
=> Optimal tableau because there are no negative values in column b

Optimal solution:
-------------------------------
    x1* = 1.00
    x2* = 1.50
    x3* = 0.00
    x4* = 2.00
    x5* = 0.00

Optimal value of z:
-------------------------------
    z*=5.50
```

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PILP solution

```
There are original variables with a fractional value
---> A cutting constraint must be introduced
and the new problem solved by the dual Simplex method

xnew =

     6

Iteration #1:
```

		1.0	3.0	0.0	0.0	0.0	0.0	
		x1	x2	x3	x4	x5	x6	b
x2	3.0	0.0	1.0	0.5	0.0	0.5	0.0	1.5
x4	0.0	0.0	0.0	-1.0	1.0	-6.0	0.0	2.0
x1	1.0	1.0	0.0	0.0	0.0	1.0	0.0	1.0
x6	0.0	-0.0	-0.0	-0.5	-0.0	-0.5	1.0	-0.5
zj-cj		0.0	0.0	1.5	0.0	2.5	0.0	5.5

```
Variable that will enter the basis -> x3
Variable that will leave the basis -> x6

Iteration #2:
```

		1.0	3.0	0.0	0.0	0.0	0.0	
		x1	x2	x3	x4	x5	x6	b
x2	3.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0
x4	0.0	0.0	0.0	0.0	1.0	-5.0	-2.0	3.0
x1	1.0	1.0	0.0	0.0	0.0	1.0	0.0	1.0
x3	0.0	0.0	0.0	1.0	0.0	1.0	-2.0	1.0
zj-cj		0.0	0.0	0.0	0.0	1.0	3.0	4.0

```
=> Optimal tableau because there are no negative values in column b

Optimal solution:
-------------------------------
    x1* = 1.00
    x2* = 1.00
    x3* = 1.00
    x4* = 3.00
    x5* = 0.00
    x6* = 0.00

Optimal value of z:
-------------------------------
    z*=4.00
```