

# Simplex

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Algoritmo para cálculo de problema de programação linear desenvolvido para a matéria EA044 e implementado usando Python 3.

## Uso:

No terminal, na mesma pasta que o arquivo main.py digite:

```
python -m main.
```

Dê os coeficientes da função objetivo a ser minimizada, em seguida os coeficientes das restrições e seu valor rhs na mesma linha, separada por espaços. Cada restrição deve estar em uma linha e separada por um Enter. Feito isso aperte Enter 2 vezes e o algoritmo deve resolver o problema. O problema deve estar na forma padrão para ser minimizado.

**Obs:** Para usar com um arquivo de texto, digite:

```
python -m main < <file>
```

Onde é o arquivo de texto como descrito acima, com a função objetivo na primeira linha e cada restrição nas linhas subsequentes. Não esqueça de adicionar 2 linhas vazias no fim do arquivo.

*Exemplo:*

```
[lib/zero_not_feasible]
```

```
1 2 0 0 0
1 1 -1 0 0 2
-1 1 0 -1 0 1
0 1 0 0 -1 3
```

## Exemplos:

### Teste 1:

Minimizar  $v = -3x_0 - 2x_1$

Sujeito a:

$$2x_0 + 1x_1 + 1x_2 = 18$$

$$2x_0 + 3x_1 + 1x_3 = 42$$

$$3x_0 + 1x_1 + 1x_4 = 24$$

Solução:

```
[test/optimal]
```

Give the coefficients of the objective function being minimized

```
>-3 -2 0 0 0
```

Give the coefficients of the left hand size of the constraints and the right hand size of the constraints

```
>2 1 1 0 0 18
>2 3 0 1 0 42
>3 1 0 0 1 24
>
```

All non-basic variables in 0 is possible solution.

...skipping phase 1.

Initializing phase 2.

Iteration 0

1	-3.00	-2.00	0.00	0.00	0.00	0.00
-----						
x2	2.00	1.00	1.00	0.00	0.00	18.00
x3	2.00	3.00	0.00	1.00	0.00	42.00
x4	3.00	1.00	0.00	0.00	1.00	24.00

v = 0.00, x1 = 0.00, x2 = 0.00, x3 = 18.00, x4 = 42.00, x5 = 24.00

Enter: x0

Leave: x4

Iteration 1

1	0.00	-1.00	0.00	0.00	1.00	24.00
-----						
x2	0.00	0.33	1.00	0.00	-0.67	2.00
x3	0.00	2.33	0.00	1.00	-0.67	26.00
x0	1.00	0.33	0.00	0.00	0.33	8.00

v = -24.00, x0 = 8.00, x1 = 0.00, x2 = 2.00, x3 = 26.00, x4 = 0.00

Enter: x1

Leave: x2

Iteration 2

1	0.00	0.00	3.00	0.00	-1.00	30.00
-----						
x1	0.00	1.00	3.00	0.00	-2.00	6.00
x3	0.00	0.00	-7.00	1.00	4.00	12.00
x0	1.00	0.00	-1.00	0.00	1.00	6.00

v = -30.00, x0 = 6.00, x1 = 6.00, x2 = 0.00, x3 = 12.00, x4 = 0.00

Enter: x4  
 Leave: x3

Iteration 3

1	0.00	0.00	1.25	0.25	0.00	33.00
-----						
x1	0.00	1.00	-0.50	0.50	0.00	12.00
x4	0.00	0.00	-1.75	0.25	1.00	3.00
x0	1.00	0.00	0.75	-0.25	0.00	3.00

$v = -33.00$ ,  $x_0 = 3.00$ ,  $x_1 = 12.00$ ,  $x_2 = 0.00$ ,  $x_3 = 0.00$ ,  $x_4 = 3.00$

...phase 2 done.

Optimal solution:

Iterations: 0 (phase 1) + 3 (phase 2) = 3

$v = -33.00$ ,  $x_0 = 3.00$ ,  $x_1 = 12.00$ ,  $x_2 = 0.00$ ,  $x_3 = 0.00$ ,  $x_4 = 3.00$

Done.

## Teste 2:

Minimizar  $v = -0.3x_0 - 0.2x_1 - 0.1x_2$

Sujeito a:

$$\begin{aligned} 3x_0 + 2x_1 + 1x_2 + 1x_3 &= 2 \\ -1x_0 + 1x_1 &+ 1x_4 = 5 \\ 10x_0 &+ 30x_2 - 1x_5 = 10 \end{aligned}$$

Solução:

[test/multiple]

Give the coefficients of the objective function being minimized

>-0.3 -0.2 -0.1 0 0 0

Give the coefficients of the left hand size of the constraints and the right hand size of the constraints

>3 2 1 1 0 0 2

>-1 1 0 0 1 0 5

>10 0 30 0 0 -1 10

>

Initializing phase 1.

Iteration 0

1	-10.00	0.00	-30.00	0.00	0.00	1.00	0.00	0.00
-----								

x3	3.00	2.00	1.00	1.00	0.00	0.00	0.00	2.00
x4	-1.00	1.00	0.00	0.00	1.00	0.00	0.00	5.00
x6	10.00	0.00	30.00	0.00	0.00	-1.00	1.00	10.00

Enter: x2  
 Leave: x6

Iteration 1								
1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	10.00
-----								
x3	2.67	2.00	0.00	1.00	0.00	0.03	-0.03	1.67
x4	-1.00	1.00	0.00	0.00	1.00	0.00	0.00	5.00
x2	0.33	0.00	1.00	0.00	0.00	-0.03	0.03	0.33

...phase 1 done.

Initializing phase 2.

Iteration 0							
1	-0.27	-0.20	0.00	0.00	0.00	-0.00	0.03
-----							
x3	2.67	2.00	0.00	1.00	0.00	0.03	1.67
x4	-1.00	1.00	0.00	0.00	1.00	0.00	5.00
x2	0.33	0.00	1.00	0.00	0.00	-0.03	0.33

v = -0.03, x1 = 0.00, x2 = 0.00, x3 = 0.33, x4 = 1.67, x5 = 5.00, x6 = 0.00

Enter: x0  
 Leave: x3

Iteration 1							
1	0.00	0.00	0.00	0.10	0.00	0.00	0.20
-----							
x0	1.00	0.75	0.00	0.38	0.00	0.01	0.62
x4	0.00	1.75	0.00	0.38	1.00	0.01	5.62
x2	0.00	-0.25	1.00	-0.12	0.00	-0.04	0.12

v = -0.20, x0 = 0.62, x1 = 0.00, x2 = 0.12, x3 = 0.00, x4 = 5.62, x5 = 0.00

...phase 2 done.

Multiple solutions  
 Showing one optimal solution:  
 Iterations: 1 (phase 1) + 1 (phase 2) = 2  
 $v = -0.20$ ,  $x_0 = 0.62$ ,  $x_1 = 0.00$ ,  $x_2 = 0.12$ ,  $x_3 = 0.00$ ,  $x_4 = 5.62$ ,  $x_5 = 0.00$   
 Done.

---

### Teste 3:

Minimizar  $v = -10x_0 - 22x_1 - 15x_2$   
 Sujeito a:  
 $1x_0 + 1x_1 - 1x_2 + 1x_3 = 200$   
 $-1x_0 + 1x_1 + 1x_4 = 10$

Solução:

[test/unbounded]

Give the coefficients of the objective function being minimized

>-10 -22 -15 0 0

Give the coefficients of the left hand size of the constraints and the right hand size of the

>1 1 -1 1 0 200

>-1 1 0 0 1 10

>

All non-basic variables in 0 is possible  
 solution.

...skipping phase 1.

Initializing phase 2.

Iteration 0

1		-10.00		-22.00		-15.00		0.00		0.00		0.00	
-----													
x3		1.00		1.00		-1.00		1.00		0.00		200.00	
x4		-1.00		1.00		0.00		0.00		1.00		10.00	

$v = 0.00$ ,  $x_1 = 0.00$ ,  $x_2 = 0.00$ ,  $x_3 = 0.00$ ,  $x_4 = 200.00$ ,  $x_5 = 10.00$

Enter: x1

Leave: x4

Iteration 1

1		-32.00		0.00		-15.00		0.00		22.00		220.00	
-----													

x3	2.00	0.00	-1.00	1.00	-1.00	190.00
x1	-1.00	1.00	0.00	0.00	1.00	10.00

v = -220.00, x0 = 0.00, x1 = 10.00, x2 = 0.00, x3 = 190.00, x4 = 0.00

Enter: x0

Leave: x3

Iteration 2

1	0.00	0.00	-31.00	16.00	6.00	3260.00
-----						
x0	1.00	0.00	-0.50	0.50	-0.50	95.00
x1	0.00	1.00	-0.50	0.50	0.50	105.00

v = -3260.00, x0 = 95.00, x1 = 105.00, x2 = 0.00, x3 = 0.00, x4 = 0.00

Enter: x2

Iteration 3

1	0.00	0.00	-31.00	16.00	6.00	3260.00
-----						
x0	1.00	0.00	-0.50	0.50	-0.50	95.00
x1	0.00	1.00	-0.50	0.50	0.50	105.00

v = -3260.00, x0 = 95.00, x1 = 105.00, x2 = 0.00, x3 = 0.00, x4 = 0.00

...phase 2 done.

Unbounded solution

Iterations: 0 (phase 1) + 3 (phase 2) = 3

v and solutions tend to infinity.

Done.