Exercice 1 - Simplex implementation

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1 Introduction

This work solves the following problem:

$$\begin{array}{ll} \text{minimize} & z = 80x_1 + 60x_2 \\ \text{subject to} & 0.20x_1 + 0.32x_2 \leq 0.25 \\ & x_1 + x_2 + x_4 = 1 \end{array}$$

1.1 How it works

This problem is solved by running simplex2 implementation without specifing a feasible base. The function simplex2 calls simplex1 in order to find a feasible base, after that using the base found the function is called again solving problem.

1.2 Results

The optimum result for this problem is:

$$\begin{array}{l} \text{z} = -119.0278 \\ \text{x} = [0, 14.1667, 2.6389, 5.0000] \end{array}$$

1.3 Input parameters

The simplxe2 implementation was configured as follow:

```
c = [2  -10  1  4  0  0  0];

A = [ 3  6  0  3  1  0  0
      4  0  0  10  0  -1  0
      -3  1  6  0  0  0  -1];

b = [100
     50
     30];

[x, z, Ir, it, tipo] = simplex2(A, b, c)
```

2 Source Code

simplex1.m

```
function [x, z, I, it, tipo] = simplex1(A, b, c, I)
    [~,n] = size(A);

    J = 1:n;
    J(I) = [];

    it = 0;

    while true
        it = it + 1;

        Ai = A(:, I) ^ -1;
        Aj = A(:, J);
        ci = c(:, I);
        cj = c(:, J);

        pi = ci * Ai;
        ccj = pi * Aj - cj;

        z = pi * b;

        x = n:1;
        x(I) = Ai * b;
        x(J) = 0;
        x = x.';

        [t,k] = max(ccj);

        if ccj == 0
            tipo = 1;
            break;
        elseif t <= 0
            tipo = 0;
            break;
        else
            xi =  Ai * b;
            Ak = Ai * A(:, J(k));

            byk = xi./Ak;

            byk(byk <= 0) = inf;
```

```
42                [t,r] = min(byk);
43
44                if t == inf
45                    tipo = -1;
46                    break;
47                end
48
49               [J(k), I(r)] = deal(I(r), J(k));
50            end
51        end
52    end
```

simplex2.m

```
1   function [x, z, I, it, tipo] = simplex2(A, b, c)
2       [m,n] = size(A);
3       I = 1:n+m;
4       ct = zeros(1, n+m);
5
6       I(1:n) = [];
7       ct(I) = 1;
8
9       B = horzcat(A, eye(m));
10
11      [x, z_f1, I_f1, it_f1, ~] = simplex1(B, b, ct, I);
12
13      if z_f1 == 0
14          [x, z, I, it_f2, tipo] = simplex1(A, b, c, I_f1);
15
16          it = it_f2 + it_f1;
17      end
18  end
```