# OR 第五周上机作业

20123101 李昀哲

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## 1、给割平面法求解（A 包含一个单位矩阵）：

接口函数[xstar,fxstar,iter] = Gomory(A,b,c)

判断整数条件可用：abs(round(x) –x) < 1e-3

例： A = [-1 3 1 0; 7 1 0 1];
b = [6 35]';
c = [7 9 0 0]';

**准备部分：**

```matlab
% Operational Research
% @author 李昀哲 20123101
% Dec 28, 2022
%% 数据准备
A = [-1 3 1 0; 7 1 0 1];
b = [6 35]';
c = [7 9 0 0];
|
```

**Gomory 函数：**

```matlab
function [xstar,fxstar,iter] = Gomory(A,b,c)
iter=0;

while true
    [m,n]=size(A);
    if min(b)>=0
        % 单纯形法求解
        [x_opt,fx_opt,CA,Cb] = simplex(A,b,c);
    else
        % 对偶单纯形法求解
        [x_opt,fx_opt,CA,Cb] = DSimplex_eye(A,b,c);
    end
    % 判断是否已经解出了整数最优解
    is_integer=1;
    for pos_x = 1:m
        if abs(round(x_opt(pos_x))-x_opt(pos_x))>=1e-3 % 判断整数条件
            is_integer=0;
            break;
        end
    end
```

```matlab
        if is_integer==1          %如果解全是整数，满足条件，循环结束
            xstar=x_opt;
            fxstar=fx_opt;
            break;
        end
        iter=iter+1;
        % 找出b中和整数相差最大的数
        % 循环遍历
        cha=0;
        row=0;
        for r=1:m
            t=abs(floor(x_opt(r))-x_opt(r));
            if t>cha
                cha=t;
                row=r; % 标记当前最大差值的位置
            end
        end


        n=n+1;
        m=m+1;
        iter=iter+1;
        %原基础上增加一行一列，第（m,n）=1
        tmp_A=zeros(m,n);
        tmp_b=zeros(m,1);
        tmp_c=zeros(1,n);
        for i=1:m-1
            for j=1:n-1
                tmp_A(i,j)=CA(i,j);
            end
            tmp_b(i,1)=Cb(i,1);
        end
        tmp_b(m,1)=floor(Cb(row,1))-Cb(row,1);
        tmp_A(m,n)=1;
        for i =1:n-1
            tmp_c(1,i)=c(i);
        end
        % add约束条件
        for i=1:n-1
            if tmp_A(row,i)==0
                tmp_A(m,i)=0;
            else
                tmp_A(m,i)=floor(tmp_A(row,i))-tmp_A(row,i);
            end
        end

        A=tmp_A;
        b=tmp_b;
        c=tmp_c;
    end
end
```

**simplex 函数：**

```matlab
function [x_opt,fx_opt,A,b] = simplex(A,b,c)
[m,n] = size(A);
ind_B =has_ones(A);
ind_N = setdiff(1:n, ind_B);


while true
    x0 = zeros(n,1);
    x0(ind_B) = b;
    cB = c(ind_B);
    sigma = zeros(1,n);
    sigma(ind_N) = c(ind_N) - cB*A(:,ind_N);
    [~, k] = max(sigma);
    if ~any(sigma > 0)
        x_opt = x0;
        fx_opt = c * x_opt;
        return
    end
    if all(A(:,k) <= 0)
        x_opt = [];
        break
    end
```

```matlab
        theta = b ./ A(:,k);
        theta(theta<=0) = 10000;
        [~, q] = min(theta);
        el = ind_B(q);
        % 换基
        ind_B(ind_B == el) = k;
        ind_N = setdiff(1:n, ind_B);
        % 更新A和b
        A(:,ind_N) = A(:,ind_B) \ A(:,ind_N);
        b = A(:,ind_B) \ b;
        A(:,ind_B) = eye(m,m);
    end
  end
```

**DSimplex_eye 函数：**

```matlab
function [x_opt,fx_opt,A,b] = DSimplex_eye(A,b,c)
[m,n] = size(A);
ind_B = has_ones(A);
ind_N = setdiff(1:n, ind_B);
while true
    x0 = zeros(n,1);
    x0(ind_B) = b;
    cB = c(ind_B);
    if ~any(b < 0)
        x_opt = x0;
        fx_opt = c*x_opt;
        return
    end
    index=find(b<0);
    for i = 1:numel(index)
        if all(A(index(i),:)>=0)
            x_opt=[];
            fx_opt = [];
            return
        end
    end

    Sigma = zeros(1,n);
    Sigma(ind_N) = c(ind_N) - cB*A(:,ind_N);
    [~,q] = min(b);
    r = ind_B(q);
    Theta = Sigma ./ A(q,:);
    Theta(Theta<=0) = 10000;
    [~,s] = min(Theta);
    % 换基
    ind_B(ind_B == r) = s;
    ind_N = setdiff(1:n, ind_B); |
    % 更新A和b
    A(:,ind_N) = A(:,ind_B) \ A(:,ind_N);
    b = A(:,ind_B) \ b;
    A(:,ind_B) = eye(m,m);
  end
  end
```

**函数调用：**

```matlab
%% 函数调用
[xstar,fxstar,iter] = Gomory(A,b,c)
```

运行结果：

```
xstar =

       4
       3
       1
       4
       0
       0


fxstar =

      55


iter =

       4
```