GomoryCuts

```
load simplex.sage
```

```
simplex functions loaded.
```

```
A=matrix(QQ,[[0,0,-1,0,0],[6,3,2,1,0],[0,-3,2,0,1]])
B=[3,4]; A
```

```
[ 0  0 -1  0  0]
[ 6  3  2  1  0]
[ 0 -3  2  0  1]
```

```
prepare_tableau(A,B)
simplex(A,B)
print A
```

```
We have an optimal solution with cost= -3/2
[ 3/2    0    0  1/4  1/4]
[   1    1    0  1/6 -1/6]
[ 3/2    0    1  1/4  1/4]
```

Since $x_2 + \frac{1}{4}x_3 + \frac{1}{4}x_4 = \frac{3}{2}$, we add the Gomory cut $-\frac{1}{4}x_3 + -\frac{1}{4}x_4 + x_5 = -\frac{1}{2}$ and proceed with dual simplex.

```
A=A.augment(matrix(A.nrows(),1)).stack(matrix(1,A.ncols()+1,[-1/2,0,0,-1/4,-
B.append(5)
print A
print B
```

```
[ 3/2    0    0  1/4  1/4    0]
[   1    1    0  1/6 -1/6    0]
[ 3/2    0    1  1/4  1/4    0]
[-1/2    0    0 -1/4 -1/4    1]
[1, 2, 5]
```

```
#dual_simplex(A,B)
pivot(A,B,3,3)
```

```
Pivoting tableau on col= 3 row= 3
[   1    0    0    0    0    1]
[ 2/3    1    0    0 -1/3  2/3]
[   1    0    1    0    0    1]
[   2    0    0    1    1   -4]
```

We now have an optimal tableau. A nonintegral component of the solution remains, so we add another Gomory cut.

```
A=A.augment(matrix(A.nrows(),1)).stack(matrix(1,A.ncols()+1,[-2/3,0,0,0,-2/3
B.append(6)
print A
print B
```

```
[   1    0    0    0    0    1    0]
[ 2/3    1    0    0 -1/3  2/3    0]
[   1    0    1    0    0    1    0]
[   2    0    0    1    1   -4    0]
[-2/3    0    0    0 -2/3 -2/3    1]
[1, 2, 3, 6]
```

```
#dual_simplex(A,B)
pivot(A,B,4,4)
```

```
Pivoting tableau on col= 4 row= 4
[   1    0    0    0    0    1    0]
[   1    1    0    0    0    1 -1/2]
[   1    0    1    0    0    1    0]
[   1    0    0    1    0   -5  3/2]
[   1    0    0    0    1    1 -3/2]
```

We now have an optimal integral solution.

```
print basic_solution(A,B)
print cost(A)
```

```
(1, 1, 1, 1, 0, 0)
-1
```