In [1]:
```
import sys, os
import docplex.mp
from docplex.mp.model import Model

path = 'D:\SISTEMAS\SEMESTRE-2020-2\Pesquisa Operacional\Lista1'
os.chdir(path)
```

In [2]:
```
modelo = Model(name='Lista_1_Questao_5')
```

In [3]:
```
X1 = modelo.continuous_var(name='X1')
X2 = modelo.continuous_var(name='X2')
```

In [4]:
```
# Função Objetiva
modelo.maximize(0.5*X1 + 2*X2)
```

In [5]:
```
# Restrições
modelo.add_constraint(X1 >= 0)
modelo.add_constraint(X2 >= 0)
modelo.add_constraint(X1 <= 20)
modelo.add_constraint(X2 <= 45)
modelo.add_constraint(2*X1 + X2 <= 50)
```

Out[5]:
```
docplex.mp.LinearConstraint[](2X1+X2,LE,50)
```

In [6]:
```
modelo.print_information()
```

```
Model: Lista_1_Questao_5
 - number of variables: 2
   - binary=0, integer=0, continuous=2
 - number of constraints: 5
   - linear=5
 - parameters: defaults
 - objective: maximize
 - problem type is: LP
```

In [7]:
```
otimizacao = modelo.solve()
modelo.print_solution()
```

```
objective: 91.250
  X1=2.500
  X2=45.000
```

In [8]:
```
modelo.parameters.lpmethod = 4
modelo.solve(url=None, key=None, log_output=True)
```

```
Version identifier: 20.1.0.0 | 2020-11-11 | 9bedb6d68
CPXPARAM_Read_DataCheck                          1
CPXPARAM_LPMethod                                4
Tried aggregator 1 time.
LP Presolve eliminated 4 rows and 0 columns.
Reduced LP has 1 rows, 2 columns, and 2 nonzeros.
Presolve time = 0.01 sec. (0.00 ticks)
Parallel mode: using up to 4 threads for barrier.
Number of nonzeros in lower triangle of A*A' = 0
Using Approximate Minimum Degree ordering
Total time for automatic ordering = 0.00 sec. (0.00 ticks)
```

```
Summary statistics for Cholesky factor:
  Threads                 = 4
  Rows in Factor          = 1
  Integer space required  = 1
  Total non-zeros in factor = 1
  Total FP ops to factor  = 1
 Itn      Primal Obj        Dual Obj  Prim Inf Upper Inf  Dual Inf Inf Ratio
   0   1.2750000e+02   2.9500000e+02  1.54e+02  1.39e+02  3.00e+00  1.00e+00
   1   9.3939167e+01   9.4801275e+01  1.40e+01  1.26e+01  2.73e-01  6.89e-02
   2   9.2060072e+01   9.2396839e+01  1.23e+00  1.11e+00  8.15e-03  1.51e+03
   3   9.1202725e+01   9.1252913e+01  2.69e-03  2.43e-03  3.59e-04  1.65e+03
   4   9.1249997e+01   9.1250003e+01  3.63e-07  3.28e-07  3.58e-08  1.13e+06
   5   9.1250000e+01   9.1250000e+01  3.70e-11  3.34e-11  3.58e-12  8.49e+09
   6   9.1250000e+01   9.1250000e+01  0.00e+00  7.25e-15  4.23e-16  8.42e+13
Barrier time = 0.03 sec. (0.01 ticks)
Parallel mode: deterministic, using up to 4 threads for concurrent optimization:
 * Starting dual Simplex on 1 thread...
 * Starting primal Simplex on 1 thread...

Dual crossover.
  Dual:  Fixed no variables.
  Primal:  Fixed no variables.

Dual simplex solved model.

Total crossover time = 0.03 sec. (0.00 ticks)

Total time on 4 threads = 0.08 sec. (0.01 ticks)
```

Out[8]:
```
docplex.mp.solution.SolveSolution(obj=91.25,values={X1:2.5,X2:45})
```

In [8]:
```
modelo.print_solution()
```

```
objective: 91.250
  X1=2.500
  X2=45.000
```

In [9]:
```
%notebook "D:\SISTEMAS\SEMESTRE-2020-2\Pesquisa Operacional\Lista1\Questao_5.ipynb"
```

In [10]:
```
dual = Model(name='Lista_1_Questao_5_dual')

L1 = dual.continuous_var(name='Lambda_1')
L2 = dual.continuous_var(name='Lambda_2')
L3 = dual.continuous_var(name='Lambda_3')

dual.minimize(50*L1 + 20*L2 + 45*L3)

dual.add_constraint(L1 >= 0)
dual.add_constraint(L2 >= 0)
dual.add_constraint(L3 >= 0)
dual.add_constraint(2*L1 + L2 >= 0.0)
dual.add_constraint(L1 + L3 >= 2)

otimizacaoDual = dual.solve()
dual.print_solution()
```

```
objective: 90.000
  Lambda_3=2.000
```