Lista 1 - Exercício 1

INF2912 - Otimização Combinatória

Prof. Marcus Vinicius Soledade Poggi de Aragão

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Ciro Cavani

BigData / **Globo.com**

Assignment Problem

- T - conjunto de tarefas $|T| = n$
- M - conjunto de máquinas $|M| = n$
- c_{ij} - custo de alocar a tarefa i na máquina j

Objetivo:

custo total mínimo

Modelo IP

$$
\begin{aligned}
\text{minimize} \quad & \sum_{i=1}^{n}\sum_{j=1}^{n} c_{ij}x_{ij} \\
\text{subject to} \quad & \sum_{i=1}^{n} x_{ij} = 1 \qquad j = 1,\ldots,n \\
& \sum_{j=1}^{n} x_{ij} = 1 \qquad i = 1,\ldots,n \\
& x_{ij} \geq 0 \qquad i,j = 1,\ldots,n \\
& x_{ij} \in \{0,1\} \qquad i,j = 1,\ldots,n
\end{aligned}
$$

JuMP

http://www.juliaopt.org/ (http://www.juliaopt.org/)

http://jump.readthedocs.org/en/stable/ (http://jump.readthedocs.org/en/stable/)

Modeling language for Mathematical Programming (linear, mixed-integer, conic, nonlinear)

```
In [1]: using JuMP
```

Exercício 1 - Assignment Problem

```julia
In [2]: n = 3

        c = [5 10 7
             8 9 6
             3 13 2]
```

```
Out[2]: 3x3 Array{Int64,2}:
         5   10   7
         8    9   6
         3   13   2
```

```julia
In [3]: map = Model()

        @defVar(map, x[1:n,1:n], Bin)

        for j=1:n
            @addConstraint(map, sum{x[i,j], i=1:n} == 1)
        end

        for i=1:n
            @addConstraint(map, sum{x[i,j], j=1:n} == 1)
        end

        @setObjective(map, Min, sum{c[i,j] * x[i,j], i=1:n, j=1:n})

        map
```

Out[3]:

$$\min \quad 5x_{1,1} + 10x_{1,2} + 7x_{1,3} + 8x_{2,1} + 9x_{2,2} + 6x_{2,3} + 3x_{3,1} + 13x_{3,2} + 2x_{3,3}$$

Subject to
$$x_{1,1} + x_{2,1} + x_{3,1} = 1$$
$$x_{1,2} + x_{2,2} + x_{3,2} = 1$$
$$x_{1,3} + x_{2,3} + x_{3,3} = 1$$
$$x_{1,1} + x_{1,2} + x_{1,3} = 1$$
$$x_{2,1} + x_{2,2} + x_{2,3} = 1$$
$$x_{3,1} + x_{3,2} + x_{3,3} = 1$$
$$x_{i,j} \in \{0,1\} \quad \forall i \in \{1,2,3\}, j \in \{1,2,3\}$$

```julia
In [4]: solve(map)
```

```
Out[4]: :Optimal
```

```julia
In [5]: typeof(getInternalModel(map))
```

```
Out[5]: Cbc.CbcMathProgSolverInterface.CbcMathProgModel
```

```julia
In [6]: getObjectiveValue(map)
```

```
Out[6]: 16.0
```

```julia
In [7]: getValue(x)
```

```
Out[7]: 3x3 Array{Float64,2}:
         1.0  0.0  0.0
         0.0  1.0  0.0
         0.0  0.0  1.0
```

In [8]: `getDual(x) # Erro Esperado - não implementado para IP`

```
LoadError: Variable bound duals (reduced costs) not available. Check that t
he model was properly solved and no integer variables are present.
while loading In[8], in expression starting on line 1

 in getDual at /home/cavani/.julia/v0.4/JuMP/src/JuMP.jl:420
 in map at abstractarray.jl:1305
 in getDual at /home/cavani/.julia/v0.4/JuMP/src/JuMPContainer.jl:179
```