Matching dual

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```
import itertools
list2d = [3*[1], 15* [0]]
merged = lambda l: list(itertools.chain(*l))
print merged(list2d)
```

```
[1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
```

```
%typeset_mode True

    # A, B
A = (merged([3*[1], 15*[0]]), merged([3*[0], 2*[1], 13 * [0]]), \
   merged([5*[0], 3*[1], 10 * [0]]) , merged([8*[0], 3*[1], 7*[0]]),
        merged([11*[0], 2*[1], 5*[0]]), merged([13*[0], 3*[1], \
   2*[0]]), merged([16*[0], 2*[1]]),
        merged([[1], 2*[0], [1], 4*[0], [1], 9 * [0]]), merged([[0],\
    [1], 4*[0], [1], 9*[0], [1], [0]]),
        merged([ 2 * [0], [1], 12*[0], [1], 2*[0]]), merged([ 4 * \
   [0], [1], 4*[0], [1], 8*[0]]),
        merged([ 5 * [0], [1], 5*[0], [1], [0], [1],  4*[0]]),
        merged([ 7 * [0], [1], 6*[0], [1], 3* [0]]),
        merged([ 10 * [0], [1], [0], [1], 4* [0], [1]])
    )
b = (14*[1])
c = tuple((18*[1]))
P = InteractiveLPProblem(A, b, c, ["xAq", "xAs","xAv", "xBq", "xBt",\
    "xCr", "xCs", "xCu", "xDq", "xDt", "xDw",
                                    "xEr", "xEw", "xFr", "xFu", "xFv",\
    "xGs", "xGw"],
                          constraint_type="==",variable_type=">=")

view(P)
```

$$\max\ xAq + xAs + xAv + xBq + xBt + xCr + xCs + xCu + xDq + xDt + xDw + xEr + xEw + xFr + xFu$$

$$xAq + xAs + xAv \qquad xBq + xBt \qquad xCr + xCs + xCu \qquad xDq + xDt + xDw \qquad xEr + xEw \qquad xFr + xFu$$

$$xAq + xBq + xDq$$
$$xAs + xCs$$
$$xAv$$
$$xBt + xDt$$
$$xCr + xEr + xFr$$
$$xCu + xFu$$
$$xDw + xEw$$

$$xAq, xAs, xAv, xBq, xBt, xCr, xCs, xCu, xDq, xDt, xDw, xEr, xEw, xFr, xFu, xFv, xGs, xGw \geq 0$$

```
# As we can see in dual program, every node gets its own variable, \
   and for every E(v1, v2) y_v1 + y_v2 >= 1,
# which is exactly the same as vertex cover formulation

view(P.dual())
```

$$\min\ y_1 + y_2 + y_3 + y_4 + y_5 + y_6 + y_7 + y_8 + y_9 + y_{10} + y_{11} + y_{12} + y_{13} + y_{14}$$

$$\begin{aligned}
y_1 + y_8 &\geq 1\\
y_1 + y_9 &\geq 1\\
y_1 + y_{10} &\geq 1\\
y_2 + y_8 &\geq 1\\
y_2 + y_{11} &\geq 1\\
y_3 + y_{12} &\geq 1\\
y_3 + y_9 &\geq 1\\
y_3 + y_{13} &\geq 1\\
y_4 + y_8 &\geq 1\\
y_4 + y_{11} &\geq 1\\
y_4 + y_{14} &\geq 1\\
y_5 + y_{12} &\geq 1\\
y_5 + y_{14} &\geq 1\\
y_6 + y_{12} &\geq 1\\
y_6 + y_{13} &\geq 1\\
y_6 + y_{10} &\geq 1\\
y_7 + y_9 &\geq 1\\
y_7 + y_{14} &\geq 1
\end{aligned}$$