LINEAR PROGRAMMING

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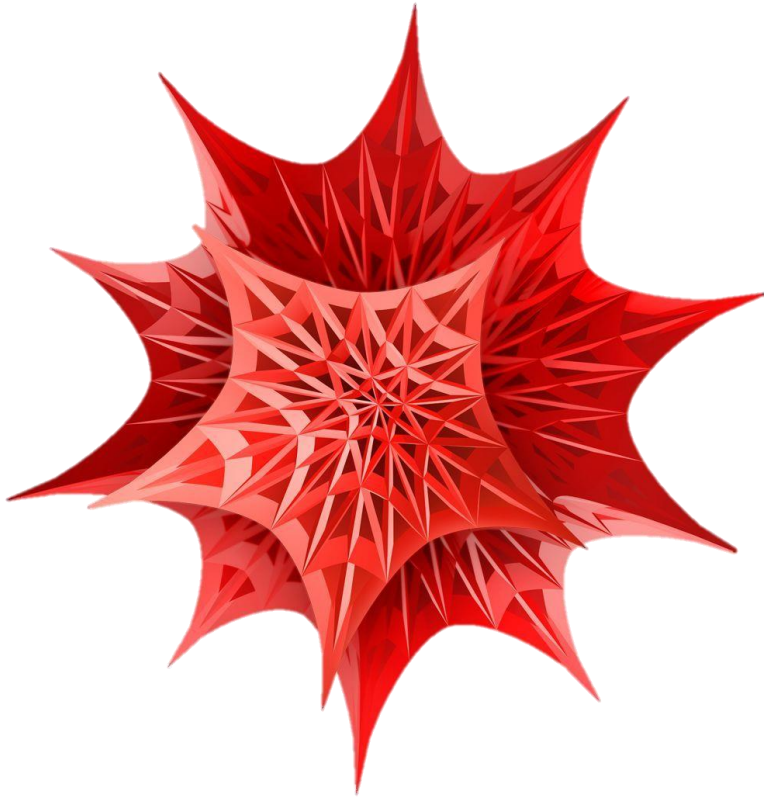
LINEAR PROGRAMMING SOFTWARE

The software which I use is Mathematica. It is a numerical calculation software published by the Wolfram.



MATHEMATICA

Mathematic is a popular numerical calculation software.

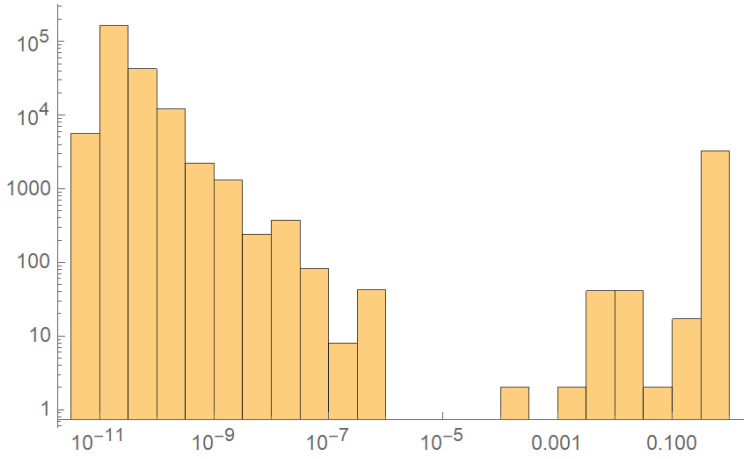
It integrates a large number of commonly used numerical computation functions and detailed documentation. And its calculation engine is very powerful.

For linear programming, it have built-in function to solve the problem. It also can provide some open source dataset to run the benchmark.

It can calculate the linear programming problem by many method, including “Interior Point” method, “Simplex” method and “Revised Simplex” method

```
In[•]:= a = ExampleData[{"LinearProgramming", "osa-60"}]
          范例数据

In[•]:= b = Append[a, Method → "InteriorPoint"];
          追加        方法

In[•]:= AbsoluteTiming[x = LinearProgramming @@ a;]
        绝对时间              线性规划
        c = a[[1]];

Out[•]= {16.774, Null}

In[•]:= Dot[x, a[[1]]]
        点积

Out[•]= 4.04407 × 10^6

In[•]:= Histogram[x, "Log", ScalingFunctions → "Log"]
        直方图              刻度函数
```

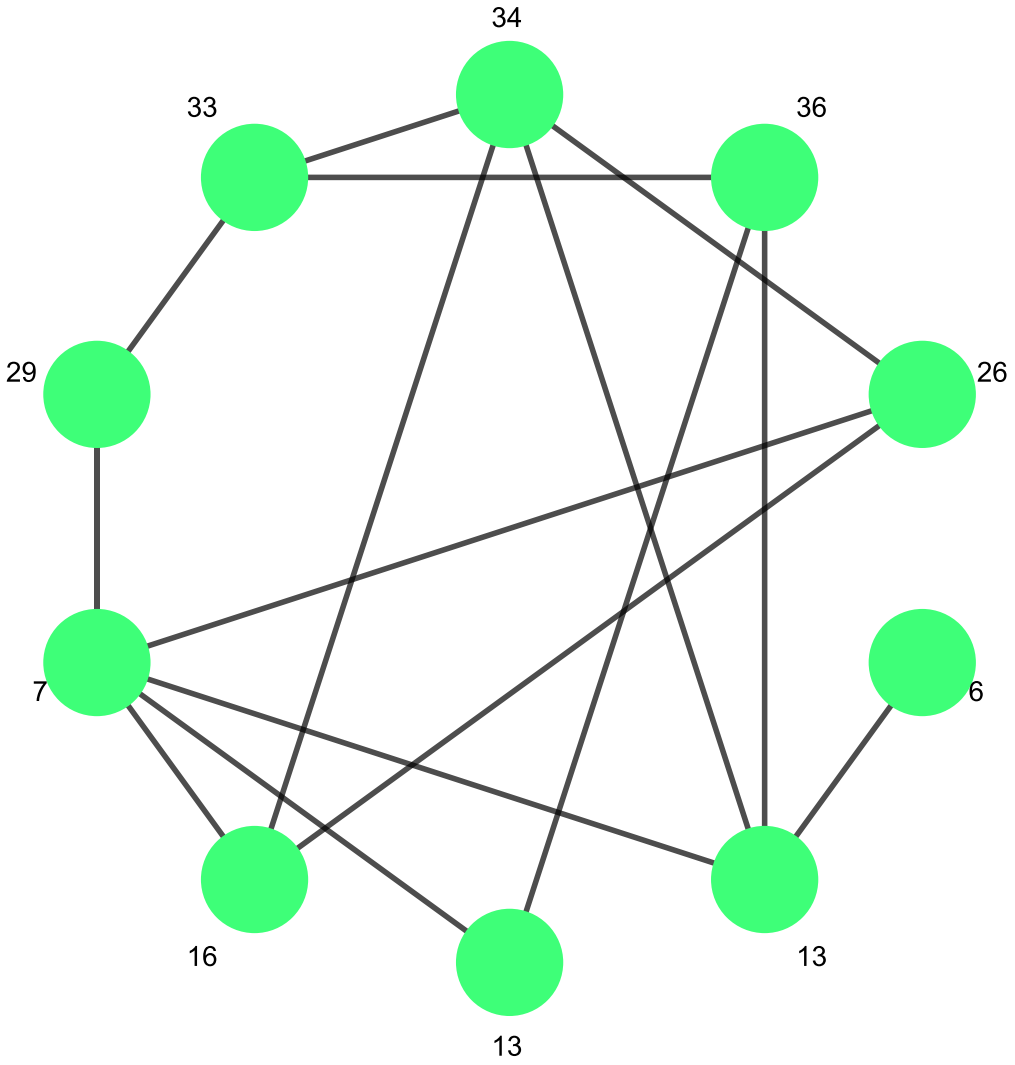
Out[•]=



SMALL EXAMPLE

The small example which I choose is a Vertex problem.

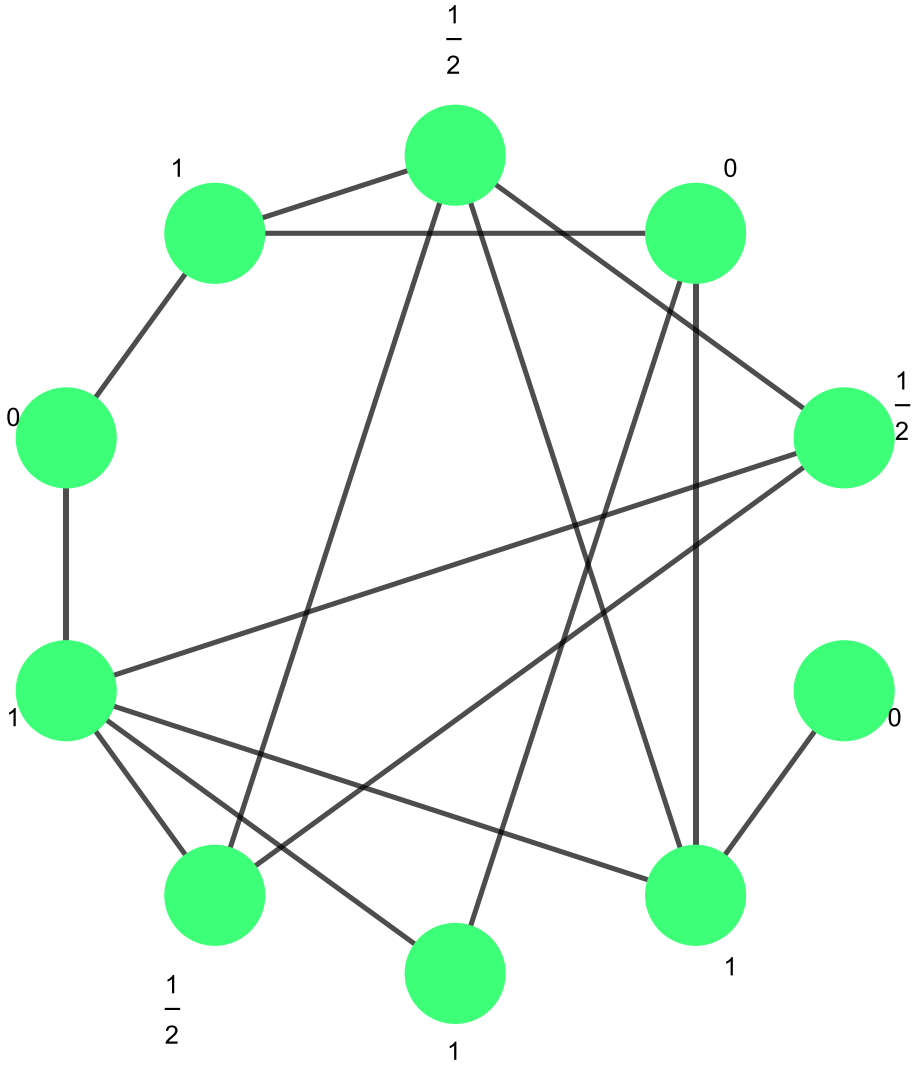
There are ten nodes in the graph, and the graph is connected



SMALL EXAMPLE

After the linear programming, we can the optimal result.

The number near the node is the x.

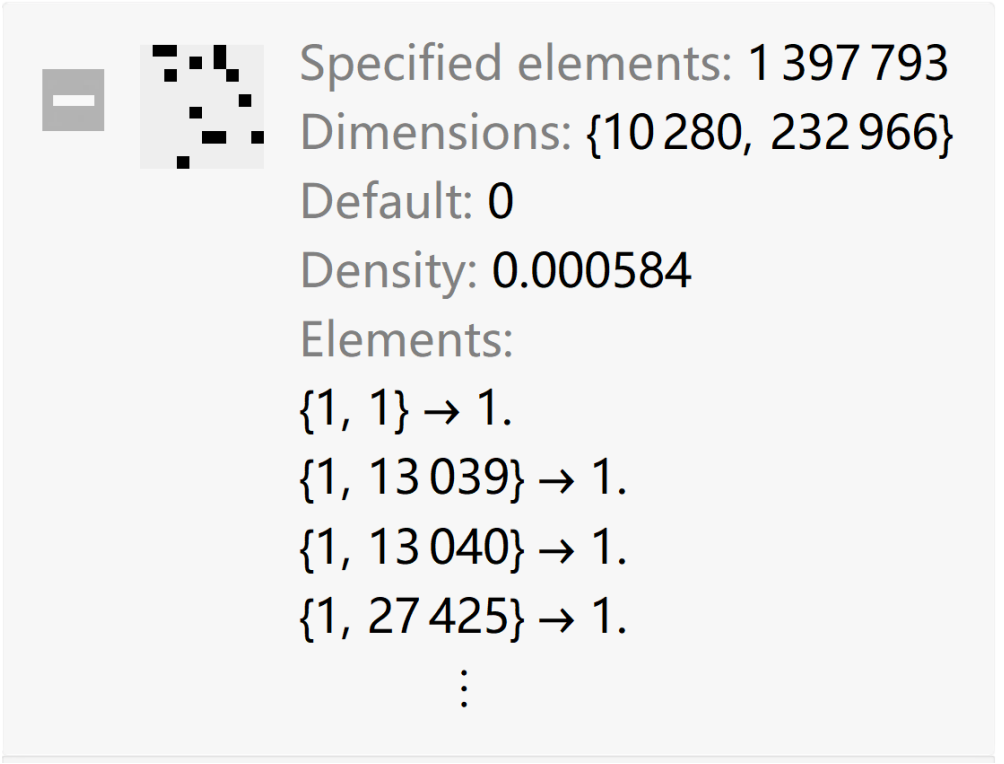


LARGE EXAMPLE

The large example is a dataset from website: www.netlib.org.

On the right is its constraint matrix, which is a sparse matrix with 1,397,793 elements which's value is not 0.

We can find it have 232,966 elements and 10,280 constraint conditions.



LARGE EXAMPLE

The large example is a dataset from website:

www.netlib.org.

For this large example. It will be solved in 16.774s,

in a laptop with 8 cores and 16GB memory.

HUGE EXAMPLE

The huge example was generated by myself.

In the class, professor has showed how to convert vertex cover problem to an linear programming problem. I try to convert the set cover problem to linear programming problem.

The weight vector $\boldsymbol{x}$ of subsets is the target which need to be solved. And the constraint matrix $\boldsymbol{A}$ have m rows, m is the number of the jobs. In each rows, there are n values. if the $\boldsymbol{jth}$ subset contain the $\boldsymbol{ith}$ elements, $\boldsymbol{A_{ij}}$ will be 1, else it will be 0.

Matrix A**:** Rows of A correspond the number of elements
Columns of A correspond the number of subsets

$$A[i,j] = \begin{cases} 1 \text{ if element i in the subset j} \\ 0 \text{ otherwise} \end{cases}$$

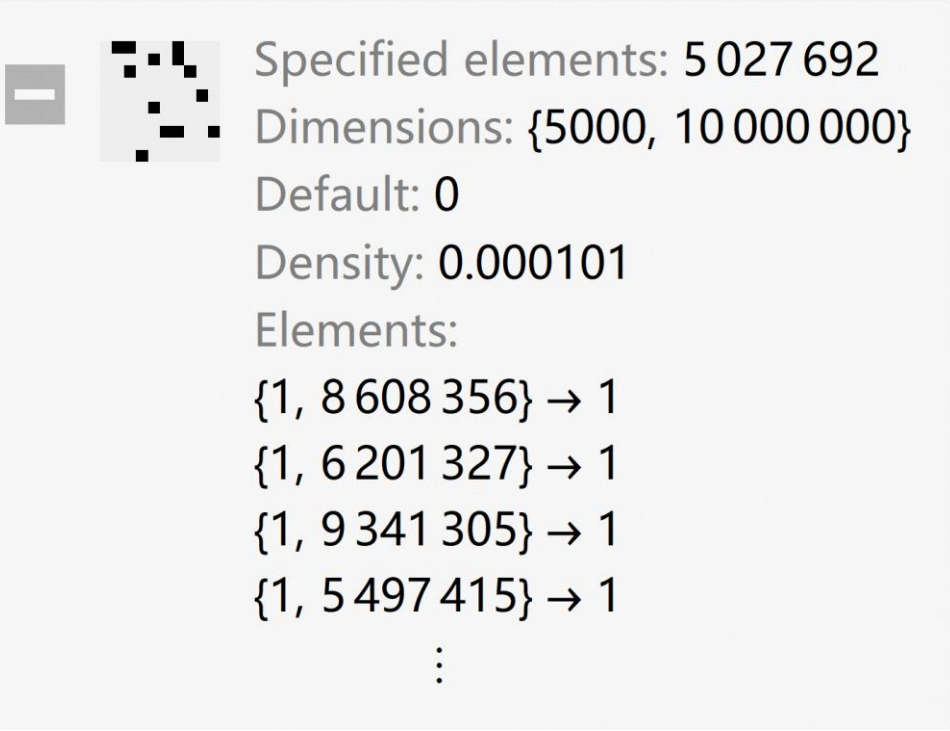
$$\text{Minimize } w(S) = \boldsymbol{w}^t \boldsymbol{x}$$

$$\text{subject to } \mathbf{1} \geq \boldsymbol{x} \geq \mathbf{0}, \quad A\boldsymbol{x} \geq \mathbf{1}$$

HUGE EXAMPLE

On the right is its constraint matrix, which is a sparse matrix with 5,027,692 elements which's value is not 0.

We can find it have 10,000,000 elements and 5,000 constraint conditions.

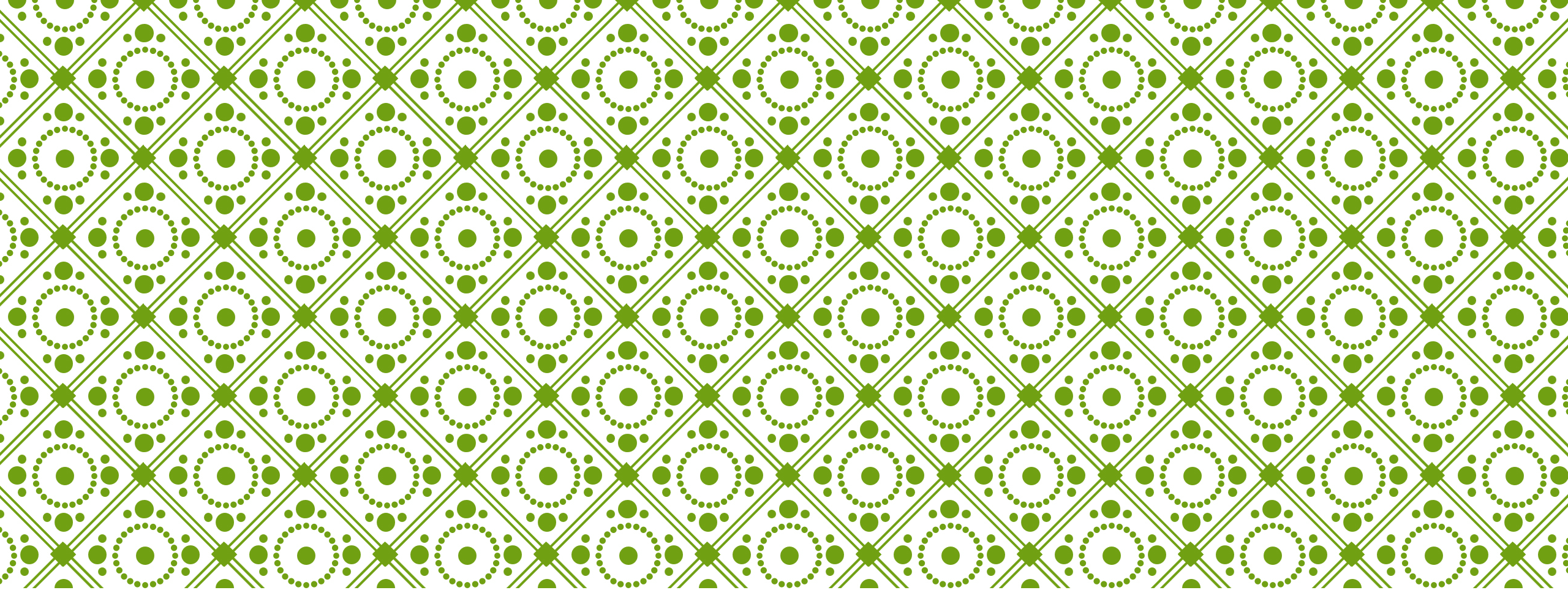


HUGE EXAMPLE

The huge example was generated by myself.

For this huge example. It will be solved in 269.93s,

in a server with 20 cores and 64GB memory.



THANK YOU !

Q&A

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