实验结果说明

操作系统：Ubuntu 20.04.3 LTS
处理器：Intel(R) Core(TM) i9-10900K CPU @ 3.70GHz
内存：64GB
SAT 求解器：MiniSAT

算法思想：

数独要求每一行、列都为 1 到 9 的数字序列，且每个九宫格也需要出现所有 1 到 9 的数字。设 i 和 j 分别表示行数和列数，且用 n 表示第 i 行、第 j 列的数字。这里使用命题 $p(i,j,n)$ 来表示命题“第 i 行、第 j 列的数字为 n”，其中 $i,j,n \in [1,\cdots,9]$。则

- 每一行需要出现所有 1 到 9 的数字编码为:

$$\bigwedge_{i=1}^{9}\bigwedge_{n=1}^{9}\bigvee_{j=1}^{9} p(i,j,n)$$

- 每一列需要出现所有 1 到 9 的数字编码为:

$$\bigwedge_{j=1}^{9}\bigwedge_{n=1}^{9}\bigvee_{i=1}^{9} p(i,j,n)$$

- 每一个 3×3 的区域需要出现所有 1 到 9 的数字编码为:

$$\bigwedge_{r=0}^{2}\bigwedge_{s=0}^{2}\bigwedge_{n=1}^{9}\bigvee_{i=1}^{3}\bigvee_{j=1}^{3} p(3r+i,3s+j,n)$$

- 每一个单元都不会出现超过一个数字:

$$\bigwedge_{i=1}^{9}\bigwedge_{j=1}^{9}\bigwedge_{n=1}^{9}\bigwedge_{n'=1}^{9}(n\neq n')\rightarrow(p(i,j,n)\rightarrow\neg p(i,j,n'))$$

工程运行方式：

进入到代码根目录下，修改 Global.cpp 文件中的 sudokupath(数独问题文件存放路径)，resultpath（最后解得的数独文件存放路径），sudokucnf(MiniSAT 输入文件)，resultcnf（MiniSAT 输出文件）,设置数独的大小（row,col)。然后运行 make clean,make 生成 main 可执行文件，./main 运行可执行文件。

代码解读：

sudoku.cpp 文件中的 ToCnf()函数读取数独，然后转化成 MiniSAT 能读取的 CNF 格式。每个 p(i,j,n)表示第 i 行，第 j 列，填入数字 n，p(i,j,n)是第 i*(row*row)+j*(row)+n 个变量，-p(i,j,n)表示¬ p(i,j,n)。

求解结果：

Problem_1.txt

```
0 0 0 1 0 0 3 2 0
5 0 0 0 9 0 4 0 6
2 6 0 0 7 3 0 0 0
0 0 9 0 3 0 0 5 0
0 0 0 0 0 0 0 0 0
0 2 0 0 4 0 9 0 0
0 0 0 3 1 0 0 4 9
8 0 5 0 6 0 0 0 3
0 9 3 0 0 5 0 0 0
```

Result_1.txt

```
9 4 8 1 5 6 3 2 7
5 3 7 8 9 2 4 1 6
2 6 1 4 7 3 8 9 5
7 8 9 2 3 1 6 5 4
1 5 4 6 8 9 7 3 2
3 2 6 5 4 7 9 8 1
6 7 2 3 1 8 5 4 9
8 1 5 9 6 4 2 7 3
4 9 3 7 2 5 1 6 8
```

```
WARNING: for repeatability, setting FPU to use double precision
============================[ Problem Statistics ]=============================
|                                                                             |
|  Number of variables:          729                                          |
|  Number of clauses:           4220                                          |
|  Parse time:                  0.00 s                                        |
|  Eliminated clauses:          0.00 Mb                                       |
|  Simplification time:         0.00 s                                        |
|                                                                             |
============================[ Search Statistics ]==============================
| Conflicts |          ORIGINAL         |          LEARNT          | Progress |
|           |    Vars  Clauses Literals |    Limit  Clauses Lit/Cl |          |
===============================================================================
|       100 |     373     1692     5723 |      620      100     11 | 34.568 % |
|       250 |     373     1692     5723 |      682      250     10 | 34.569 % |
|       475 |     373     1692     5723 |      750      475     11 | 34.568 % |
|       812 |     371     1685     5698 |      825      675     11 | 34.844 % |
|      1318 |     370     1685     5698 |      908      622     12 | 34.980 % |
|      2077 |     367     1673     5655 |      999      777      9 | 35.392 % |
|      3216 |     365     1642     5585 |     1099     1259     10 | 35.667 % |
===============================================================================
restarts              : 17
conflicts             : 3403           (151426 /sec)
decisions             : 5957           (0.00 % random) (265074 /sec)
propagations          : 66365          (2953099 /sec)
conflict literals     : 37213          (15.68 % deleted)
Memory used           : 10.63 MB
CPU time              : 0.022473 s

SATISFIABLE
```

Problem_2.txt

0 0 0 0 7 0 0 0 0
6 4 0 0 0 3 5 0 0
1 0 0 4 9 0 0 6 0
0 0 6 8 0 0 0 0 0
0 2 0 3 4 1 0 5 0
0 0 0 0 0 9 2 0 0
0 8 0 0 3 4 0 0 6
0 0 2 9 0 0 0 8 3
0 0 0 0 1 0 0 0 0

Result_2.txt

2 9 8 5 7 6 3 1 4
6 4 7 1 8 3 5 9 2
1 3 5 4 9 2 8 6 7
3 1 6 8 2 5 7 4 9
7 2 9 3 4 1 6 5 8
8 5 4 7 6 9 2 3 1
5 8 1 2 3 4 9 7 6
4 6 2 9 5 7 1 8 3
9 7 3 6 1 8 4 2 5

```
WARNING: for repeatability, setting FPU to use double precision
============================[ Problem Statistics ]=============================
|                                                                             |
|  Number of variables:          729                                          |
|  Number of clauses:           4280                                          |
|  Parse time:                  0.00 s                                        |
|  Eliminated clauses:          0.00 Mb                                       |
|  Simplification time:         0.00 s                                        |
|                                                                             |
============================[ Search Statistics ]==============================
| Conflicts |          ORIGINAL         |          LEARNT          | Progress |
|           |    Vars  Clauses Literals |    Limit  Clauses Lit/Cl |          |
===============================================================================
|       100 |     391     1797     6167 |      658      100     19 | 33.334 % |
|       250 |     391     1797     6167 |      724      250     15 | 33.334 % |
|       475 |     389     1797     6167 |      797      473     13 | 33.609 % |
|       812 |     389     1784     6139 |      876      799     13 | 33.608 % |
|      1318 |     387     1784     6139 |      964      737     12 | 33.882 % |
|      2077 |     386     1765     6084 |     1061      857     12 | 34.019 % |
|      3216 |     385     1757     6058 |     1167     1315     14 | 34.157 % |
|      4924 |     385     1757     6058 |     1284      839     15 | 34.157 % |
|      7486 |     378     1738     5997 |     1412      942     14 | 35.117 % |
|     11330 |     375     1695     5887 |     1553     1135     21 | 35.528 % |
|     17096 |     365     1649     5775 |     1709     1154     13 | 36.900 % |
|     25745 |     330     1464     5241 |     1879     1838     13 | 41.701 % |
===============================================================================
restarts              : 98
conflicts             : 27722          (162822 /sec)
decisions             : 46874          (0.00 % random) (275308 /sec)
propagations          : 553023         (3248109 /sec)
conflict literals     : 378761         (14.90 % deleted)
Memory used           : 10.63 MB
CPU time              : 0.17026 s
```

Problem_3.txt

```
3 0 0 0 6 0 0 2 5
8 0 0 0 0 0 0 0 0
0 0 0 2 0 5 0 0 0
0 0 5 0 1 0 9 0 0
6 0 0 3 9 7 0 0 8
0 0 3 0 5 0 1 0 0
0 0 0 1 0 4 0 0 0
0 0 0 0 0 0 0 0 9
4 1 0 0 7 0 0 0 6
```

Result_3.txt

```
3 9 4 8 6 1 7 2 5
8 5 2 7 4 9 6 3 1
1 7 6 2 3 5 8 9 4
7 8 5 4 1 2 9 6 3
6 2 1 3 9 7 5 4 8
9 4 3 6 5 8 1 7 2
5 6 9 1 2 4 3 8 7
2 3 7 5 8 6 4 1 9
4 1 8 9 7 3 2 5 6
```

```
WARNING: for repeatability, setting FPU to use double precision
============================[ Problem Statistics ]=============================
|                                                                             |
|  Number of variables:          729                                          |
|  Number of clauses:           4419                                          |
|  Parse time:                  0.00 s                                        |
|  Eliminated clauses:          0.00 Mb                                       |
|  Simplification time:         0.00 s                                        |
|                                                                             |
============================[ Search Statistics ]==============================
| Conflicts |          ORIGINAL         |          LEARNT          | Progress |
|           |    Vars  Clauses Literals |    Limit  Clauses Lit/Cl |          |
===============================================================================
|       100 |     417     1945     6591 |      713      100     13 | 30.864 % |
|       250 |     417     1945     6591 |      784      250     15 | 30.866 % |
|       475 |     417     1945     6591 |      862      475     16 | 30.864 % |
|       812 |     416     1937     6569 |      949      809     16 | 31.003 % |
|      1318 |     415     1937     6569 |     1044      714     18 | 31.139 % |
|      2077 |     414     1924     6531 |     1148      767     15 | 31.276 % |
|      3216 |     412     1924     6531 |     1263     1183     13 | 31.552 % |
|      4924 |     408     1884     6414 |     1389     1331     14 | 32.099 % |
|      7486 |     405     1870     6376 |     1528     1327     14 | 32.511 % |
|     11330 |     405     1864     6357 |     1681     1561     17 | 32.510 % |
|     17096 |     399     1822     6253 |     1849     1377     19 | 33.334 % |
|     25745 |     394     1790     6186 |     2034     1406     14 | 34.021 % |
|     38719 |     378     1685     5887 |     2238     1410     17 | 36.214 % |
===============================================================================
restarts              : 165
conflicts             : 53950          (146464 /sec)
decisions             : 88366          (0.00 % random) (239897 /sec)
propagations          : 1073653        (2914771 /sec)
conflict literals     : 813530         (15.75 % deleted)
Memory used           : 10.63 MB
CPU time              : 0.368349 s
```

Problem_4.txt

0 0 1 0 0 0 0 3 14 0 2 0 0 15 7 0
0 10 13 0 1 0 0 4 16 0 0 7 6 12 0 5
12 14 0 11 0 6 0 0 0 0 0 0 13 2 0 3
0 7 0 0 12 11 0 16 15 0 0 13 1 0 4 0
0 6 8 0 5 12 16 15 0 3 11 10 7 0 9 4
3 0 12 0 11 0 0 0 0 2 13 15 0 0 6 0
0 15 7 16 9 0 10 0 6 0 0 5 3 1 0 2
0 0 0 1 6 0 0 2 0 9 4 0 0 0 0 0
5 2 15 0 0 0 0 10 0 0 0 12 0 11 3 1
14 3 0 4 0 2 0 0 11 13 0 6 9 0 0 0
8 13 0 0 0 0 11 0 0 1 5 0 0 4 10 0
1 0 9 0 14 0 0 12 0 16 0 0 5 0 0 8
11 0 0 0 10 0 0 0 0 8 7 1 15 16 0 12
7 12 2 0 0 0 0 8 5 0 0 11 0 0 1 6
16 0 0 0 0 1 0 11 13 0 0 9 4 3 0 0
9 1 0 0 15 0 3 0 0 4 16 0 8 0 0 11

Result_4.txt

6 16 1 8 13 10 5 3 14 12 2 4 11 15 7 9
15 10 13 9 1 14 2 4 16 11 3 7 6 12 8 5
12 14 4 11 7 6 15 9 10 5 1 8 13 2 16 3
2 7 3 5 12 11 8 16 15 6 9 13 1 10 4 14
13 6 8 2 5 12 16 15 1 3 11 10 7 14 9 4
3 9 12 14 11 4 7 1 8 2 13 15 16 5 6 10
4 15 7 16 9 8 10 13 6 14 12 5 3 1 11 2
10 5 11 1 6 3 14 2 7 9 4 16 12 8 15 13
5 2 15 6 16 13 9 10 4 7 8 12 14 11 3 1
14 3 10 4 8 2 1 5 11 13 15 6 9 7 12 16
8 13 16 12 3 7 11 6 9 1 5 14 2 4 10 15
1 11 9 7 14 15 4 12 2 16 10 3 5 6 13 8
11 4 5 13 10 9 6 14 3 8 7 1 15 16 2 12
7 12 2 3 4 16 13 8 5 15 14 11 10 9 1 6
16 8 14 15 2 1 12 11 13 10 6 9 4 3 5 7
9 1 6 10 15 5 3 7 12 4 16 2 8 13 14 11

```
WARNING: for repeatability, setting FPU to use double precision
============================[ Problem Statistics ]=============================
|                                                                             |
|  Number of variables:          4096                                         |
|  Number of clauses:           35963                                         |
|  Parse time:                   0.01 s                                       |
|  Eliminated clauses:           0.02 Mb                                      |
|  Simplification time:          0.02 s                                       |
|                                                                             |
============================[ Search Statistics ]==============================
| Conflicts |          ORIGINAL         |          LEARNT          | Progress |
|           |    Vars  Clauses Literals |    Limit  Clauses Lit/Cl |          |
===============================================================================
|       100 |    1475    11270    47226 |     4132      100     23 | 48.828 % |
|       250 |    1475    11270    47226 |     4545      250     20 | 48.828 % |
|       475 |    1475    11270    47226 |     5000      475     20 | 48.828 % |
|       812 |    1475    11270    47226 |     5500      812     19 | 48.828 % |
|      1318 |    1475    11270    47226 |     6050     1318     19 | 48.828 % |
|      2077 |    1475    11270    47226 |     6655     2077     19 | 48.828 % |
|      3216 |    1475    11270    47226 |     7320     3216     17 | 48.828 % |
|      4924 |    1475    11270    47226 |     8052     4924     17 | 48.828 % |
|      7486 |    1474    11258    47167 |     8858     2654     18 | 48.853 % |
|     11330 |    1472    11236    47104 |     9743     6472     18 | 48.901 % |
|     17096 |    1472    11236    47104 |    10718     6312     24 | 48.901 % |
|     25745 |    1471    11222    47076 |    11790     8455     19 | 48.926 % |
|     38719 |    1470    11210    47026 |    12969    13872     22 | 48.950 % |
|     58180 |    1469    11199    46978 |    14265     9917     22 | 48.975 % |
|     87372 |    1465    11151    46786 |    15692    15042     20 | 49.072 % |
|    131161 |    1464    11139    46726 |    17261    14192     21 | 49.097 % |
|    196845 |    1462    11116    46646 |    18987    11507     23 | 49.146 % |
|    295371 |    1439    10899    45786 |    20886    18013     20 | 49.707 % |
|    443160 |    1368    10165    43253 |    22975    15470     21 | 51.440 % |
|    664843 |    1250     9154    39562 |    25272    23919     23 | 54.321 % |
===============================================================================
restarts              : 1505
conflicts             : 688249         (47428 /sec)
decisions             : 931156         (0.00 % random) (64167 /sec)
propagations          : 14653236       (1009771 /sec)
conflict literals     : 13838756       (18.73 % deleted)
Memory used           : 30.80 MB
CPU time              : 14.5114 s
```

Problem_5.txt

```
0 16 1 8 0 0 5 3 14 12 2 4 0 15 7 0
15 0 0 0 1 14 2 4 16 11 3 0 6 12 8 0
12 14 0 0 0 0 0 9 0 0 1 8 0 2 0 0
0 7 3 0 12 0 8 16 0 6 0 0 0 10 0 14
0 0 8 0 0 12 16 15 0 3 0 0 7 14 0 4
3 9 12 14 0 4 7 1 0 2 13 0 0 5 6 10
0 15 7 16 9 8 10 13 6 14 0 0 0 1 11 2
10 5 11 1 6 3 14 2 7 9 4 16 0 8 15 13
0 0 15 0 16 13 0 10 4 0 8 0 14 0 3 1
0 3 0 4 0 0 1 0 0 13 15 0 9 0 12 16
0 0 0 0 3 7 11 6 9 1 0 14 0 4 10 0
1 0 9 0 0 0 0 12 0 0 10 0 0 0 13 8
0 0 0 13 10 9 6 0 3 0 7 1 15 16 0 12
7 0 0 3 4 0 0 8 5 15 14 11 0 9 1 6
0 8 0 15 2 1 0 0 13 10 6 0 4 0 5 7
9 1 6 10 15 0 3 7 12 0 0 0 0 0 14 0
```

Result_5.txt

```
6 16 1 8 13 10 5 3 14 12 2 4 11 15 7 9
15 10 13 9 1 14 2 4 16 11 3 7 6 12 8 5
12 14 4 11 7 6 15 9 10 5 1 8 13 2 16 3
2 7 3 5 12 11 8 16 15 6 9 13 1 10 4 14
13 2 8 6 5 12 16 15 1 3 11 10 7 14 9 4
3 9 12 14 11 4 7 1 8 2 13 15 16 5 6 10
4 15 7 16 9 8 10 13 6 14 12 5 3 1 11 2
10 5 11 1 6 3 14 2 7 9 4 16 12 8 15 13
5 11 15 2 16 13 9 10 4 7 8 12 14 6 3 1
14 3 10 4 8 2 1 5 11 13 15 6 9 7 12 16
8 13 16 12 3 7 11 6 9 1 5 14 2 4 10 15
1 6 9 7 14 15 4 12 2 16 10 3 5 11 13 8
11 4 5 13 10 9 6 14 3 8 7 1 15 16 2 12
7 12 2 3 4 16 13 8 5 15 14 11 10 9 1 6
16 8 14 15 2 1 12 11 13 10 6 9 4 3 5 7
9 1 6 10 15 5 3 7 12 4 16 2 8 13 14 11
```

```
WARNING: for repeatability, setting FPU to use double precision
============================[ Problem Statistics ]=============================
|                                                                             |
|  Number of variables:          4096                                         |
|  Number of clauses:           29936                                         |
|  Parse time:                   0.01 s                                       |
|  Eliminated clauses:           0.01 Mb                                      |
|  Simplification time:          0.02 s                                       |
|                                                                             |
============================[ Search Statistics ]==============================
| Conflicts |          ORIGINAL         |          LEARNT          | Progress |
|           |    Vars  Clauses Literals |    Limit  Clauses Lit/Cl |          |
===============================================================================
|       100 |     944     6390    24773 |     2343      100     14 | 60.938 % |
|       250 |     944     6390    24773 |     2577      250     14 | 60.938 % |
|       475 |     944     6390    24773 |     2835      475     14 | 60.938 % |
|       812 |     944     6390    24773 |     3118      812     15 | 60.938 % |
|      1318 |     944     6390    24773 |     3430     1318     16 | 60.938 % |
|      2077 |     942     6390    24773 |     3773     2075     14 | 60.986 % |
|      3216 |     941     6390    24773 |     4150     3213     14 | 61.011 % |
|      4924 |     940     6354    24650 |     4565     4853     13 | 61.035 % |
|      7486 |     940     6347    24625 |     5022     3844     19 | 61.035 % |
|     11330 |     940     6347    24625 |     5524     3891     24 | 61.035 % |
|     17096 |     939     6337    24581 |     6077     5436     22 | 61.060 % |
|     25745 |     923     6244    24142 |     6684     5304     17 | 61.450 % |
|     38719 |     914     6108    23777 |     7353     7416     20 | 61.670 % |
|     58180 |     887     5877    22720 |     8088     4642     17 | 62.329 % |
===============================================================================
restarts              : 221
conflicts             : 72150          (69881 /sec)
decisions             : 104557         (0.00 % random) (101269 /sec)
propagations          : 1689405        (1636278 /sec)
conflict literals     : 1363076        (19.99 % deleted)
Memory used           : 12.37 MB
CPU time              : 1.03247 s
```

Problem_6.txt

0 16 0 8 0 10 0 0 0 0 2 0 11 0 0 0
15 10 13 0 0 0 0 4 16 11 0 7 0 0 0 5
0 14 0 11 0 6 15 9 0 5 0 0 0 2 16 0
2 7 0 5 12 0 8 16 15 0 9 0 1 0 4 14
0 0 0 2 5 12 0 0 1 0 0 0 0 14 9 0
3 0 0 14 11 4 7 1 0 0 0 15 16 5 6 10
4 0 0 0 9 8 0 0 6 0 0 0 3 1 11 0
10 0 11 1 6 0 0 2 0 0 4 0 12 8 0 13
0 0 0 6 0 0 9 0 4 7 8 0 0 0 0 1
14 3 0 0 8 0 1 5 11 13 0 0 0 0 0 0
0 13 0 12 0 0 0 0 0 1 5 0 2 4 0 15
1 11 0 0 0 0 0 12 0 16 10 3 5 0 13 8
0 4 0 0 0 9 6 14 3 0 7 0 0 16 2 0
0 12 2 0 0 16 0 8 0 15 0 11 0 9 1 0
0 0 14 0 2 1 0 11 0 10 0 9 0 0 0 0
9 1 0 10 0 0 0 0 0 0 0 0 2 0 13 0 11

Result_6.txt

6 16 1 8 3 10 5 13 14 12 2 4 11 15 7 9
15 10 13 9 1 14 2 4 16 11 3 7 6 12 8 5
12 14 4 11 7 6 15 9 10 5 1 8 13 2 16 3
2 7 3 5 12 11 8 16 15 6 9 13 1 10 4 14
16 6 8 2 5 12 13 15 1 3 11 10 4 14 9 7
3 9 12 14 11 4 7 1 8 2 13 15 16 5 6 10
4 15 7 13 9 8 16 10 6 14 12 5 3 1 11 2
10 5 11 1 6 3 14 2 7 9 4 16 12 8 15 13
5 2 15 6 16 13 9 3 4 7 8 12 14 11 10 1
14 3 10 4 8 2 1 5 11 13 15 6 9 7 12 16
8 13 16 12 10 7 11 6 9 1 5 14 2 4 3 15
1 11 9 7 14 15 4 12 2 16 10 3 5 6 13 8
11 4 5 15 13 9 6 14 3 8 7 1 10 16 2 12
13 12 2 3 4 16 10 8 5 15 14 11 7 9 1 6
7 8 14 16 2 1 12 11 13 10 6 9 15 3 5 4
9 1 6 10 15 5 3 7 12 4 16 2 8 13 14 11

```
WARNING: for repeatability, setting FPU to use double precision
============================[ Problem Statistics ]=============================
|                                                                             |
|  Number of variables:          4096                                         |
|  Number of clauses:           36599                                         |
|  Parse time:                   0.01 s                                       |
|  Eliminated clauses:           0.02 Mb                                      |
|  Simplification time:          0.02 s                                       |
|                                                                             |
============================[ Search Statistics ]==============================
| Conflicts |          ORIGINAL         |          LEARNT          | Progress |
|           |    Vars  Clauses Literals |    Limit  Clauses Lit/Cl |          |
===============================================================================
|       100 |    1534    11534    47113 |     4229      100     25 | 47.656 % |
|       250 |    1534    11534    47113 |     4652      250     25 | 47.656 % |
|       475 |    1534    11534    47113 |     5117      475     23 | 47.656 % |
|       812 |    1534    11534    47113 |     5628      812     26 | 47.656 % |
|      1318 |    1534    11534    47113 |     6191     1318     27 | 47.656 % |
|      2077 |    1534    11534    47113 |     6811     2077     26 | 47.656 % |
|      3216 |    1534    11534    47113 |     7492     3216     26 | 47.656 % |
|      4924 |    1534    11534    47113 |     8241     4924     26 | 47.656 % |
|      7486 |    1534    11534    47113 |     9065     7486     27 | 47.656 % |
|     11330 |    1534    11534    47113 |     9972     5790     29 | 47.656 % |
|     17096 |    1534    11534    47113 |    10969    11556     29 | 47.656 % |
|     25745 |    1534    11534    47113 |    12066     7178     20 | 47.656 % |
|     38719 |    1534    11534    47113 |    13272    13022     22 | 47.656 % |
|     58180 |    1534    11534    47113 |    14600     9575     20 | 47.656 % |
|     87372 |    1533    11521    47062 |    16060    12765     24 | 47.681 % |
|    131161 |    1532    11509    47034 |    17666    11084     19 | 47.705 % |
|    196845 |    1526    11440    46784 |    19432    11001     24 | 47.852 % |
|    295371 |    1516    11326    46401 |    21376    11170     21 | 48.096 % |
|    443160 |    1512    11284    46248 |    23513    16666     31 | 48.193 % |
|    664843 |    1484    10996    45260 |    25864    12736     20 | 48.877 % |
|    997368 |    1430    10473    43531 |    28451    26490     34 | 50.195 % |
|   1496156 |    1365     9787    41396 |    31296    17018     24 | 51.782 % |
|   2244338 |    1188     8027    35256 |    34426    27721     27 | 56.104 % |
===============================================================================
restarts              : 4535
conflicts             : 2621356        (37546 /sec)
decisions             : 3462620        (0.00 % random) (49595 /sec)
propagations          : 58123359       (832504 /sec)
conflict literals     : 60441374       (18.35 % deleted)
Memory used           : 58.22 MB
CPU time              : 69.8175 s
```

MiniSAT 求解数独问题的时间随着数独规模的扩大呈现一个递增的态势，数独规模越大，需要的变量越多，9x9 的数独是 729 个变量，16x16 的数独有 4096 个变量，9x9 数独生成的子句一般是 4000 左右的量级，16x16 的数独生成的子句是 30000 左右的量级，两种规模数独的求解时间差了 100 倍左右。