Assignment

Modify the file queens.py and write a Python program to generate all solutions of the 8 queens problem.

Find all possible ways to arrange eight queens on a chess board so that no two queens are "en prise".

The queens are not in positions to be taken by each other.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| list/index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| q[0] | x |  |  |  |  |  |  |  |
| q[1] |  |  |  |  |  |  |  | x |
| q[2] |  |  |  | x |  |  |  |  |
| q[3] |  |  |  |  | x |  |  |  |
| q[4] |  |  |  |  |  |  | x |  |
| q[5] |  | x |  |  |  |  |  |  |
| q[6] |  |  | x |  |  |  |  |  |
| q[7] |  | x |  |  |  |  |  |  |

Show the number of solutions and the time used to find them.

Add the statement **pause=input()** at the end of your program.

Level 1 -- find all the solutions

Level 2 -- find all non-duplicated solutions (eliminate solutions from horizontal flip, vertical flip)

Level 3 -- find all non-duplicated solutions (eliminate solutions from horizontal flip, vertical flip, rotation 180, rotation +-90)

level 4 -- find all non-duplicated solutions (eliminate solutions from horizontal flip, vertical flip, rotation 180, rotation +-90, flip+rotation) \*\* These are called the fundamental solutions.

Test your program. Check against the following sample output.

File name e.g. 4C03ChanTaiMan\_queens.py

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Level 1 -- all the solutions

1 5 8 6 3 7 2 4

1 6 8 3 7 4 2 5

1 7 4 6 8 2 5 3

1 7 5 8 2 4 6 3

2 4 6 8 3 1 7 5

2 5 7 1 3 8 6 4

2 5 7 4 1 8 6 3

2 6 1 7 4 8 3 5

2 6 8 3 1 4 7 5

2 7 3 6 8 5 1 4

2 7 5 8 1 4 6 3

2 8 6 1 3 5 7 4

3 1 7 5 8 2 4 6

3 5 2 8 1 7 4 6

3 5 2 8 6 4 7 1

3 5 7 1 4 2 8 6

3 5 8 4 1 7 2 6

3 6 2 5 8 1 7 4

3 6 2 7 1 4 8 5

3 6 2 7 5 1 8 4

3 6 4 1 8 5 7 2

3 6 4 2 8 5 7 1

3 6 8 1 4 7 5 2

3 6 8 1 5 7 2 4

3 6 8 2 4 1 7 5

3 7 2 8 5 1 4 6

3 7 2 8 6 4 1 5

3 8 4 7 1 6 2 5

4 1 5 8 2 7 3 6

4 1 5 8 6 3 7 2

4 2 5 8 6 1 3 7

4 2 7 3 6 8 1 5

4 2 7 3 6 8 5 1

4 2 7 5 1 8 6 3

4 2 8 5 7 1 3 6

4 2 8 6 1 3 5 7

4 6 1 5 2 8 3 7

4 6 8 2 7 1 3 5

4 6 8 3 1 7 5 2

4 7 1 8 5 2 6 3

4 7 3 8 2 5 1 6

4 7 5 2 6 1 3 8

4 7 5 3 1 6 8 2

4 8 1 3 6 2 7 5

4 8 1 5 7 2 6 3

4 8 5 3 1 7 2 6

5 1 4 6 8 2 7 3

5 1 8 4 2 7 3 6

5 1 8 6 3 7 2 4

5 2 4 6 8 3 1 7

5 2 4 7 3 8 6 1

5 2 6 1 7 4 8 3

5 2 8 1 4 7 3 6

5 3 1 6 8 2 4 7

5 3 1 7 2 8 6 4

5 3 8 4 7 1 6 2

5 7 1 3 8 6 4 2

5 7 1 4 2 8 6 3

5 7 2 4 8 1 3 6

5 7 2 6 3 1 4 8

5 7 2 6 3 1 8 4

5 7 4 1 3 8 6 2

5 8 4 1 3 6 2 7

5 8 4 1 7 2 6 3

6 1 5 2 8 3 7 4

6 2 7 1 3 5 8 4

6 2 7 1 4 8 5 3

6 3 1 7 5 8 2 4

6 3 1 8 4 2 7 5

6 3 1 8 5 2 4 7

6 3 5 7 1 4 2 8

6 3 5 8 1 4 2 7

6 3 7 2 4 8 1 5

6 3 7 2 8 5 1 4

6 3 7 4 1 8 2 5

6 4 1 5 8 2 7 3

6 4 2 8 5 7 1 3

6 4 7 1 3 5 2 8

6 4 7 1 8 2 5 3

6 8 2 4 1 7 5 3

7 1 3 8 6 4 2 5

7 2 4 1 8 5 3 6

7 2 6 3 1 4 8 5

7 3 1 6 8 5 2 4

7 3 8 2 5 1 6 4

7 4 2 5 8 1 3 6

7 4 2 8 6 1 3 5

7 5 3 1 6 8 2 4

8 2 4 1 7 5 3 6

8 2 5 3 1 7 4 6

8 3 1 6 2 5 7 4

8 4 1 3 6 2 7 5

Number of solutions= 92

Time: 0:00:41.324688

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Level 2 -- all non-duplicated solutions (eliminate solutions from horizontal flip, vertical flip)

1 5 8 6 3 7 2 4

1 6 8 3 7 4 2 5

1 7 4 6 8 2 5 3

1 7 5 8 2 4 6 3

2 4 6 8 3 1 7 5

2 5 7 1 3 8 6 4

2 5 7 4 1 8 6 3

2 6 1 7 4 8 3 5

2 6 8 3 1 4 7 5

2 7 3 6 8 5 1 4

2 7 5 8 1 4 6 3

2 8 6 1 3 5 7 4

3 1 7 5 8 2 4 6

3 5 2 8 1 7 4 6

3 5 7 1 4 2 8 6

3 5 8 4 1 7 2 6

3 6 2 5 8 1 7 4

3 6 2 7 1 4 8 5

3 6 2 7 5 1 8 4

3 6 8 1 5 7 2 4

3 6 8 2 4 1 7 5

3 7 2 8 5 1 4 6

3 7 2 8 6 4 1 5

3 8 4 7 1 6 2 5

4 1 5 8 2 7 3 6

4 2 5 8 6 1 3 7

4 2 7 3 6 8 1 5

4 2 8 5 7 1 3 6

4 2 8 6 1 3 5 7

4 6 1 5 2 8 3 7

4 6 8 2 7 1 3 5

4 7 3 8 2 5 1 6

4 7 5 2 6 1 3 8

4 8 1 3 6 2 7 5

4 8 5 3 1 7 2 6

Number of solutions= 35

Time: 0:00:19.870510

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Level 3 -- all non-duplicated solutions (eliminate solutions from horizontal flip, vertical flip, rotation 180, rotation +-90)

1 5 8 6 3 7 2 4

1 6 8 3 7 4 2 5

1 7 4 6 8 2 5 3

1 7 5 8 2 4 6 3

2 4 6 8 3 1 7 5

2 5 7 1 3 8 6 4

2 5 7 4 1 8 6 3

2 6 1 7 4 8 3 5

2 6 8 3 1 4 7 5

2 7 3 6 8 5 1 4

2 7 5 8 1 4 6 3

3 1 7 5 8 2 4 6

3 5 2 8 1 7 4 6

3 5 8 4 1 7 2 6

3 6 2 5 8 1 7 4

3 6 2 7 1 4 8 5

3 6 2 7 5 1 8 4

Number of solutions= 17

Time: 0:00:22.538826

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Level 4 -- find all non-duplicated solutions (eliminate solutions from horizontal flip, vertical flip, rotation 180, rotation +-90, flip+rotation)

1 5 8 6 3 7 2 4

1 6 8 3 7 4 2 5

2 4 6 8 3 1 7 5

2 5 7 1 3 8 6 4

2 5 7 4 1 8 6 3

2 6 1 7 4 8 3 5

2 6 8 3 1 4 7 5

2 7 3 6 8 5 1 4

2 7 5 8 1 4 6 3

3 5 2 8 1 7 4 6

3 5 8 4 1 7 2 6

3 6 2 5 8 1 7 4

Number of solutions= 12

Time: 0:00:20.460073

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The eight queens puzzle has 92 distinct solutions. If solutions that differ only by the symmetry operations of rotation and reflection of the board are counted as one, the puzzle has 12 solutions. These are called fundamental solutions.

1 5 8 6 3 7 2 4

1 6 8 3 7 4 2 5

2 4 6 8 3 1 7 5 \*\* = 3 8 4 7 1 6 2 5 (some sources show this solution)

2 5 7 1 3 8 6 4

2 5 7 4 1 8 6 3

2 6 1 7 4 8 3 5

2 6 8 3 1 4 7 5

2 7 3 6 8 5 1 4

2 7 5 8 1 4 6 3

3 5 2 8 1 7 4 6 \*\* This solution is invariant under rotating the chessboard by 180 degrees

3 5 8 4 1 7 2 6

3 6 2 5 8 1 7 4

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