Eight Queens Puzzle

A computational display of the eight queens puzzle in java

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Presentation outline

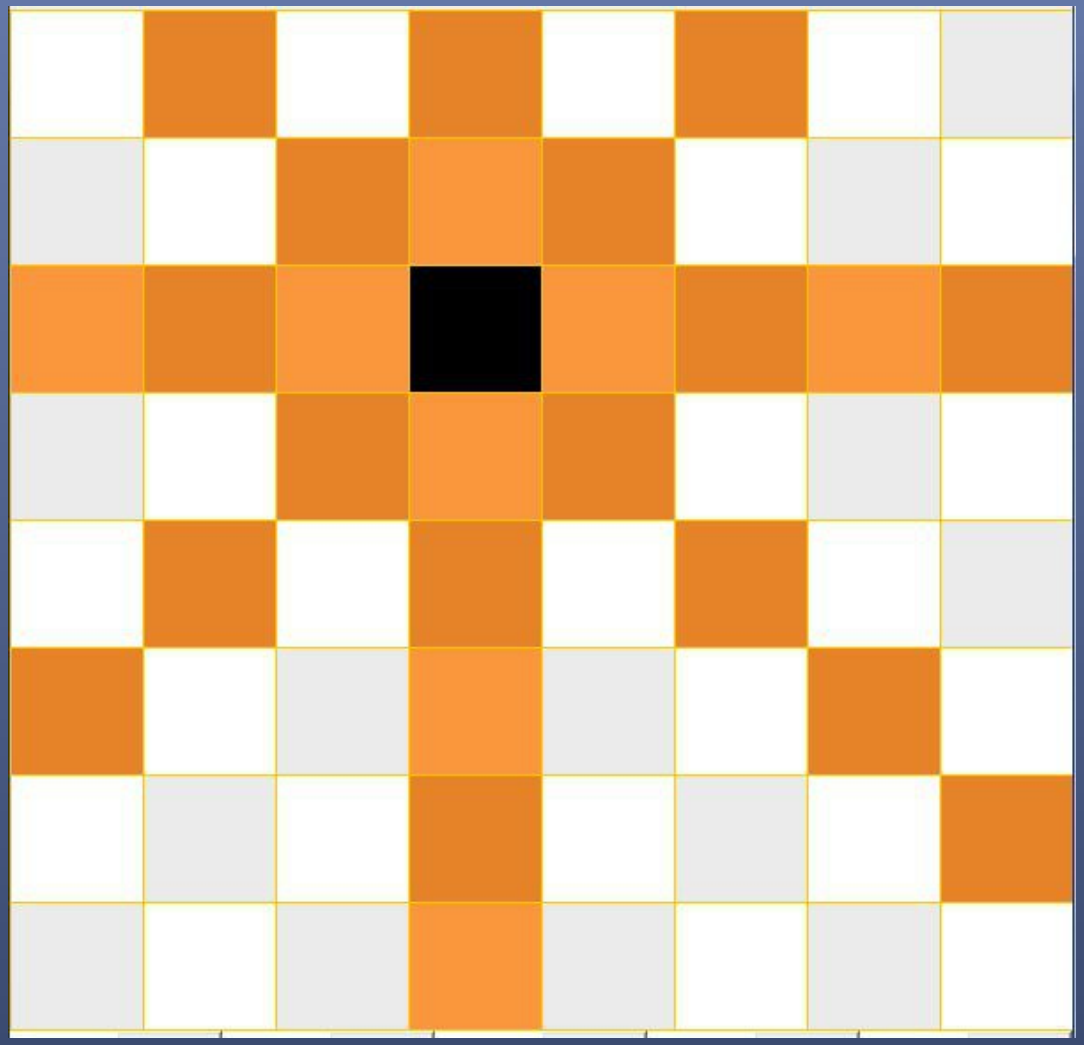
- Review of eight queens puzzle
- The interface
- Algorithm
- Solution display
- Extensions of eight queens problem
- Conclusion
- Reference

Review

The eight queens puzzle

Is the problem of putting eight chess queens on an 8×8 chessboard such that none of them is able to capture any other using the standard chess queen's moves. The queens must be placed in such a way that no two queens would be able to attack each other. Thus, a solution requires that no two queens share the same row, column, or diagonal.

The eight queens puzzle is an example of the more general n queens puzzle of placing n queens on an n×n chessboard, where solutions exist only for n = 1 and n ≥ 4.

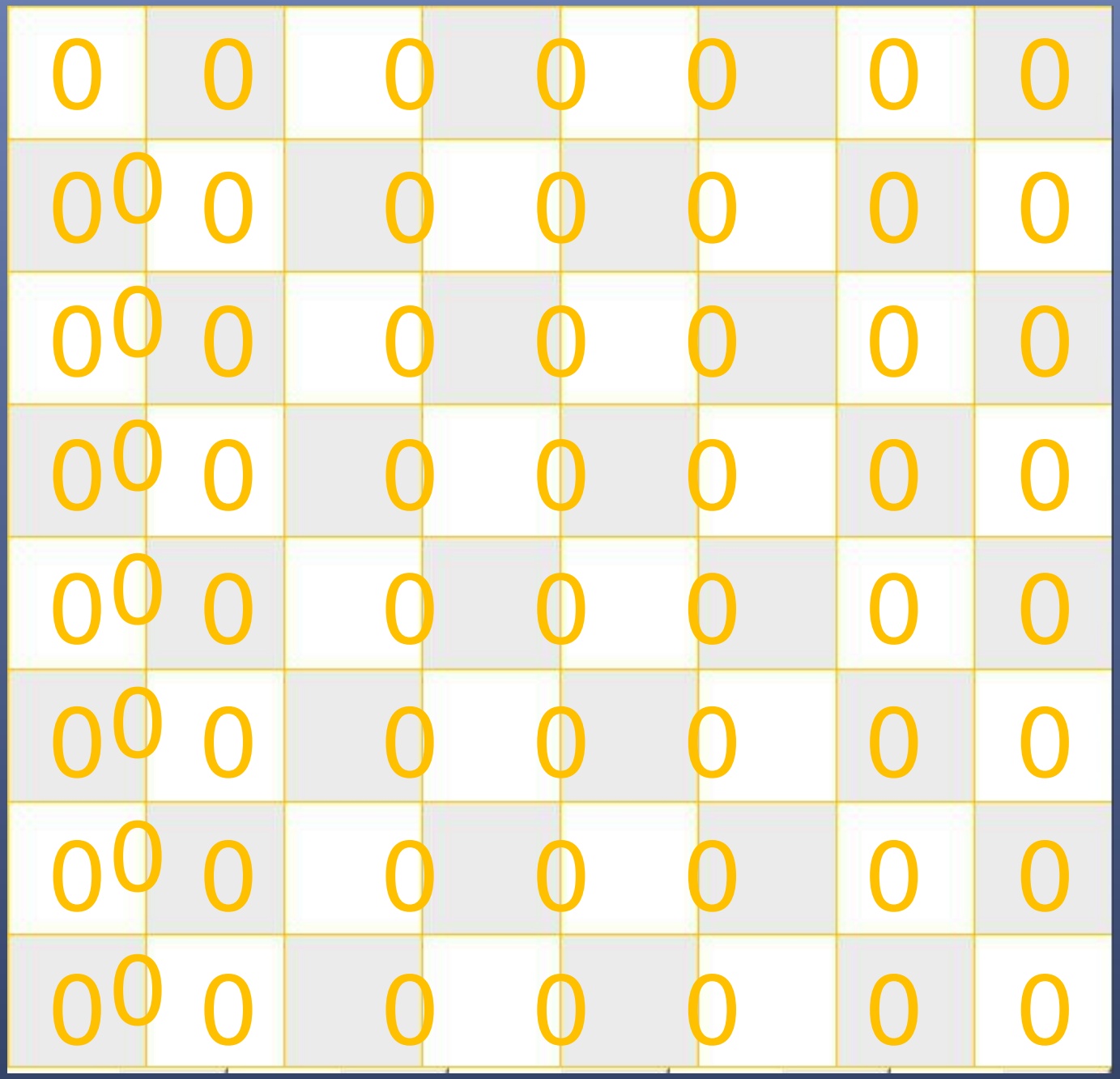


Programming

- Java
- Java methods: main routine and subroutine
- Find help online about java programming
- Try to interpret existed java codes about eight queens puzzle
- Make my own program

Project components

- An interface: a chess board with panels and buttons, which handles the mouse clicks, shows instantaneous result.
- An algorithm “brain” that calculates each movement and solution.
- Some supportive parts like counting queens numbers, drawing cells, checking occupation and so on.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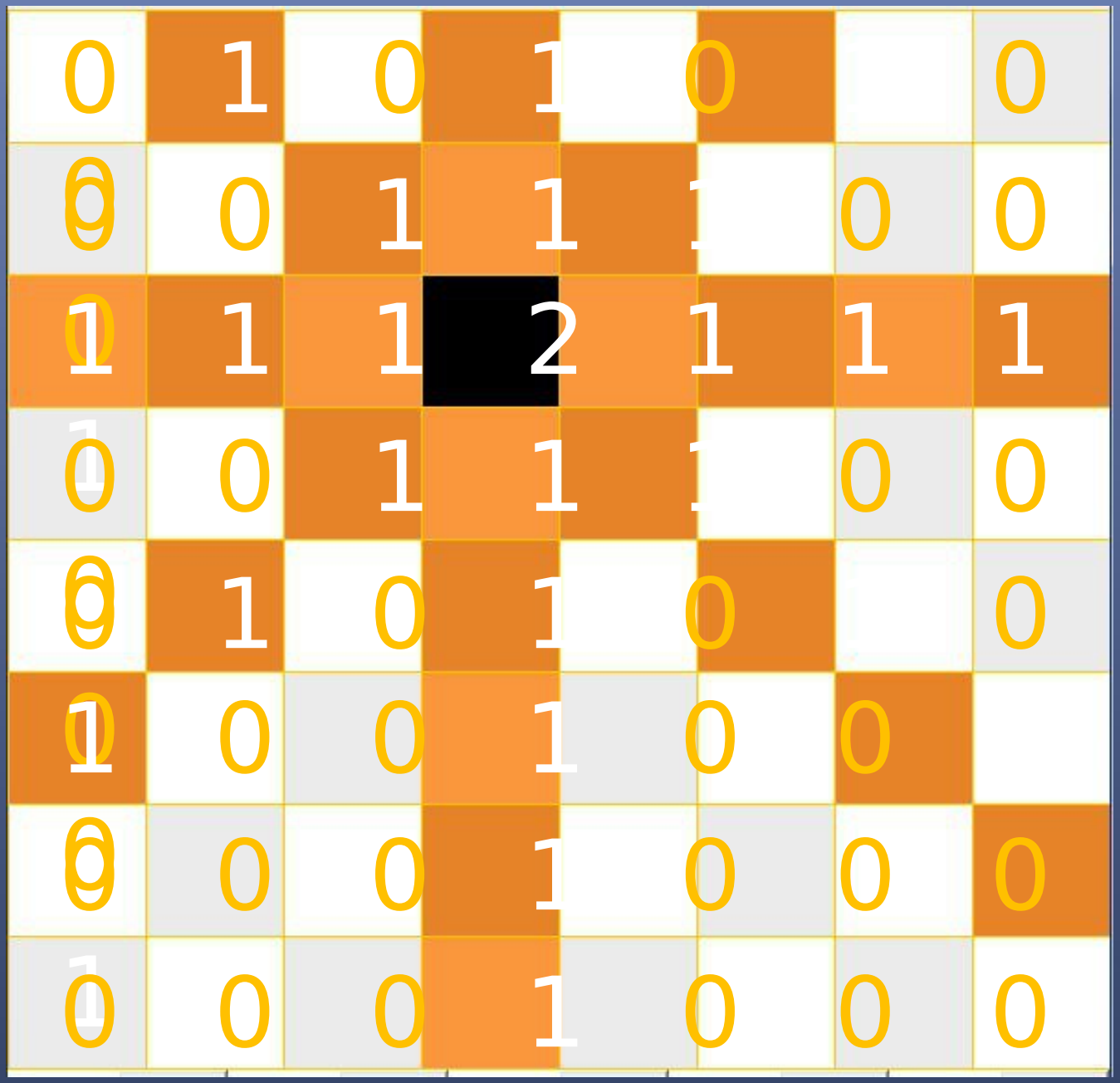
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Solutions

Solutions for N queens:

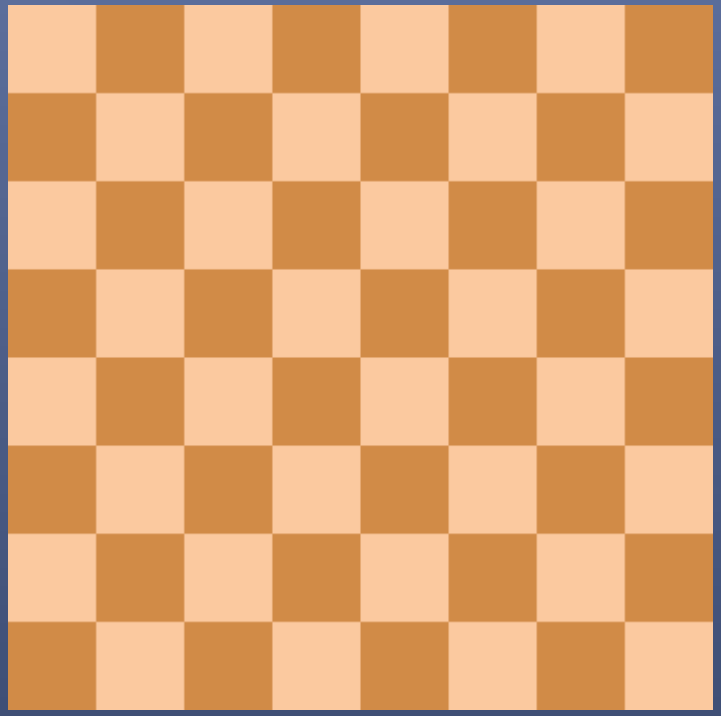
N	1	2	3	4	5	6	7	8	9	10	...
U	1	0	0	1	2	1	6	12	46	92	...
D	1	0	0	2	10	4	40	92	352	724	...

For eight queens, if each row is occupied by one queen only, there are 16,777,216 (8*8) possible combinations.

Solve by "counting"

1. Divide *n* by 12. Remember the remainder (*n* is 8 for the eight queens puzzle).
2. Write a list of the even numbers from 2 to *n* in order.
3. If the remainder is 3 or 9, move 2 to the end of the list.
4. Append the odd numbers from 1 to *n* in order, but, if the remainder is 8, switch pairs (i.e. 3, 1, 7, 5, 11, 9, ...).
5. If the remainder is 2, switch the places of 1 and 3, then move 5 to the end of the list.
6. If the remainder is 3 or 9, move 1 and 3 to the end of the list.
7. Place the first-column queen in the row with the first number in the list, place the second-column queen in the row with the second number in the list, etc.

Solve using recursion



Other Methods:

- LV probability algorithm
- The closed circle DNA algorithm

Project show

http://www.physics.ubc.ca/~yanw123/p210/QueensApplet.html

Some extensions of eight queens puzzle:

- N queens on n×n board
- Using pieces other than queens on 8×8: 32 knights, 14 bishops, 16 kings or 8 rooks
- Board in other shapes instead of square
- Other than 2D, maybe 3D or higher dimensions

Conclusion

- Recursion is a very effective way in solving logical problems that have no formulas, unless trying each possibility.
- As a classical puzzle, “eight queens” is a good tool in methods exploration.
- The “eight queens” model is just a special case of a series of puzzles.

Refernce

"History" --*Wikipedia*
http://en.wikipedia.org/wiki/Eight_queens_puzzle

"Counting solutions " --*Wikipedia*
http://en.wikipedia.org/wiki/Eight_queens_puzzle#Counting_solutions

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http://en.wikipedia.org/wiki/Eight_queens_puzzle#Constructing_a_solution

"Eight queen problem: model of closed circle DNA algorithm of Eight Queens problem
– Tong Xiaojun
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"Recursive solution " -- *Wikipedia*
http://en.wikipedia.org/wiki/Eight_queens_puzzle#An_animated_version_of_the_recur

"Related problems" -- *Wikipedia*
http://en.wikipedia.org/wiki/Eight_queens_puzzle#Related_problems

Thank you!