

# The $n$ -Queens Problem

A Discrete Constraint Optimization Problem

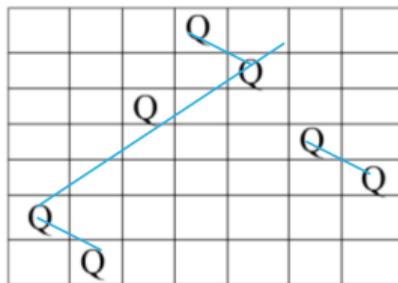
Configuration  $\longrightarrow$  Collision Count  $\longrightarrow$  Search

# N-QUEENS PROBLEM

The n-queens problem consists of placing n queens on a n x n chessboard in such a way that no two queens capture each other.

In order for this to happen,

- no two queens should be placed on the same row, on the same column, or on the same diagonal,
- If two queens are placed such that they are able to capture each other, it is said that a "collision" has occurred.



Column  
Position of Queen

row 1                      #collisions = 4                      row 7

4	5	3	6	7	1	2
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# Iteration 0 (Starting Point)

*Iteration 0 (Starting Point)*

*Current solution*

4	5	3	6	7	1	2
---	---	---	---	---	---	---

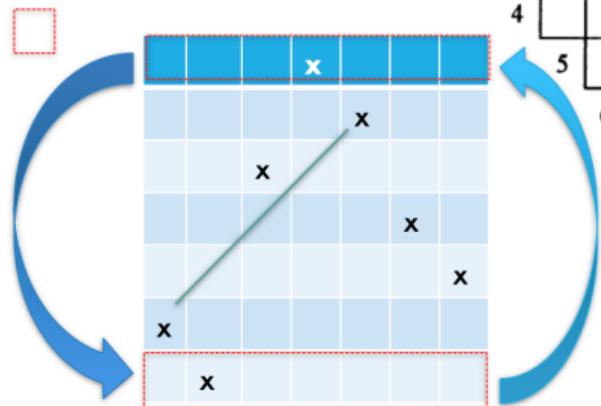
Number of collisions = 4

*Tabu structure*

	2	3	4	5	6	7
1						
2						
3						
4						
5						
6						

*Top 5 candidates*

Swap	Value	
1 7	-2	*
2 4	-2	
2 6	-2	
5 6	-2	
1 5	-1	



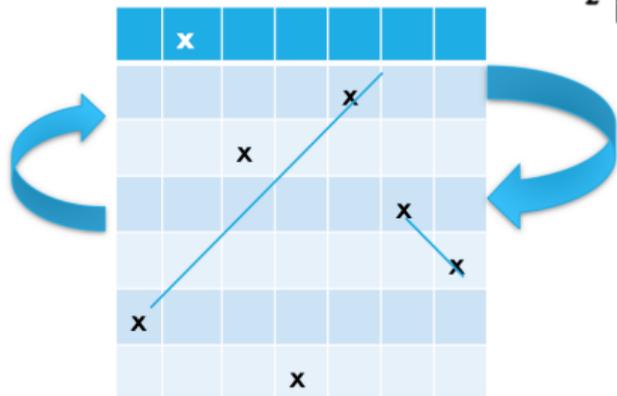
# Iteration 1

## Iteration 1

Current solution

2	5	3	6	7	1	4
---	---	---	---	---	---	---

Number of collisions = 2



Tabu structure

	2	3	4	5	6	7
1						3
2						
3						
4						
5						
6						
7						

Top 5 candidates

	Swap	Value
2	4	-1
1	6	0
2	5	0
1	2	1
1	3	1

# Iteration 2

## Iteration 2

*Current solution*

2	6	3	5	7	1	4
---	---	---	---	---	---	---

Number of collisions = 1

*Tabu structure*

	2	3	4	5	6	7
1						2
	2		3			
		3				
			4			
				5		
					6	

*Top 5 candidates*

	Swap	Value	
1	3	0	*
1	7	1	T
2	4	1	T
4	5	1	
6	7	1	

# Iteration 3

## Iteration 3

Current solution

3	6	2	5	7	1	4
---	---	---	---	---	---	---

Number of collisions = 1

Tabu structure

	2	3	4	5	6	7
1		3				1
2			2			
3						
4						
5						
6						

Top 5 candidates

Swap	Value		
1	3	0	T
1	7	0	T
5	7	1	*
6	7	1	1
1	2	2	

# Iteration 4

## Iteration 4

*Current solution*

3	6	2	5	4	1	7
---	---	---	---	---	---	---

Number of collisions = 2

*Tabu structure*

	2	3	4	5	6	7
1		2				
2			1			
3						
4						
5						3
6						

*Top 5 candidates*

Swap	Value	
4	7	-1 *
5	7	-1 T
1	5	0
2	5	0
2	4	2 T

# Iteration 5

## Iteration 5

*Current solution*

3	6	2	7	4	1	5
---	---	---	---	---	---	---

Number of collisions = 1

*Tabu structure*

	2	3	4	5	6	7
1		1				
	2					
		3				
			4			3
				5		2
					6	

*Top 5 candidates*

Swap	Value	
1 3	-1	T*
5 6	-1	
5 7	0	T
1 6	0	
1 7	2	

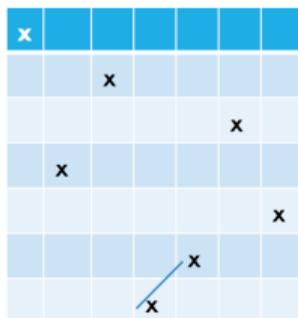
# Iteration 26 (Frequency-based Diversification)

Iteration 26

Current solution

1	3	6	2	7	5	4
---	---	---	---	---	---	---

Number of collisions = 1



Tabu structure

	1	2	3	4	5	6	7
1							3
2							
3	5						2
4		3					1
5	2			4			
6	1				2		
7		4	3	1			

Frequency

Top 5 candidates

Swap	Value	Penalized Value		
1	6	0	1	T
1	3	1	6	
1	5	1	3	*
2	7	1	5	
3	7	1	4	

