Knight’s Tour Problem
(Algorithmic Problems)

Knight’s Tour Problem

- the problem is that we have to visit every cell on an **NxN** chessboard such that we visit every cell exactly once
- closed tour - when the knight end point is the same as the starting point
- the knight's tour problem is an instance of the more general **Hamiltonian path** problem
- of course the closed knight’s tour is the same as finding the **Hamiltonian cycle** of a **G(V,E)** graph

Knight's Tour Problem

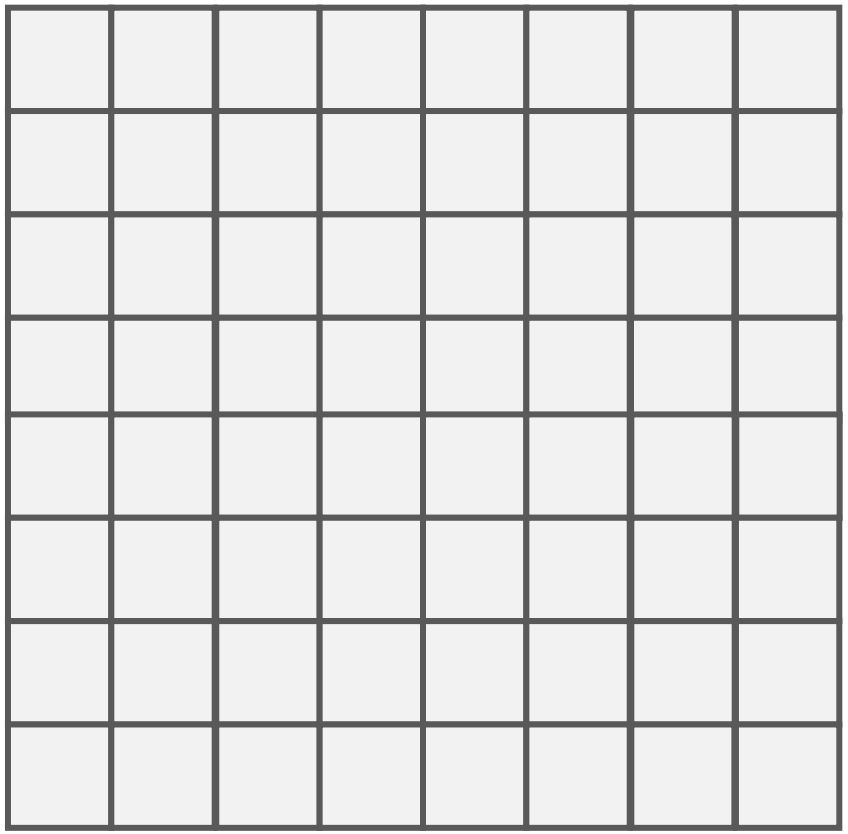
- the problem is that we have to visit every cell on an **NxN** chessboard such that we visit every cell exactly once
- what is the size of the search space?
- we can make **8** possible move with the knight in a single iteration but we have to do it to **NxN** every cell of the board
- it has **$O(2^{3(NxN)})$ exponential running time** complexity
- unlike Hamiltonian path problem it can be solved in **O(N)** linear running time with **divide-and-conquer** approach

Knight's Tour Problem

For an **MxN** chessboard the closed knight tour problem is always feasible, unless:

- **M** and **N** are both odds
- **M** = 1,2 or 4
- **M** = 3 and **N** = 4, 6 or 8

Knight’s Tour Problem



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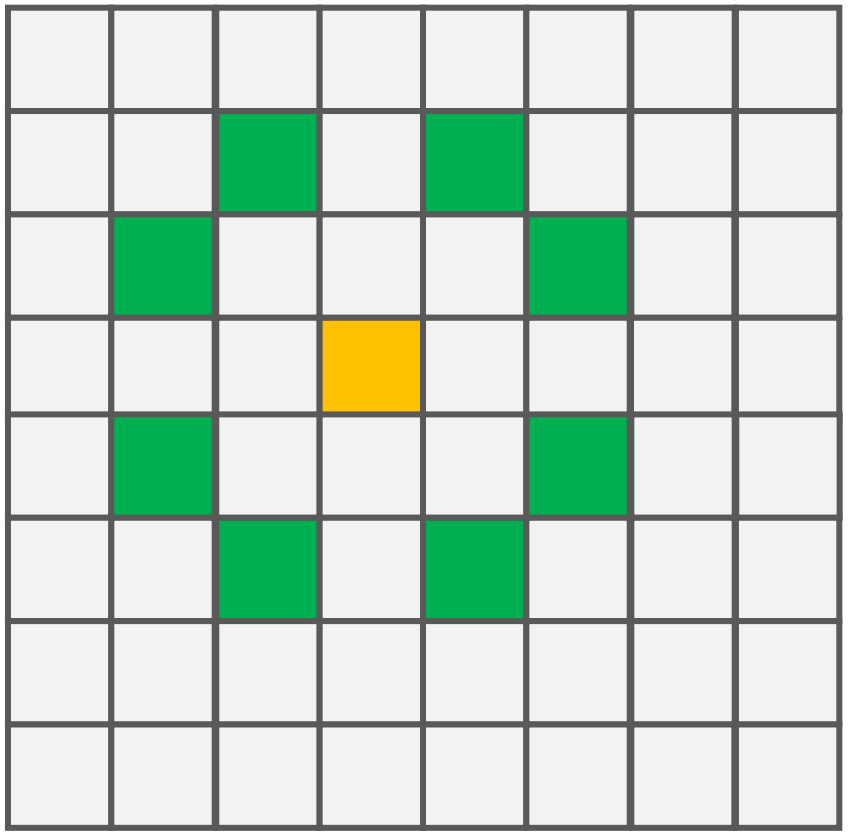

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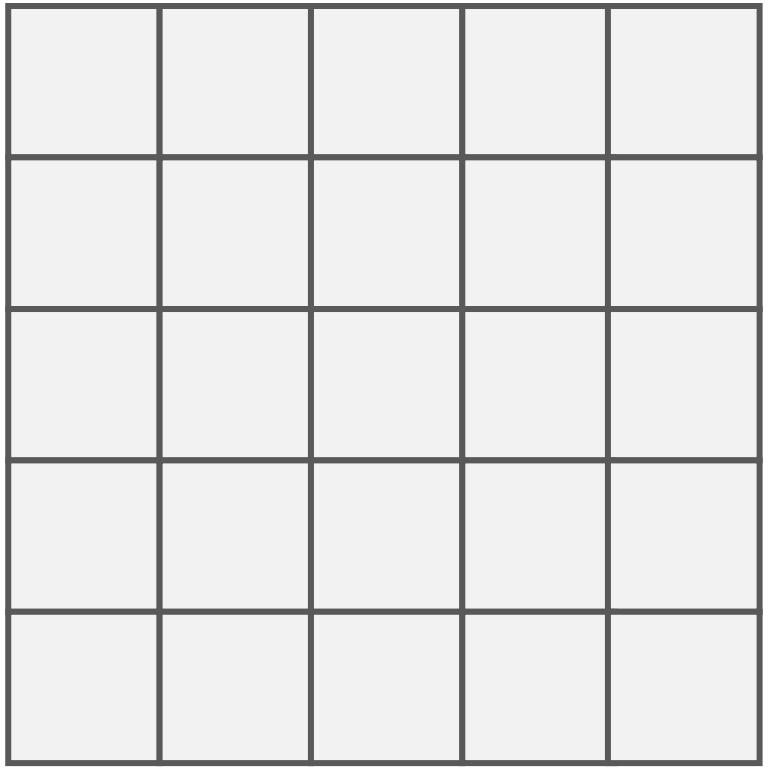

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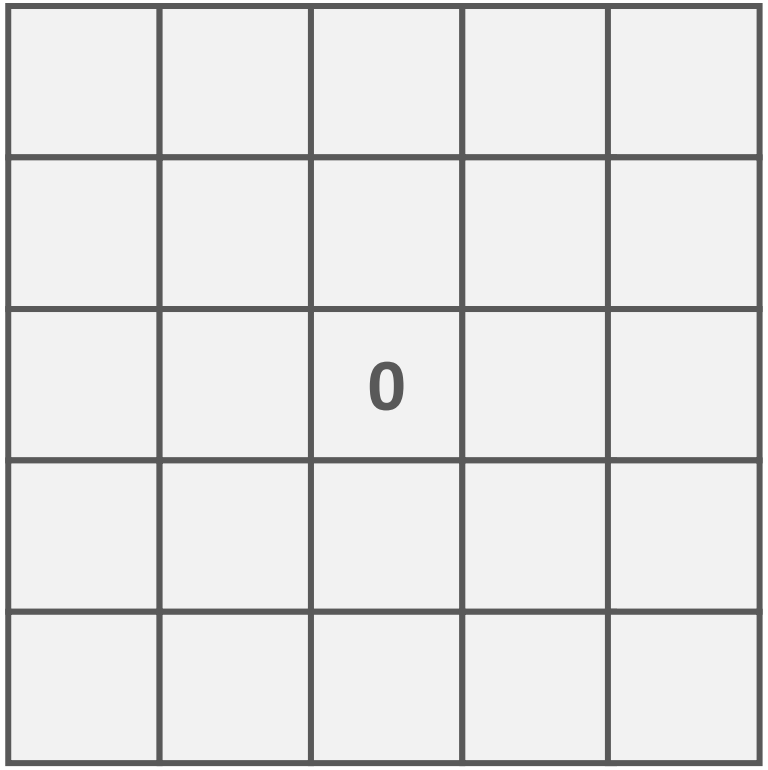

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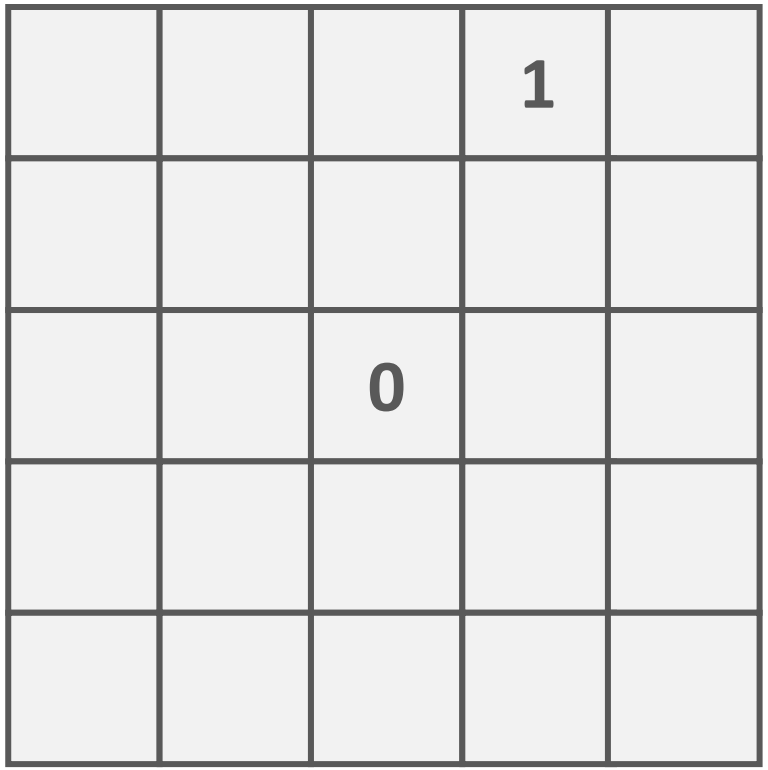

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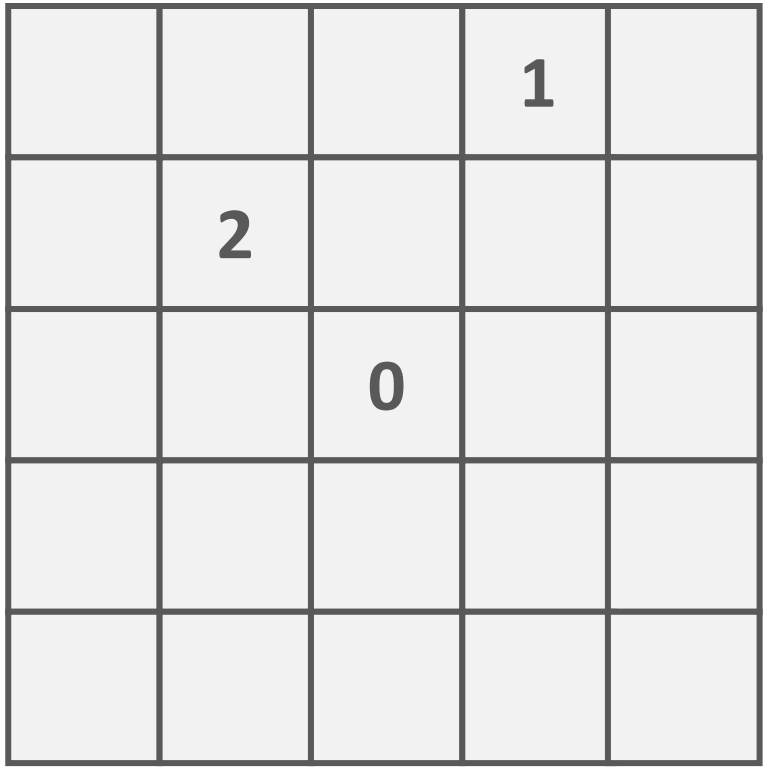

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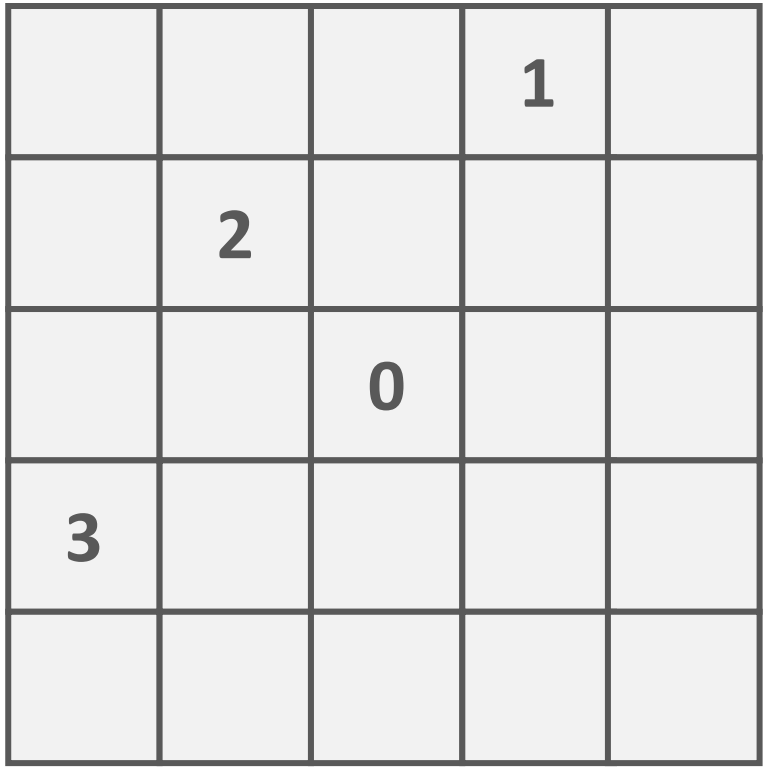

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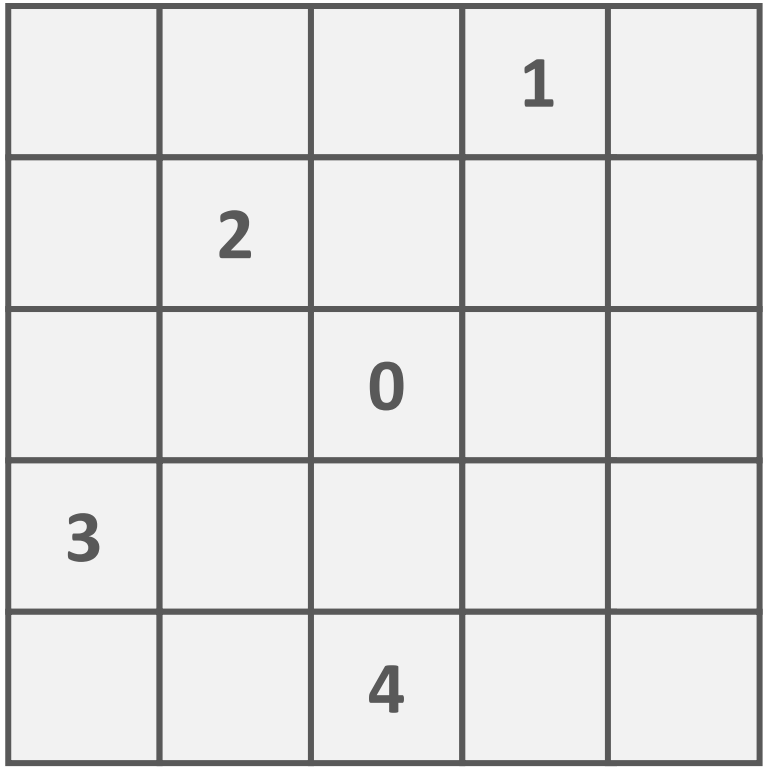

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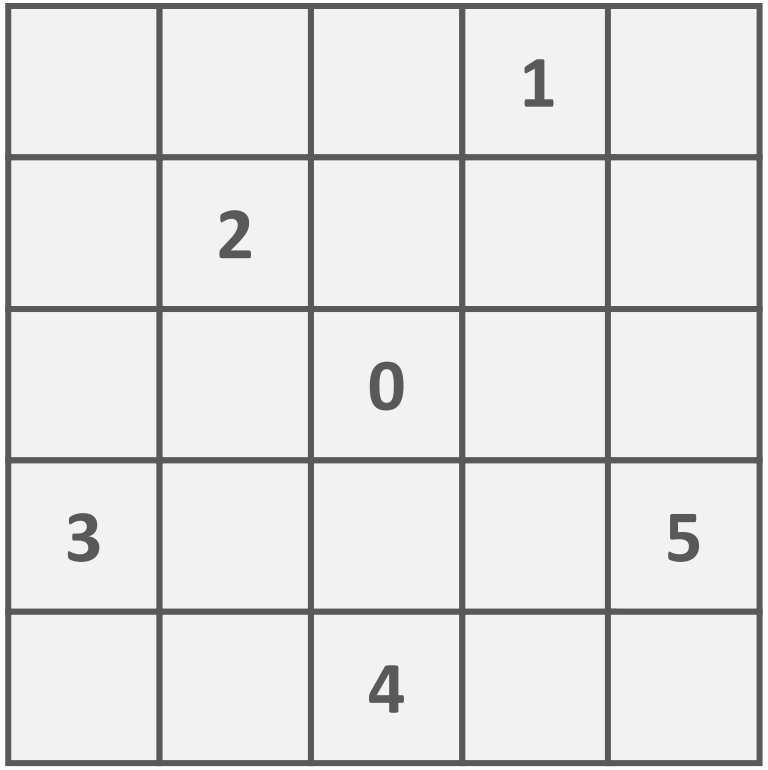

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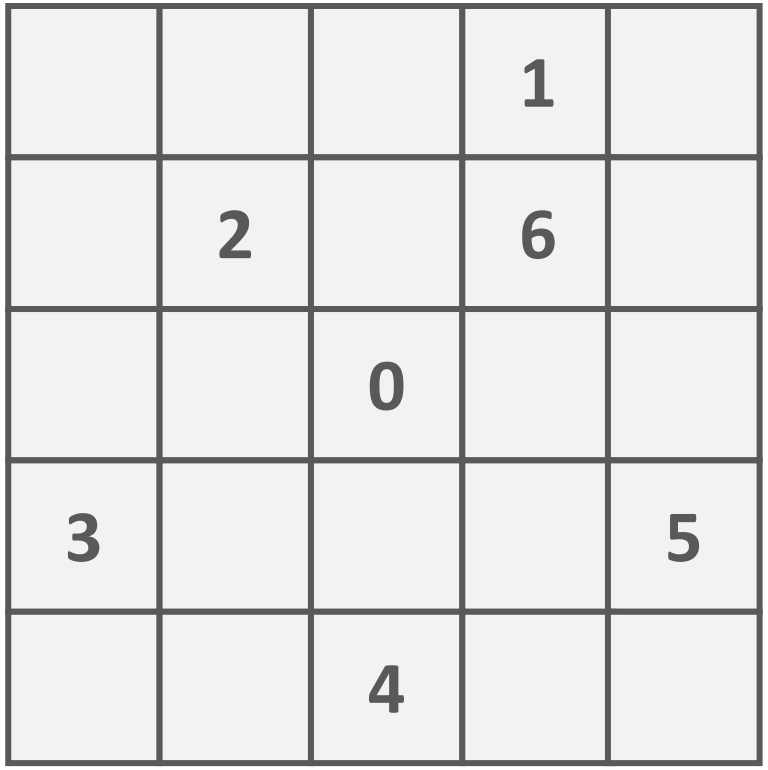

Knight’s Tour Problem

	7		1	
	2		6	
		0		
3				5
		4		

Knight’s Tour Problem

	7		1	
	2		6	
8		0		
3				5
		4		

Knight’s Tour Problem

	7		1	
	2		6	
8		0		
3				5
	9	4		

Knight’s Tour Problem

	7		1	
	2		6	
8		0		
3			10	5
	9	4		

Knight’s Tour Problem

	7		1	
	2		6	11
8		0		
3			10	5
	9	4		

Knight’s Tour Problem

	7	12	1	
	2		6	11
8		0		
3			10	5
	9	4		

Knight’s Tour Problem

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

Knight’s Tour Problem

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

Knight’s Tour Problem

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

Knight’s Tour Problem

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

Knight’s Tour Problem

	7	12	1	
13	2		6	11
8		0		16
3	14	17	10	5
	9	4	15	

Knight’s Tour Problem

	7	12	1	
13	2		6	11
8		0		16
3	14	17	10	5
	9	4	15	18

Knight’s Tour Problem

	7	12	1	
13	2		6	11
8		0	19	16
3	14	17	10	5
	9	4	15	18

Knight’s Tour Problem

	7	12	1	20
13	2		6	11
8		0	19	16
3	14	17	10	5
	9	4	15	18

Knight’s Tour Problem

	7	12	1	20
13	2	21	6	11
8		0	19	16
3	14	17	10	5
	9	4	15	18

Knight’s Tour Problem

22	7	12	1	20
13	2	21	6	11
8		0	19	16
3	14	17	10	5
	9	4	15	18

Knight’s Tour Problem

22	7	12	1	20
13	2	21	6	11
8	23	0	19	16
3	14	17	10	5
	9	4	15	18

Knight’s Tour Problem

22	7	12	1	20
13	2	21	6	11
8	23	0	19	16
3	14	17	10	5
24	9	4	15	18