THE KNIGHT'S TOUR

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INTRODUCTION

The Knight's Tour is a very renowned problem whose objective is to find the possible legal paths that a single knight can take on a chessboard to visit every square exactly once. This problem has two variations: One where the knights ends on any position of the chessboard and the other where the knight ends one legal knight move away from the starting position.

SCOPE OF THE PROJECT

Our aim is to understand and develop algorithms using different solving techniques to solve the Knight's Tour problem and implement it using Python.

METHODOLOGY

Warnsdorf's rule : Warnsdorf's rule is a heuristic for finding a knight's tour. The knight is moved so that it always proceeds to the square from which the knight will have the fewest onward moves. When calculating the number of onward moves for each candidate square, we do not count moves that revisit any square already visited.
Time Complexity : $O(k^n)$

Backtracking : Works in an incremental way to attack problems. When we add an item, we check if adding the current item violates the problem constraint, if it does then we remove the item and try other alternatives. If none of the alternatives work out then we go to previous stage and remove the item added in the previous stage. If we reach the initial stage back then we say that no solution exists. If adding an item doesn't violate constraints then we recursively add items one by one.
Time Complexity : $O(8^{(n^2-1)})$

Brute Force : Brute force is a reliable but very expensive method of solving programs in terms of time and space. Basically in this algorithm we will try every possibility without considering optimal solutions. This is not an efficient code but will ultimately get the solution. The algorithm will search for any possibility and if it is found it will go forward to the next position.

Time Complexity : O(n!)

	Time complexity
Warnsdorf's heuristic	$O(k^n)$
Backtracking	$O(8^{(n^2-1)})$
Brute Force	O(n!)

In 2003 a paper was published in which a proof was given which showed that the closed Knight's Tour is only possible for n>5 and for even n only.

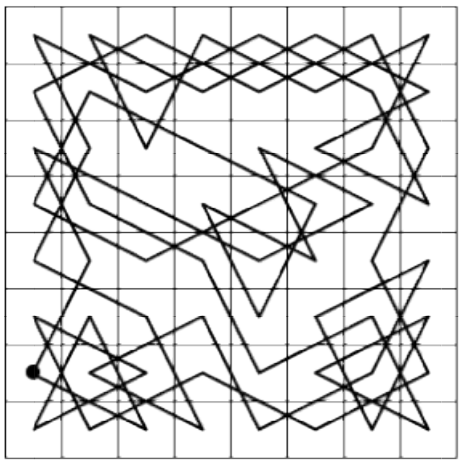
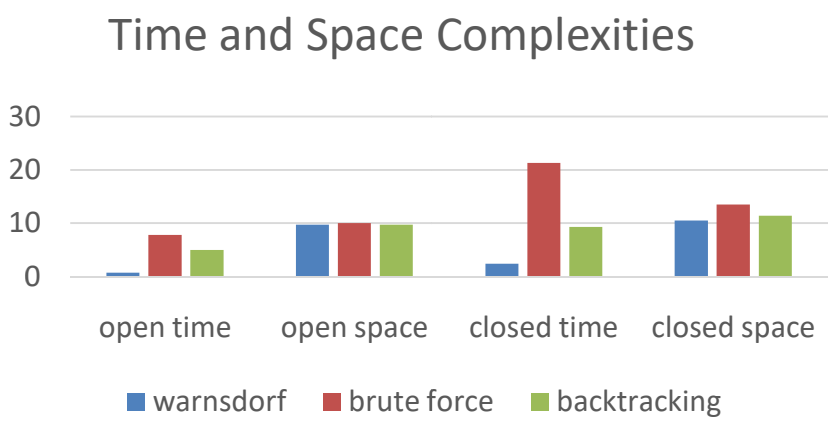


Figure 1 : Warsndorf solution

RESULT

We can see from the time complexities that the Warnsdorf heuristic is the most efficient method to solve the problem of the Knight's Tour. However, in recent times a faster algorithm has been presented by Arnd Roth although it doesn't work for higher order n.



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