FAI/p1

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MSc – Fundamentals of Artificial Intelligence
First Assessed Practical

Knight's Tour

The problem of the knight's tour is as follows.

On a square board with $n \times n$ positions, an initial square is given. Find a sequence of moves that the knight in chess can make from that square such that it visits each square on the board exactly once. The knight's move goes from a square to another square two squares away horizontally and one square vertically, or two squares away vertically and one square horizontally.

The classic version was given for the 8×8 chessboard – more information about this case is at

`www.borderschess.org/KnightTour.htm`.

1. To regard this as a state space search problem, we need an appropriate notion of state. Let's take the state to be given by the current position of the knight, together with the list of positions already visited.

   Give an estimate of the number of states are there in the $n \times n$ problem, for example by considering an arbitrary list of distinct positions, rather than lists got from a sequence of knight's moves. What is the branching factor b? You should justify your answers.

2. Which search strategy do you think is best suited to solve this problem, between *breadth first,depth first* and *iterative deepening*? Again, justify your answer.

3. Give pseudo-code for a depth-first search for a solution to this problem. You may assume that there is a procedure `step` which takes as input a position on the board and returns the list of positions on the board that are one knight move away.

4. Estimate the "big oh" complexity of this depth-first search algorithm. You should explain how your answer is worked out in terms of the recursive structure of your pseudo-code, rather than simply quoting a textbook answer.

5. A heuristic function for this problem was given by Warnsdorff in 1845: for position p on the board, $h_W(p)$ is the number of free squares (squares not yet visited) that the knight could move to. Give a reason why this heuristic helps to find solutions (at least for small values of n).

6. Explain why, for this problem, A^* search with Warnsdorff's heuristic gives no improvement over greedy depth-first search with Warnsdorff's heuristic.

Submission

Submit your answers as a text or PDF file on the Informatics system. Use the command

```
submit msc fai 1 <yourFile>
```

The deadline for submissions is

16:00 on Monday 27th October

Normally, late submissions will not be accepted.

If you have a good reason[1] to need to submit late, you must fill in the ITO support form as soon as possible. Your request is sent on to the course organiser (and recorded by the ITO); the course organiser will decide whether the request can be granted.

[1] as in `http://www.inf.ed.ac.uk/admin/committees/teaching/meetings/25-04-07/good_reason.html`