Homework and Programming Assignment 12

For the following, you need to install Pycosat:

```
pip3.12 install pycosat
```

assuming that you are using Python 3.12. Make sure you are selecting the right Python version if you have more than one on your computer.

## Problem 1:

A knight in chess moves by one step diagonally and one step vertically, as indicated on the right. You are supposed to find a positions for a number of knights such that neither knight can threaten another knight and there is a knight in each row and in each column and none on the main diagonal and the counter diagonal (which goes from the top right to the bottom left).



Of course you can solve this problem very simply by just marking a chess-board or using back-tracking. However, you have to translate the problem into a CNF-satisfiability problem and also show that the problem of finding such an arrangement is in $\mathscr{P}$.

Hand in your code and an explanation (as a pdf file).
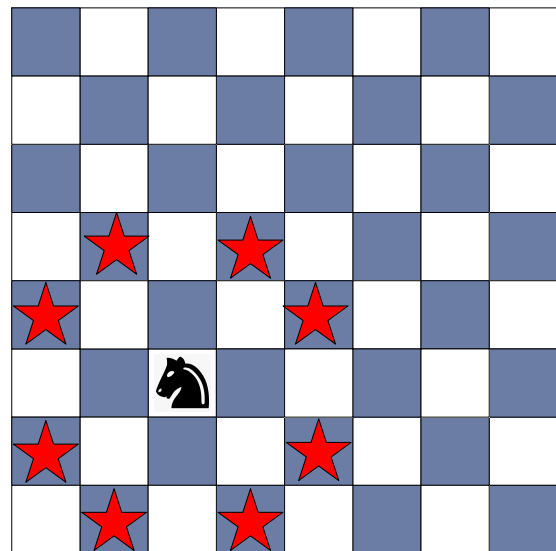
## Problem 2:

Translate the Hamiltonian path problem in a directed graph into 3SAT. The path has to go from Node 1 to Node $n$ and there are $n$ nodes total. Let $v_{i,j}$ mean that Node $i$ is in the $j^{\text{th}}$ position in the path. Express the following in CNF:

1. The path starts in Node 1 and ends in Node $n$.

2. Each node appears at least once in the path.

3. No node appears more than once in the path.

4. At least one node appears in position $l$.

5. At most one node appears in position $l$.

6. A Node $j$ appears after a Node $k$ in the path only if there is an edge from $j$ to $k$.

Do these conditions imply that there is a Hamiltonian path?

Translate your conditions into code and use Pycosat to show that there exists a Hamiltonian path from 1 to 7 but not from 7 to 1. (That you can find a path almost immediately is of no import for this problem, you need to use the code.)