

Constraint Programming

Exercise Lab 1.

6 January 2022

1 Send More Money

Model the following cryptogram :

$$\begin{array}{rcccccc} & & S & E & N & D & \\ + & M & O & R & E & & \\ \hline M & O & N & E & Y & & \end{array}$$

Two models are possible (with carried numbers and without).

2 Golomb ruler [Exam]

A **Golomb ruler** is a set of integers in which the distances between elements are pairwise different. For a given integer n , a Golomb ruler is « optimum » if its length (maximum distance) is minimum. Examples of optimum Golomb rulers :

$$\begin{array}{l|l} n = 2 & 0 \ 1 \\ n = 3 & 0 \ 1 \ 3 \\ n = 4 & 0 \ 1 \ 4 \ 6 \\ n = 5 & 0 \ 2 \ 7 \ 8 \ 11 \end{array}$$

Model the problem to find an optimum Golomb ruler for a given integer n as a CSP.

3 Zebra puzzle by Lewis Carroll

There are five houses (situated on a line) of different colors. People of different nationalities live there. Everyone owns a different pet, drinks different beverages, and smokes a different cigarettes brand. Then, we know that :

- The Norwegian lives in the first house.
- The Norwegian lives next to the blue house.
- Milk is drunk in the middle house.
- The Englishman lives in the red house.
- Coffee is drunk in the green house.
- *Kools* are smoked in the yellow house.
- The green house is immediately to the right of the ivory house.

- The Spaniard owns the dog.
 - The Ukrainian drinks tea.
 - The Japanese smokes *Parliaments*.
 - The *Old Gold* smoker owns snails.
 - The *Lucky Strike* smoker drinks orange juice.
 - The man who smokes *Chesterfields* lives in the house next to the man with the fox.
 - *Kools* are smoked in the house next to the house where the horse is kept.
- Who drinks water ? To which person zebra belongs ?

4 Latin square [Exam]

A **Latin square** is an $n \times n$ array filled with n different symbols, each occurring exactly once in each row and exactly once in each column..

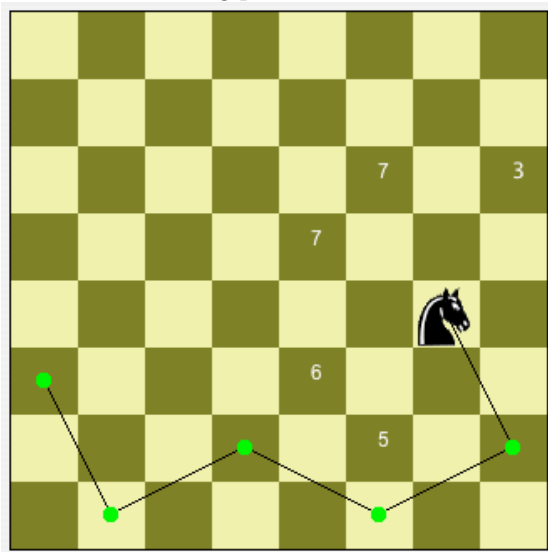
An example of a 4×4 Latin square is :

$$\begin{bmatrix} 1 & 3 & 2 & 4 \\ 4 & 2 & 1 & 3 \\ 2 & 4 & 3 & 1 \\ 3 & 1 & 4 & 2 \end{bmatrix}$$

Model the problem of finding an $n \times n$ Latin square.

5 Euler knight's tour

Model the following problem :



Find a *knight's tour* which is a sequence of moves of a knight on a chessboard such that the knight visits every square exactly once and comes back to the starting square.