Université Montpellier II - Master Informatique - Introduction à l'IA - Modélisation de CSP

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1 Golomb Rulers

These problems are said to have many practical applications including sensor placements for x-ray crystallography and radio astronomy. A Golomb ruler may be defined as a set of m integers $0 = x_1 < x_2 < \ldots < x_m$ such that the $m(m-1)/2$ differences $x_j - x_i$, $1 \leq i < j \leq m$ are distinct. Such a ruler is said to contain m marks and is of length a_m. The objective is to find optimal (minimum length) or near optimal rulers.

Question :

1. Give the corresponding set of decision variables
2. Give the variable domains
3. Give the elementary constraints that translate the problem of Golomb rulers
4. Give an objective function
5. Give a possible reformulation by adding auxilary variables, channeling constraints, an *all-Different* global constraint.
6. Give a redundant constraint
7. Is it possible to break symmetry using ($x_2 - x_1 < x_m - x_{m-1}$) ? how ? is it a symmetry on values or on variables ?
8. Is there other possible symmetries to break ?

2 N-queens

Can n queens be placed on a $n \times n$ chessboard so that none of the queens can attack each other ?

Question :

1. Give the corresponding set of decision variables
2. Give the variable domains
3. Give the elementary constraints that translate the problem of N-queens
4. Give a possible reformulation by adding auxilary variables, channeling constraints, an *all-Different* global constraint.
5. Give a redundant constraint
6. Locate and break symmetries, if any

3 Social Golfer problem

The coordinator of a local golf club has come to you with the following problem. In her club, there are 32 social golfers, each of whom play golf once a week, and always in groups of 4. She would like you to come up with a schedule of play for these golfers, to last as many weeks as possible, such that no golfer plays in the same group as any other golfer on more than one occasion. Possible variants of the above problem include : finding a 10-week schedule with "maximum socialisation" ; that is, as few repeated pairs as possible (this has the same solutions as the original problem if it is possible to have no repeated pairs), and finding a schedule of minimum length such that each golfer plays with every other golfer at least once ("full socialisation").

The problem can easily be generalized to that of scheduling m groups of n golfers over p weeks, such that no golfer plays in the same group as any other golfer twice (i.e. maximum socialisation is achieved).

Question :

1. Give the corresponding set of decision variables
2. Give the variable domains
3. Give the elementary constraints that translate the problem of N-queens
4. Give a redundant constraint
5. Locate and break symmetries, if any