CMPSCI 683 HW2 Fubao Wu

Problem 1:

Solution:

1.1:

Define a new variable XY whose domain is pair of numbers. XY indicates the X-th tuple

of variable Y.

We know A+B=C can be transferred to AZ+BZ=CZ

Since a binary constraint is satisfied only if the tuple X is in the domain of Y, which is compatible with a value a in the domain of A (for the first constraint) such that XY =A. This applies to B an C as well.

So we have constraints as A=X1Y; B= X2Y; C=X3Y

All of these three constraints are binary since they have 2 variables.

Therefore A+B=C can be turned into three binary constraints

1.2:

We can see from the previous question that it’s easy to extend the number of constraints to n variables. We just have to give each additional variable a constraint with variable XY. Then it’s trivial to solve the problem in a similar way.

1.3 For unary constraint, we can directly limit the domain for that variable. For instance, for variable A with domain {1, 2, 3, 4, 5} If we want the constraint as A > 3, we can modify the domain of A as

{4, 5}. This solves the problem for unary constraints.

Problem 2:

2.1 Sudoku is CSP problem. There are 81 variables needed. Their domains are numbers from 1 to 9. Form these variables to a 9\*9 grid, The constraints are

a. Each column contains all of the digits from 1 to 9.

b. Each row contains all of the digits from 1 to 9.

c. Each of the nine 3×3 sub-grids that compose the grid contains all of the digits from 1 to 9.

mathematically,

Xi,j is any a value in a cell (i,j)

1. for l = 1, 2, 3,..., 9 and l !=i

Xl,j != Xi,j

1. for m = 1,2,3,...,9 and m != j

Xi,m != Xi,j

1. for the subgrid around the cell (i, j)

For p= 0,1,2:

For q = 0,1,2

If p != (i-i%3) and q != (j-j%3):

Xp+i-i%3,q+j-j%3 != Xi,j

2.2 See the code file