PRACTICE 4

CONSTRAINT SATISFACTION PROBLEMS

1. Consider the problem of placing k knights on an n × n chessboard such that no two knights are attacking each other, where k is given and $k \leq n^2$

a. Choose a CSP formulation. In your formulation, what are the variables?
b. What are the possible values of each variable?
c. What sets of variables are constrained, and how?

2. Perform the AC-3 algorithm to turn these problems into arc-consistent ones with a reduced domain.

a	Variables	A, B, C ∈ {1, 2, 3}
	Constraints	(1) A > B (2) B = C

b	Variables	A, B, C ∈ {1, 2, 3, 4, 5, 6}
	Constraints	(1) A * B = 12 (2) A > C + 1 (3) C != B - 3

c	Variables	A, B, C ∈ {1, 2, 3, 4, 5, 6, 7, 8, 9}
	Constraints	(1) A + C = 6 (2) A != B (3) B < C + 3

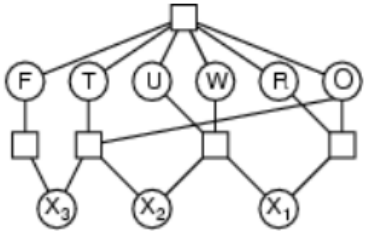
3. Solve the cryptarithmetic problem by hand, using the strategy of backtracking with forward checking and the MRV and least-constraining-value heuristics.

REMINDER:

1. Why should we choose the most constrained variable (a.k.a. minimum remaining values) heuristic?
2. Why should we choose the least-constraining value (the value that rules out the fewest values in the remaining variables)?
3. What does forward checking do?

3. Solve the cryptarithmetic problem by hand, using the strategy of backtracking with forward checking and the MRV and least-constraining-value heuristics.

$$\begin{array}{r} \text{T W O} \\ +\ \text{T W O} \\ \hline \text{F O U R} \end{array}$$



- Variables: $F\ T\ U\ W\ R\ O\ \ X_1\ X_2\ X_3$ (the memories of the operator "+")
- Value domain: {0,1,2,3,4,5,6,7,8,9} for the 6 variables of F, T, U, W, R, O, and {0, 1} for the 3 variables of X_1, X_2, X_3
- Constraints: The values of the variables F, T, U, W, R, O are different
  - $O + O = R + 10 * X_1$
  - $X_1 + W + W = U + 10 * X_2$
  - $X_2 + T + T = O + 10 * X_3$
  - $X_3 = F$
  - $T \neq 0$
  - $F \neq 0$