Constraint Satisfaction Problems

(Source: https://aimacode.github.io/aima-exercises/, accessed in Nov 2022)

Exercise 01

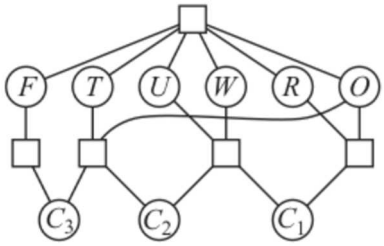
Give precise formulations for each of the following as constraint satisfaction problems:

1. **Rectilinear floor-planning**: find non-overlapping places in a large rectangle for several smaller rectangles.
2. **Class scheduling**: There is a fixed number of professors and classrooms, a list of classes to be offered, and a list of possible time slots for classes. Each professor has a set of classes that he or she can teach.
3. **Hamiltonian tour**: given a network of cities connected by roads, choose an order to visit all cities in a country without repeating any.

Exercise 02

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

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



Exercise 03

Consider the graph with 8 nodes $A_1, A_2, A_3, A_4, H, T, F_1, F_2$. A_i is connected to A_{i+1} for all i, each A_i is connected to H, H is connected to T, and T is connected to each F_i. Find a 3-coloring of this graph by hand using the following strategy: backtracking with conflict-directed back jumping, the variable order $A_1, H, A_4, F_1, A_2, F_2, A_3, T$, and the value order R, G, B.

Exercise 04

Consider the problem of completely tiling a surface with n dominoes (2×1 rectangles). The surface is an arbitrary edge-connected, i.e., adjacent along an edge, collection of $2n$ 1×1 squares (e.g., a checkerboard, a checkerboard with some squares missing, a 10×1 row of squares, etc.).

1. Formulate this problem precisely as a CSP where the dominoes are the variables.
2. Formulate this problem precisely as a CSP where the squares are the variables, keeping the state space as small as possible. (Hint: does it matter which domino goes on a given pair of squares?)