CS3600 – Homework 2.5 – Constraint Satisfaction Problems

Recall that constraint satisfaction problems (CSPs), define a set of variables, domains of the possible values for each variable, and a set of constraints, each involving one or more variables, that must be satisfied in a solution to the CSP.

In this homework you will solve a CSP by hand. The problem is a cryptarithmetic puzzle (ever read "Sideways Stories from Wayside School"?). There are a set of variables, each represented by a capital letter, and each variable can be any integer from 0 to 9, inclusive. Each variable must be a different digit. Also, there must be no leading zeros. The variables must satisfy the following base-10 addition problem:

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

In order to solve this problem, we must define auxiliary variables and constraints representing the carrying digits for the addition:

$$O + O = R + 10 \cdot X_1$$
$$X_1 + W + W = U + 10 \cdot X_2$$
$$X_2 + T + T = O + 10 \cdot X_3$$
$$X_3 = F$$

Your task for this homework is to define and label the constraints in the hypergraph depicting this CSP (reproduced below), and then to solve the CSP by hand. Whenever possible, you should use backtracking, the minimum remaining values (MRV) heuristic, the least-constraining-value heuristic, and forward checking.