Exercise 1

Foundations of Constraint Programming

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Exercise 1.1

There are 5 houses in a row, each with a different kind of tree in front of it. In each house lives a different person that owns a different type of car. The 5 persons like a certain type of food, do a certain sport, and keep certain pets. No two owners like the same food, do the same sport, or keep the same pets. Consider additionally the following information:

- The Volvo is parked in front of house four.
- There is one house between the mice and the Volleyball player.
- There are two houses between the birch trees and the Porsche on the left.
- The person in house four does not eat cheese.
- The birds live to the left of the BMW driver.
- There are two houses between the horses and the person eating steaks.
- There is one house between the eucalyptus trees and the person eating potatoes on the right.
- The person in house five plays Volleyball.
- There is one house between the firs and the Soccer player.
- The person with palm trees drives a BMW.
- The person playing Badminton eats steaks.
- The person with the dogs eats waffles.
- The birds live directly next to the Soccer player.
- The maple trees grow directly next to the Ferrari.
- The eucalyptus trees grow in front of house three.
- There are two houses between the Tennis player and the person eating cheese.

The questions are: Who grows maple trees? Who owns a VW? Who plays rugby? Who keeps snakes? Who likes pancakes? (Assuming that for each of the questions there exists a person fulfilling it.) Formulate this problem as a constraint satisfaction problem and solve it by hand.

Exercise 1.2

Consider the task of assigning to each node of a finite graph a color in such a way that no two adjacent nodes have the same color. Such an assignment is called a coloring of the graph. A coloring of the graph involving the minimal number of colors is called the chromatic number of the graph. Formulate the problem of finding the chromatic number of a graph as a constrained optimization problem.

Exercise 1.3

Formulate the following problem as a constrained optimization problem: Place a minimum number of queens on the chess board so that each unoccupied field comes under attack.