
Homework for Artificial Intelligence for Robotics Assignment 8

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1 THEORETICAL PART

1.1 TASK

Consider the following puzzle and represent it as a Constraint Satisfaction Problem. Do not solve/implement it. Provide only the variables, the values of those variables, and the constraints.

- There are five houses.
- The Englishman lives in the red house.
- The Spaniard owns the dog.
- Coffee is drunk in the green house.
- The Ukrainian drinks tea.
- The green house is immediately to the right of the ivory house.
- The Old Gold smoker owns snails.
- Kools are smoked in the yellow house.
- Milk is drunk in the middle house.
- The Norwegian lives in the first house.

- The man who smokes Chesterfields lives in the house next to the man with the fox.
- Kools are smoked in a house next to the house where the horse is kept.
- The Lucky Strike smoker drinks orange juice.
- The Japanese smokes Parliaments.
- The Norwegian lives next to the blue house.

The question posed by the puzzle is: Who drinks water? Who owns the zebra?

1.2 SOLUTION

A **Constraint Satisfaction Problem** is described by defining the **possible states** and the **goal test**. The state consists of **variables** and their **domains**. The goal test consists of all combinations of value assignments to variables that have to be fulfilled for a state to be considered a solution to the problem.

1.2.1 VARIABLES

The Variables are the five houses:

Variables = {First, Second, Third, Fourth, Fifth }

1.2.2 VARIABLE DOMAINS

Each variable consists of exactly five values: The color of the house, the person living in the house, the pet of the person living in the house, the drink the person in the house drinks and the brand of the smoke the person in the house smokes.

Domain = {
 {red, green, ivory, yellow, blue},
 {Englishman, Spaniard, Ukrainian, Norwegian, Japanese},
 {tea, coffee, milk, orange juice, water},
 {dog, horse, snails, fox, zebra},
 {Lucky Strike, Parliaments, Kools, Old Gold, Chesterfield}
 }.

1.2.3 GOAL TEST

Assume that each house has an index according to its place (First = 1, Second = 2, Third = 3, Fourth = 4 and Fifth = 5) and that *index{...}* returns the house's index of a given value, then the constraints are the following:

- $\text{index}\{\text{Englishman}\} == \text{index}\{\text{red}\}$
- $\text{index}\{\text{Spaniard}\} == \text{index}\{\text{dog}\}$

- $\text{index}\{\text{coffee}\} == \text{index}\{\text{green}\}$
- $\text{index}\{\text{Ukrainian}\} == \text{index}\{\text{tea}\}$
- $\text{index}\{\text{green}\} == \text{index}\{\text{ivory} - 1\}$
- $\text{index}\{\text{Old Gold}\} == \text{index}\{\text{snails}\}$
- $\text{index}\{\text{Kools}\} == \text{index}\{\text{yellow}\}$
- $\text{index}\{\text{milk}\} == 3$
- $\text{index}\{\text{Norwegian}\} == 1$
- $\text{index}\{\text{Chesterfield}\} == \text{index}\{\text{fox}\} + 1 \parallel \text{index}\{\text{Chesterfield}\} == \text{index}\{\text{fox}\} - 1$
- $\text{index}\{\text{Kools}\} == \text{index}\{\text{horse}\} + 1 \parallel \text{index}\{\text{Kools}\} == \text{index}\{\text{horse}\} - 1$
- $\text{index}\{\text{Lucky Strike}\} == \text{index}\{\text{orange juice}\}$
- $\text{index}\{\text{Japanese}\} == \text{index}\{\text{Parliament}\}$
- $\text{index}\{\text{Norwegian}\} == \text{index}\{\text{blue}\} + 1 \parallel \text{index}\{\text{Norwegian}\} == \text{index}\{\text{blue}\} - 1$

2 PRACTICAL PART

2.1 TASK

Solve the same Travelling Salesman Problem as the previous assignment, but using Simulated Annealing and all cities in the file. Get the best solution for different computation time (say 5, 10, 15 minutes).

2.2 APPROACH

2.3 RESULT