Artificial Intelligence

Lab 4 – CSPs

Reykjavik University

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1. To model the problem as CSP the houses get assigned numbers {1, … ,5} and then each of the other variables gets assigned the same number as the house that the variable belongs to. The variables are then:

   X = {color, pet, drink, smokes, nationality}

   The domain for every variables is:

   D = {1, 2, 3, 4, 5}

   And the constraints are:

   C = {$color_I \neq color_J$, $pet_I \neq pet_J$, $drink_I \neq drink_J$, $smokes_I \neq smokes_J$, $nationality_I \neq nationality_J$} where I ≠ J in domain D

2. Given the model above and that all the variables have a value from the same domain then for ***n*** number of variables the size of the state space is $S = D^n$ then for this problem the size of the state space is $S = 5^5 = 25$.
   The depth of the search tree is always exactly the same as the number of variables in the state space, d = 5, and the branching factor is the same as the number of values in the variable domain, b = 5. The size of the search tree is therefore $S = 5^5 = 25$.

3. Solution 0, time = 0.03 s
   Red = 3 Green = 5 Ivory = 4 Yellow = 1 Blue = 2
   Englishman = 3 Spaniard = 4 Norwegian = 1 Ukrainian = 2 Japanese = 5
   Old Gold = 3 Kools = 1 Chesterfields = 2 Lucky Strike = 4 Parliaments = 5
   Water = 1 Orange juice = 4 Tea = 2 Coffee = 5 Milk = 3
   Zebra = 5 Dog = 4 Fox = 1 Snails = 3 Horse = 2

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1 solution(s) found.
CpSolverResponse summary:
status: OPTIMAL
objective: 0
best_bound: 0
booleans: 37
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conflicts: 0
branches: 0
propagations: 37
integer_propagations: 0
restarts: 0
lp_iterations: 0
walltime: 0.0261127
usertime: 0.0261128
deterministic_time: 3.821e-05
gap_integral: 0
```

4.

The size of the state space and the search tree are based on the number of variables and values in the domain and do not take the constraints into account. They thereby represent an upper boundary to the search problem. The constraints of the problem then have the effect of reducing the possible branching factor which reduces the runtime.