CSP and Local Search

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Outline

1. Contraint Satisfaction
2. Local Search
3. Homework

Cryptogram

A cryptogram is a type of puzzle which consists of a short piece of encrypted text such that each letter of the alphabet (A-Z) is mapped to a different letter (A-Z). Spaces are preserved. The assignments are consistent.

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- Used extensively in telegrams in World War I

  Zimmermann Telegram: proposal from the German Empire to Mexico to make war againts US. intercepted by the British and decrypted

Cryptogram as a CSP

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- Example Problem

  `ABC DC EFG HGIIJK FBE`

  1. What are the variables?
  2. What is the domain of those variables?
  3. What are the constraints?

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  `Dom(ABC) = Dom(EFG) = Dom(FBE) = {DOG, MAN, THE, HAT }`
  `Dom(DC) = {IN, MY, TO}`
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- Solve the cryptogram by using backtracking search (without forward checking) assigning variables from left to right.

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- How would the search change if forward checking was allowed?

Traveling Salesman Problem

- A problem in graph theory requiring the most efficient (i.e., least total distance) Hamiltonian cycle a salesman can take through each of cities.

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- No general method of solution is known, and the problem is NP-hard.

Small Traveling Salesman Problem

A traveler needs to visit 4 cities. He knows the distance between each pair of cities. His aim to figure out the shortest route that visits all the cities.
Distances between cities.

```
A-B 6
A-C 1
A-D 5
B-C 3
B-D 2
C-D 4
```

Local Search for Traveling Salesman Problem

- State space: a set of all possible tours, e.g. ABCD, ACBD etc
- Operators: change position of adjacent cities within the current tour
- Heuristic function - length of the tour
- Initial State - ABCD
- Distances between cities.

```
A-B 6
A-C 1
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```

- Perform steepest descent.

Pay attention to

- algorithms specified in the homework questions.
- difference between a ‘state’ of the world and a ‘node’