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Artificial Intelligence - HOMEWORK No. 3
CSCE 5210.

Reasoning With Constraints.

1)

1	2	3
4		
5		

Words: add, age, aid, aim, air, are, arm, art, bad, bat, bee, boa, dim, ear, eel, eft, lee, oaf.

Ans: The Crossword problem is represented as nine Squares with each square representing a Variable.

Each Variable's domain consists of every letter of the alphabet that may potentially be utilized to build a word from Specified word list

Considering each Square to be a slot that can hold any letter of the alphabet. However, not just any letter may go into a slot; the letters must assist to construct a word from the word list when coupled with the letters in the adjoining

Let's discuss on questions:

Domain consistency:

The goal is here to ensure that the value assigned to a Variable is compatible with the restrictions.

for example, if no word in the wordlist begins with the letter 'Z,' then 'z' cannot be in the top-left square. As a result, the letter 'z' would be removed from the domain (Possible Values) of that square.

(e) Arc Consistency:

This assures that for every value of one variable, there is a compatible value in another variable so that no constraints are violated.

Example: Consider two neighboring squares, A and B, with A to the left of B. If A includes the letter 'U' and no word in the word list begins with 'U' followed by any letter that B may accept, then assigning 'U' to A would render B inconsistent. In such a circumstance, 'U' might be pruned from A's domain or certain values from B, guaranteeing arc consistency.

(f) Adequacy of Domain and Arc Consistency:

Are they sufficient? Using Domain and arc consistency reduces the number of alternative letter assignments by removing those that will not lead to a solution. They do not, however, promise a complete answer. Consider them filters that screen out terrible selections, but you may still need to investigate the remaining options.

Why? Because, even if every square (Variable) contains a valid letter (Value) and every pair of adjacent squares (Variables) adheres to word restrictions (arc-consistency), the entire grid may not include legitimate words everywhere. You're assuring that portions of the puzzle are constant, but not complete the jigsaw.

To summarize, domain and arc consistency act as sieves, removing evident discrepancies. While work on puzzle although deleting impossible possibilities makes it easier, you may still need to try different combinations of the remaining options.

Q2) Consider a scheduling problem, where there are five activities to be scheduled in four time slots. Suppose we represent the activity by the Variables by the Variables A, B, C, D, and E, where the domain of each variable is {1, 2, 3, 4} and constraints are $A > D$, $D > E$, $C \neq A$, $C > E$, $C \neq D$, $B \geq A$, $B \neq C$ and $C \neq D + 1$.

(a) Show how Back-tracking solve this problem?
This solution looks like tree based on Variable ordering C, D, A, B, E

$C = 1$
- $D = 1$ failure
- $D = 2$
  - $A = 1$ failure
  - $A = 3$ failure
    - $B = 1$ failure
    - $B = 2$ failure

B = 3 E = 1 failure
E = 2 failure
E = 3 failure
E = 4 failure

B = 4 E = 1 failure
E = 2 failure
E = 3 failure
E = 4 failure

A = 4 B = 1 failure
B = 2 failure

B = 3 failure
B = 4 E = 1 failure
E = 2 failure
E = 3 failure
E = 4 failure

D = 3 A = 1 failure
A = 2 failure
A = 3 failure
A = 4 B = 1 failure
B = 2 failure
B = 3 failure
B = 4 E = 1 failure
E = 2 failure
E = 3 failure
E = 4

D = 4 A = 1 failure
A = 2 failure
A = 3 failure
A = 4 failure

C = 2 D = 1 failure
D = 2 failure
D = 3 A = 1 failure
A = 2 failure
A = 3 failure

A = 4 B = 1 failure
B = 2 failure
B = 3 failure
B = 4 E = 1 Solution
E = 2 failure
E = 3 failure
E = 4 failure

D = 4 A = 1 failure
A = 2 failure
A = 3 failure
A = 4 failure

C = 3 D = 1 A = 1 failure
A = 2 B = 1 failure
B = 2 failure
B = 3 failure
B = 4 E = 1 failure
E = 2 failure
E = 3 failure
E = 4 failure

D = 2 failure
D = 3 failure
D = 4 A = 1 failure
A = 2 failure
A = 3 failure
A = 4 failure

C = 4 D = 1 A = 1 failure
A = 2 B = 1 failure
E = 1 failure
E = 2 failure
E = 3 failure
E = 4 failure
B = 2
B = 3 E = 1 failure
E = 2 failure
E = 3 failure
E = 4 failure
B = 4 failure

A = 3 failure

D = 2 A = 1 failure

A = 2 failure

A = 3 B = 1 failure

B = 2 failure

B = 3 E = 1 solution

E = 2 failure

E = 3 failure

E = 4 failure

B = 4 failure

A = 4 failure

D = 3 A = 1 failure

A = 2 failure

A = 3 failure

A = 4 failure

D = 4 failure