AI Theory Homework Week4

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1 Standard search problems and constraint satisfaction problem

Similarities

1. They are both search problems, and CSP is a special subset of standard search problems and can be framed as a standard search problem.
2. They both have state. for Standard search problems it is values from its defined state space, and for CSPs, it is defined as its variables X_i that can take on values from domain D_i
3. They both have an initial state. For CSPs it always starts from an empty assignment {}
4. They both have actions, for goal search it can be seen as filling a variable with a specific value in its domain.
5. They all have a Goal test. For Standard search problems is to test whether the state is the goal state, for CSPs, it is testing if the current assigment is complete and consistent.

Differences

1. Standard search problems interested in sequence of actions leading to the goal state, whereas CSP interested in the goal state itself.
2. Standard search problems all path have various costs and depths, whereas for CSP all path have the same depth (the depth where all variables are filled).
3. In a standard search problem, state is a 'black box' that can be arbitrary data structure. In CSP, state is defined by variables Xi with values from a domain Di (sometimes D depends on i)

2 Cryptarithmetic Problem

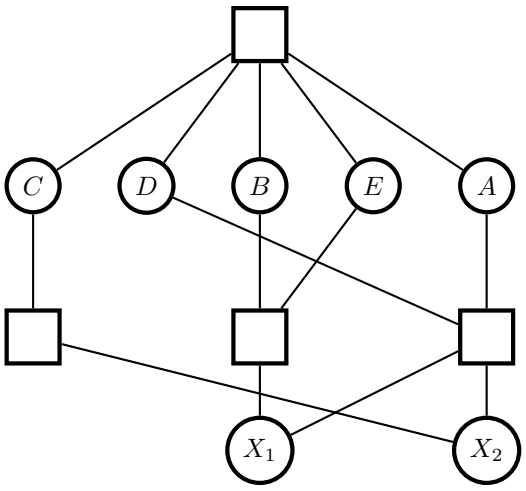
Variable. B, E, A, D, C, X_1, X_2

Domains. 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Constraints.

1. $alldiff\{B, E, A, D, C\}$
2. $B + B = E + 10 * X_1$
3. $A + A + X1 = D + 10 * X_2$
4. $X_2 = C$

Constraint Graph.



3 Pure backtracking.

procedure see 1. Final Assignment: $V1 : G, V2 : B, V3 : R, V4 : G$

4 Backtracking with forward checking

See 2 Final Assignment: $V1 : G, V2 : B, V3 : R, V4 : G$

Vertices	color
V1	R
V2	G
V3	R
V3	G
V4	G
V2	B
V3	R
V3	G
V4	G
V1	G
V2	G
V2	B
V3	R
V4	G

Table 1: Procedure with only backtracking

Vertices	Color
V1	R
V2	G
V2	B
V3	G
V1	G
V2	B
V3	R
V4	G

Table 2: Procedure with foward-checking

5 Arc consistency

Assuming the arc queue initialized with the following order: [V1-V2, V4-V2, V1-V3, V4-V3, V2-V1, V2-V4, V3-V1, V3-V4]. Final Assignment: $V1 : G, V2 : B, V3 : R, V4 : G$ Results see: 3

Arc	Domain	Domain	comment
V1 - V2	D1=RGB	D2=GB	
V4 - V2	D4=G	D2=GB	
V1 - V3	D1=RGB	D3=RG	
V4 - V3	D4=G	D3=RG	
V2 - V1	D2=GB	D1=RGB	
V2 - V4	D2=B	D4=G	D2 = G deleted adding V1 - V2, V4 - V2 to the queue
V3 - V1	D3=RG	D1=RGB	
V3 - V4	D3=R	D4=G	D3 = G deleted adding V1 - V3, V4 - V3 to the queue
V1 - V2	D1=GR	D2=B	
V4 - V2	D4=G	D2=B	
V1 - V3	D1=G	D3=R	D1 = R deleted adding V2 - V1, V3 - V1 to the queue
V4 - V3	D4=G	D3=R	
V2 - V1	D2=B	D1=G	
V3 - V1	D3=R	D1=G	

Table 3: