50.021 Homework 2

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Question 1

Compare between standard search problems and constraint satisfaction problems. List down two similarities and three differences.

Similarities:

- They both have states, to physically represent a configuration of the problem, so that it is possible to work towards a goal.
- They both have goals, and goal tests to see if the programme has arrived at a state that is the goal.

Differences:

- SSP is more interested in the sequence of actions (path) to the goal while CSP is more interested in the goal itself, not the sequence of actions (path) there
- For SSP, paths have various costs and depths while for CSP, all paths have the same depth (for some formulations)
- For SSP, the state space is quite broad, and can be strings, or countries etc, while for CSPs, the states are represented by variables X_i which can take on values from domain D_i

Question 2

Formulate this as a CSP problem, by stating all variables, domains and constraints.
Also, draw the corresponding constraint graph.

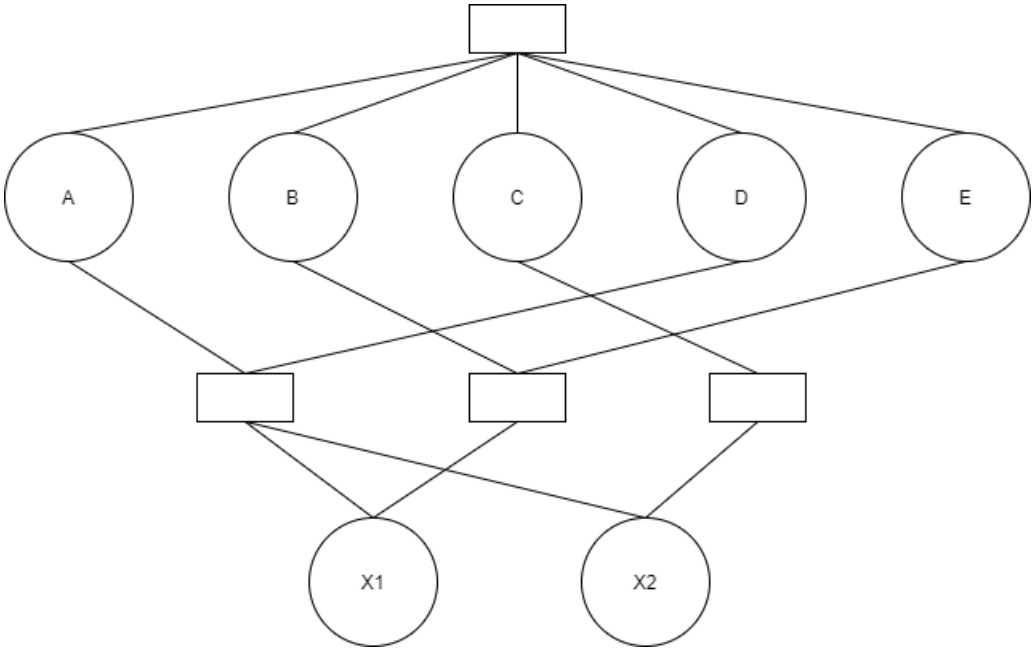
Variables: A, B, C, D, E, X_1, X_2

where X_1, X_2 represent the carryover for each decimal position

Domains: $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$

Constraints:

- $\text{alldiff}(A, B, C, D, E)$
- $B + B = E + X_1 \cdot 10$
- $A + A + X_1 = D + X_2 \cdot 10$
- $C = X_2$



Question 3

Variable	Colour	Inconsistency found
$V1$	R	
$V2$	G	
$V3$	R	$\times$
$V3$	G	
$V4$	G	$\times$
$V2$	B	
$V3$	R	$\times$
$V3$	G	
$V4$	G	$\times$
$V1$	G	
$V2$	G	$\times$
$V2$	B	
$V3$	R	
$V4$	G	solution

$\therefore$ the solution is $\{V1 : G, V2 : B, V3 : R, V4 : G\}$

Question 4

Variable	Colour	Domain empty
$V1$	R	
$V2$	G	$\times$
$V2$	B	
$V3$	G	$\times$
$V1$	G	
$V2$	B	
$V3$	R	
$V4$	G	solution

Question 5

I did this question following the sequence of V1 to V4 on the LHS, then V1 to V4 on the RHS, after the first few arcs from the question.

Variable	Variable	Domain	Domain
$V1$	$V2$	$D1 : RGB$	$D2 : GB$
$V4$	$V2$	$D4 : G$	$D2 : GB$
$V1$	$V3$	$D1 : RGB$	$D3 : RG$
$V2$	$V1$	$D2 : GB$	$D1 : RGB$
$V2$	$V4$	$D2 : \cancel{G}B$	$D4 : G$
$V3$	$V1$	$D3 : RG$	$D1 : RGB$
$V3$	$V4$	$D3 : R\cancel{G}$	$D4 : G$
$V4$	$V3$	$D4 : G$	$D3 : R\cancel{G}$
$V1$	$V2$	$D1 : RG\cancel{B}$	$D2 : \cancel{G}B$
$V4$	$V2$	$D4 : G$	$D2 : \cancel{G}B$
$V1$	$V3$	$D1 : \cancel{R}G\cancel{B}$	$D3 : R\cancel{G}$
$V4$	$V3$	$D4 : G$	$D3 : R\cancel{G}$
$V2$	$V1$	$D2 : \cancel{G}B$	$D1 : \cancel{R}G\cancel{B}$
$V3$	$V1$	$D3 : R\cancel{G}$	$D1 : \cancel{R}G\cancel{B}$

Each domain is actually left with only one letter after doing the arc consistency check, meaning there is only one possible solution for this problem: $\{V1 : G, V2 : B, V3 : R, V4 : G\}$