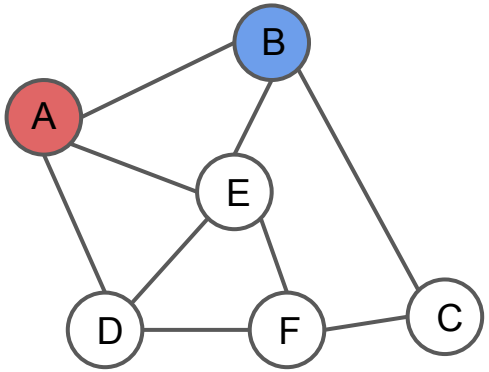
Filtering & Ordering



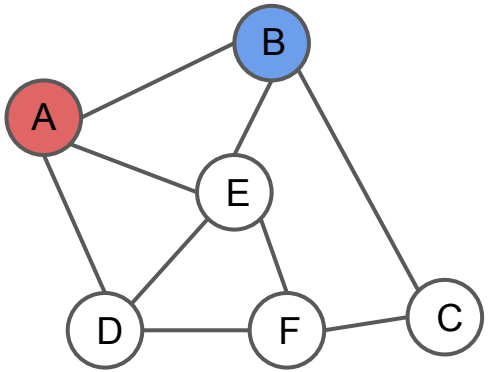
Now we want to color the graph with **Red**, **Blue**, **Green** without coloring two adjacent nodes with the same color. Now we have assigned Red to node A and Blue to node B.

(1) If we assign **Red** to node C, what will be the remaining legal values in D, E, F after running (a) forwarding checking (b) arc consistency?

(2) (MRV) Based on the MRV rule, which variable should be chosen next?

(3) (LCV) Based on the LCV principle, which value should we choose if we want to assign color to Node D first? (Assume we use *forward checking* for the filtering step)

Solutions



Forward checking

D	B, G
E	G
F	B, G

Arc consistency

D	B
E	G
F	Empty

or

D	Empty
E	G
F	B

MRV: In order to decide which variable to assign based on MRV principle, we can list all the legal values left in the domain. Legal values for each node is listed in the table on the right. As we can, node E has the fewest options for color, therefore we will choose E.

C	R, G
D	B, G
E	G
F	R, B, G

Solutions

Based on **LCV** principle, we list all left legal values for C, E, F based on different values for D. As we can see from the table, when we choose Blue for node D, it has more legal values left in the domain. So we should assign **Blue** to node D if we are going to assign node D next.

D	B	G
C	R, G	R, G
E	G	empty
F	R, G	R, B

Filtering & ordering

A 3	B 4	C	D
E	F 1	G 3	H
I	J	K 4	L 2
M	N 3	O	P

Now we consider using arc consistency algorithm for this sudoko problem.

(1) If we assign value 1 to variable i, what will be the result of running (a) forwarding checking (b) arc consistency (only consider one iteration)?

(2) (MRV) Based on the MRV rule, which variable should be chosen next?

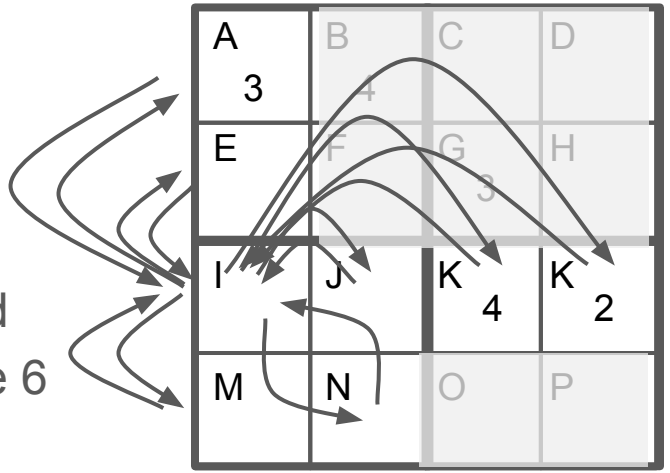
(3) (LCV) Based on the LCV principle, which value should we choose if we want to assign the variable m first?

Solution

(1) 6 + 6 + 2 = 14. 6 arcs in the column, 6 arcs in the row, and two arcs on the diagonal (i->n and n->i). The figure on the right only visualized the 6 arcs in the column.

(2) Based on MRV, we should choose either variable d, i or o. Because all these variables only have one legal value 1.

(3) We should choose value 4 for the variable m. (WIP)

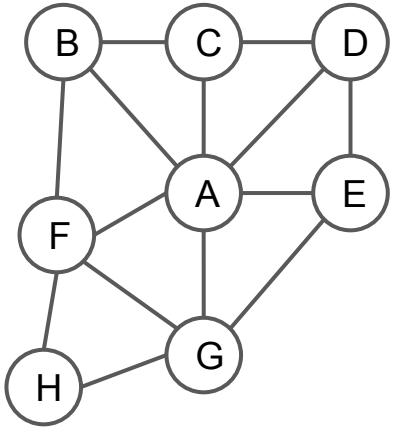


Tree-structured CSP

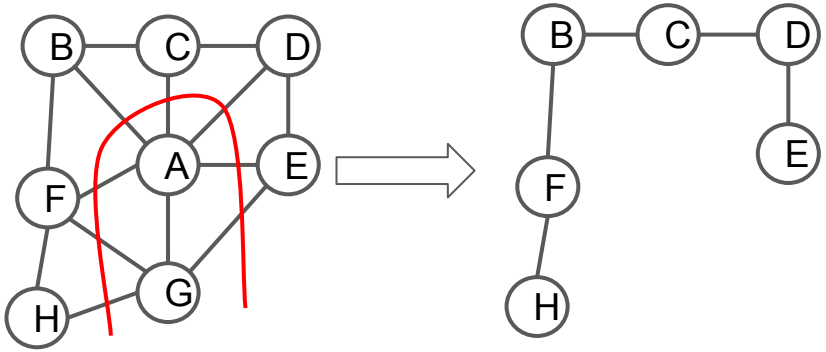
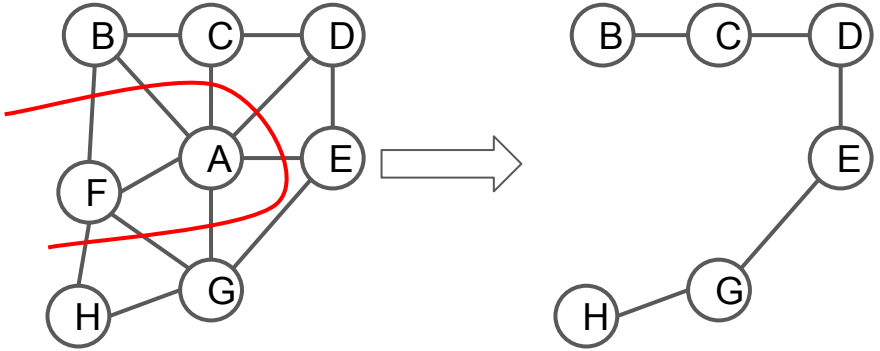
Now we want to color all nodes in the graph with color Red, Green, Blue and Yellow. Any pair of connected nodes cannot have the same color.

(1) How many minimal cutsets are there? What are they? (Note: a minimal cutset is a cutset with the smallest number of nodes)

(2) How many residual tree-structured CSPs do we have after cutset conditioning?



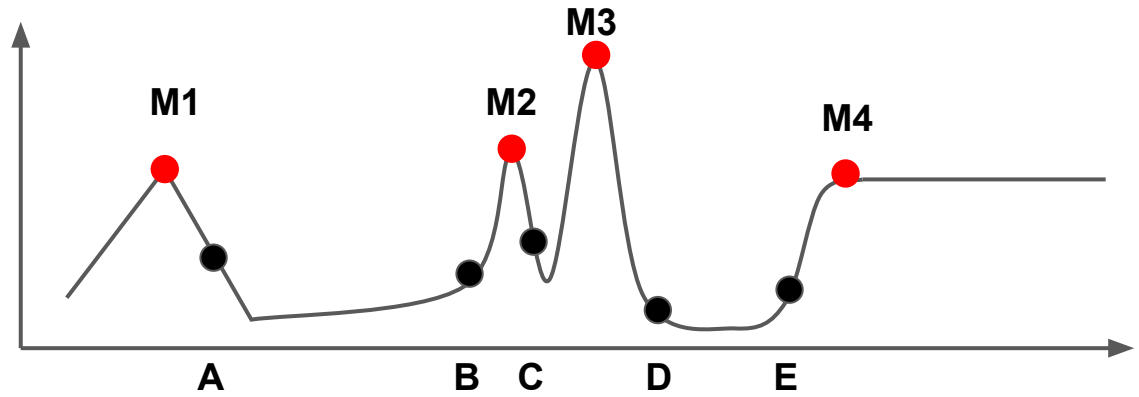
Solution

Solution 1: {A, G}	Solution 2: {A, F}
	

We can have 4x3 = 12 kinds of assignments to node A and G (or F). Therefore it will give us 12 residual tree-structured CSPs.

Local Search - Hill Climbing

(1) In this plot, if we do hill climbing from points A, B, C, D, E respectively, where on the plot will we end up in each case?



Solution