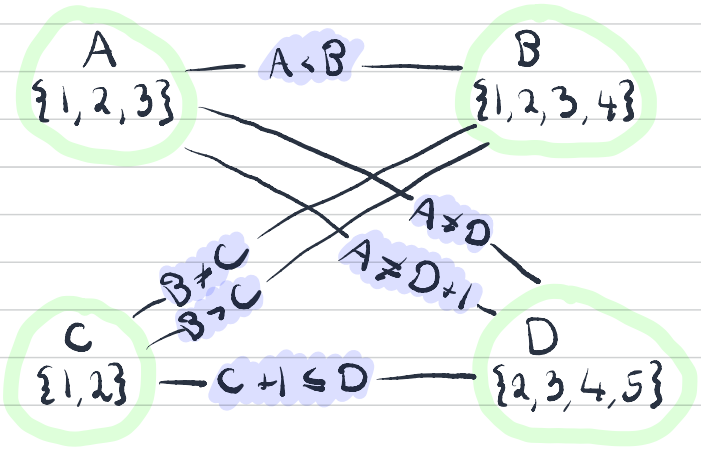
← for picking variables

1. • MRV - minimum remaining values (pick variable with fewest legal values)
   - fail-first approach

   • Degree - when there is a MRV tiebreak
   Heuristic - choose variable with most constraints on remaining variables
   - reduces branching factor

   • LCV - least constraining value (pick value that rules out fewest values in remaining variables)

2. (a)

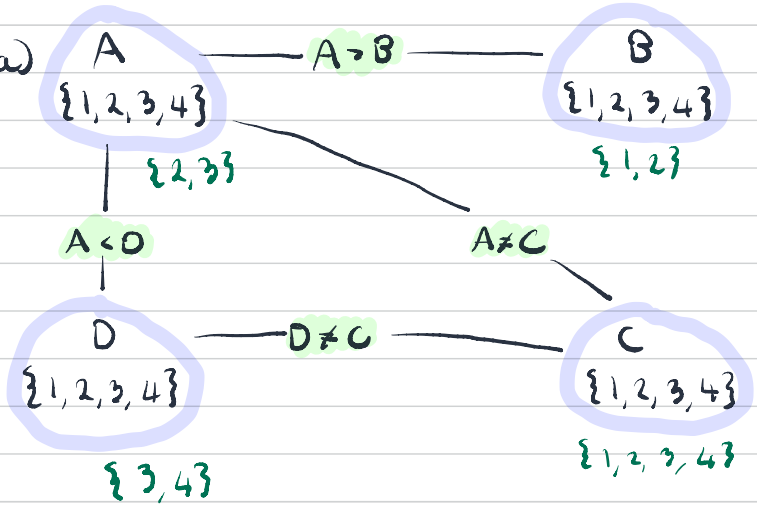


(b)

A	B	C	D
1,2,3	1,2,3,4	1,2	2,3,4,5
1,2,3	1,2,3,4	1	2,3,4,5
1	2,3,4	1	2,3,4,5
1	2	1	2,3,4,5
1	2	1	2

1. MRV = C, LCV = 1
2. MRV = A/B, Deg = A, LCV = 1
3. MRV = B, LCV = 2 (any)
4. MRV = D, LCV = 2 (any)

3.(a)



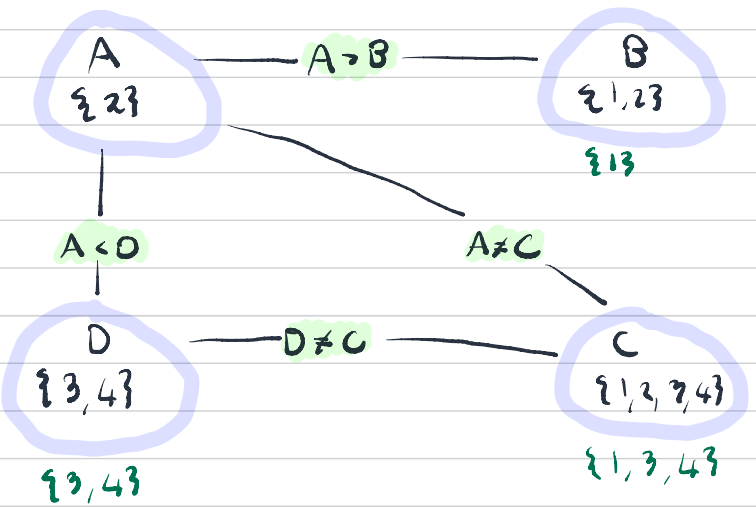
1. $A > B$: $A = \{1,2,3,4\}$, $B = \{1,2,3,4\}$
2. $A < D$: $A = \{2,3,4\}$, $D = \{1,2,3,4\}$
3. $D \neq C$: $D = \{2,3,4\}$, $C = \{1,2,3,4\}$
4. $A \neq C$: $A = \{2,3\}$, $C = \{1,2,3,4\}$
5. $A > B$: $A = \{2,3\}$, $B = \{1,2,3\}$

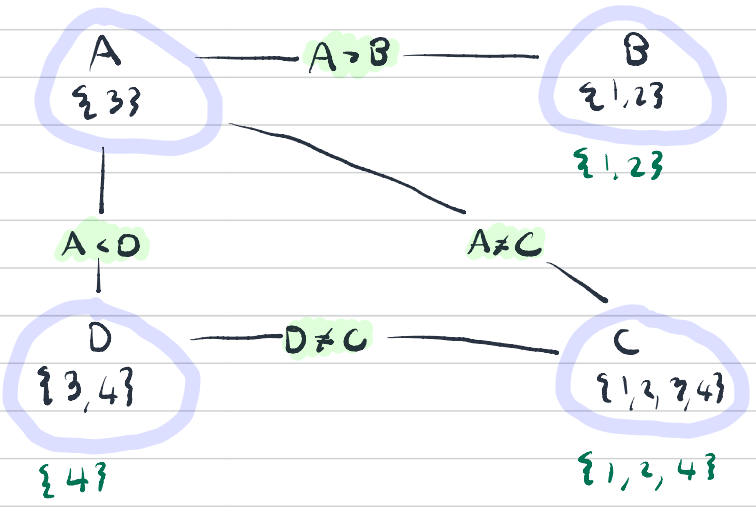
(b)

A	B	C	D
2,3	1,2	1,2,3,4	3,4
2	1,2	1,2,3,4	3,4
2	1	1,3,4	3,4
2	1	1,3,4	3
2	1	1	3

1. MRV = A, B, D
   Deg = A, LCV = 2 (any)
2. MRV = B, LCV = 1
3. MRV = D, LCV = 3 (any)
4. MRV = C, LCV = 1 (any)

4. Split A into {2} and {3}





A	B	C	D	
2	1	1,3,4	3,4	1. A→B
2	1	1,3,4	3,4	2. MRV=D, LCV=3 (any)
2	1	1,3,4	3	3. MRV=C, LCV=1 (any)
2	1	1	3	

A	B	D	C	
3	1,2	4	1,2,4	1. A→D
3	1,2	4	1,2,4	2. MRV=B/C
				Deg=C, LCV=1 (any)
3	1,2	4	1	3. MRV=B, LCV=1 (any)
3	1	4	1	

Solutions → A=2, B=1, C=1, D=3
A=3, B=1, C=1, D=4

5. Use cutset conditioning to assign all possible values to nodes that are causing the constraint graph to not be a tree, then solve each tree.

Cutset = {D} ← node causing all loops

Instantiate D in all ways, {1, 2, 3} then solve the subtrees → H, I, J

A, B, C E, F, G

c: size of cutset
d: size of domain
n: number of variables

without
$O(d^n)$ $= O(3^{10}) = 59049$

with
$O(d^c (n-c) d^2) = O(3^1 (10-1) 3^2) = 243$ ← a lot less