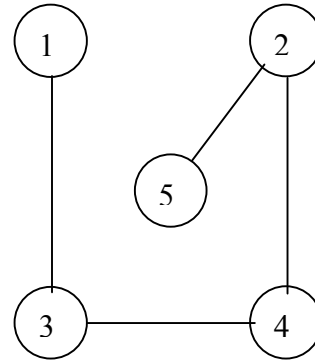


## 6.034 Fall 2000 Final Problem 3 (Revised<sup>1</sup>), Constraint Satisfaction

**Note -- the Parts of this problem can be done independently.**

Consider the following constraint graph. Assume each variable has the same domain  $D_i = \{A, B, C\}$ . The only valid assignments to pairs of constrained variables are given in the table below.

Constraint ( $V_i-V_j$ )	Valid assignments ( $V_i-V_j$ )	
1-3	A-C	B-A
2-4	A-A	B-B
3-4	A-B	C-A
2-5	B-A	A-C



### Part 1

- A. Do constraint propagation repeated until you achieve arc consistency and show the legal domain values for each variable after the constraint propagation.

Var	Legal Values
1	
2	
3	
4	
5	

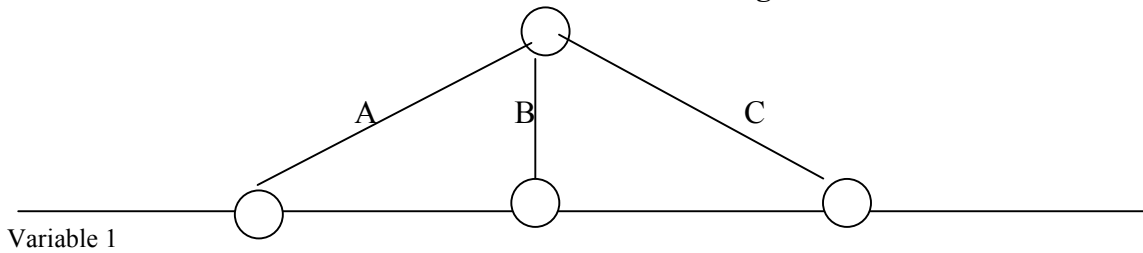
- B. Given only the list of legal values in Part A, what can you say about the number of possible solutions to this problem. Give either a **definite** number or a **definite** range of numbers (specify both the **lower** and upper bounds of the range).

<sup>1</sup> Part 3 and 4 added (due to Kimberle Koile).

**Part 2**

**In what follows, do not assume that any constraint propagation has been done. Start from scratch!**

Find **one** of the valid solutions for this problem using backtracking with forward checking (BT-FC). Examine variables in numerical order and values in alphabetical order. Draw the search tree below; we have started the tree for you. For every node in the tree draw **only** the valid descendants at that point. Each horizontal line indicates the level of the tree corresponding to the assignment of values of the specified variable. **Number the nodes in the tree in the order in which assignments are considered.**



Variable 2

Variable 3

Variable 4

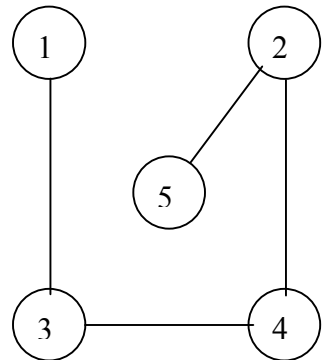
Variable 5

The answer found is:

1	
2	
3	
4	
5	

Constraint (V <sub>i</sub> -V <sub>j</sub> )	Valid assignments (V <sub>i</sub> -V <sub>j</sub> )	
1-3	A-C	B-A
2-4	A-A	B-B
3-4	A-B	C-A
2-5	B-A	A-C

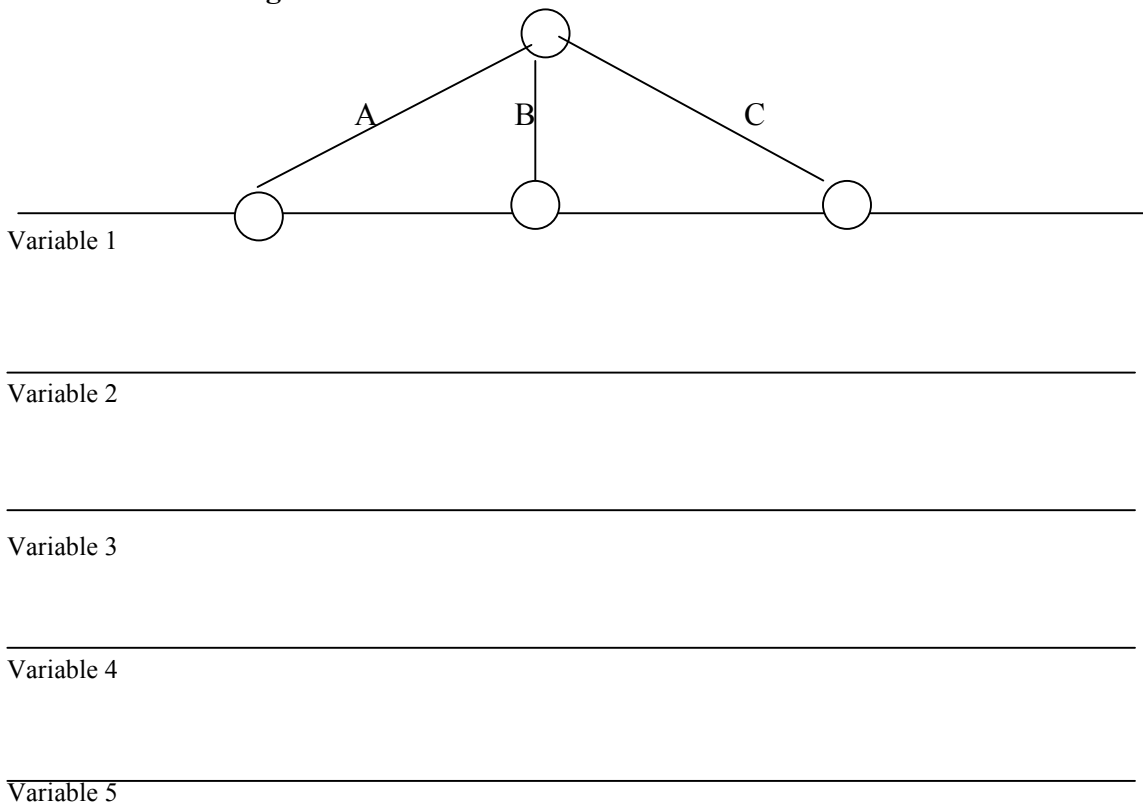
Repeated for your convenience



**Part 3 (Revised Part 2.)**

**In what follows, do not assume that any constraint propagation has been done. Start from scratch!**

Find **one** of the valid solutions for this problem using backtracking with forward checking (BT-FC) and propagating through singleton domains. Examine variables in numerical order and values in alphabetical order. Draw the search tree below; we have started the tree for you. For every node in the tree draw **only** the valid descendants at that point. Each horizontal line indicates the level of the tree corresponding to the assignment of values of the specified variable. **Number the nodes in the tree in the order in which assignments are considered.**

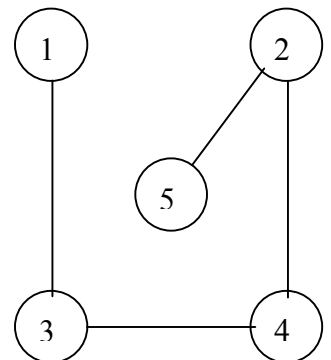


The answer found is:

1	
2	
3	
4	
5	

Constraint (V <sub>i</sub> -V <sub>j</sub> )	Valid assignments (V <sub>i</sub> -V <sub>j</sub> )	
1-3	A-C	B-A
2-4	A-A	B-B
3-4	A-B	C-A
2-5	B-A	A-C

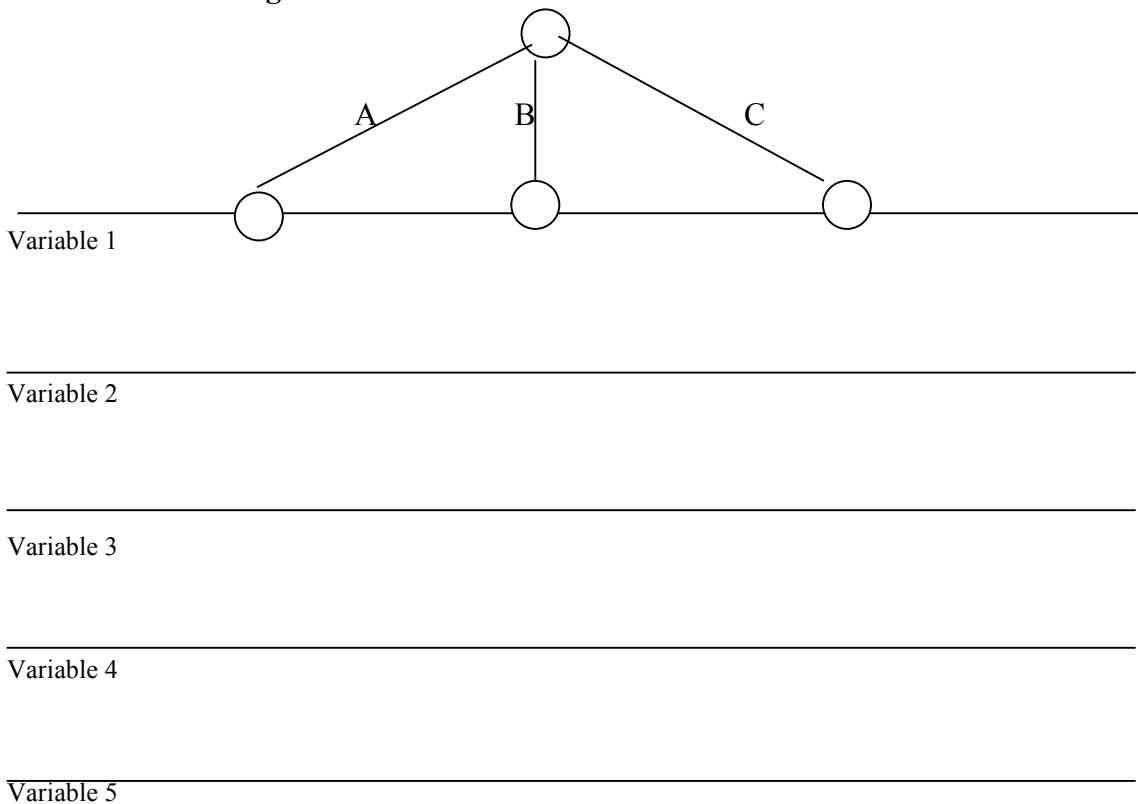
Repeated for your convenience



**Part 4 (Added new valid assignments and constraints to Part 3.)**

**In what follows, do not assume that any constraint propagation has been done. Start from scratch!**

Find **one** of the valid solutions for this problem using backtracking with forward checking (BT-FC) and propagating through singleton domains. Examine variables in numerical order and values in alphabetical order. Draw the search tree below; we have started the tree for you. For every node in the tree draw **only** the valid descendants at that point. Each horizontal line indicates the level of the tree corresponding to the assignment of values of the specified variable. **Number the nodes in the tree in the order in which assignments are considered.**



The answer found is:

1	
2	
3	
4	
5	

Constraint (V <sub>i</sub> -V <sub>j</sub> )	Valid assignments (V <sub>i</sub> -V <sub>j</sub> )		
1-3	A-C	B-A	
2-4	A-A	B-B	A-B
3-4	A-B	C-A	C-B
2-5	B-A	A-C	A-B
4-5	A-A	B-C	

Repeated for your convenience

