

CSC384H Tutorial 4

CSP & Constraint Propagation

Summer 2025

Questions

1. Consider the following constraint satisfaction problem:

Variables:	X, Y, Z
Domains:	$D_X = D_Y = D_Z = \{0, 1, 2, 3, 4\}$
Constraints:	$C_1 := (X = Y + 1)$ $C_2 := (Y = 2Z)$

Find the *first solution* to this CSP using the *Forward Checking* algorithm. Use the *Degree Heuristic* as the primary heuristic and *Minimum Remaining Value (MRV)* as the secondary heuristic to order the variables selected for assignment at each step.

In the table below list the variable being assigned at each step and the current domain of each variable after the prunes that result from forward checking.

Step	Variable Assignment	Current Domains
1		
2		
3		
4		
5		
6		
7		

2. Consider the following constraint satisfaction problem: there are four variables x_1, x_2, x_3, x_4 whose domains are $D = \{1, 2, 3\}$. They have the following constraints:

$$\begin{array}{ll} C_1 : x_1 + x_2 \leq 3 & C_3 : x_1 + x_3 \geq 4 \\ C_2 : x_2 + x_3 \leq 3 & C_4 : x_3 + x_4 \leq 2 \end{array}$$

What will be the domains of each variable if we run GAC-enforce on the CSP as a pre-processing step, prior to initiating backtracking search? Show your work by filling out the following table.

Constraint extracted	Queue	Current Domains
-	$\{C_4, C_3, C_2, C_1\}$	$CurrDom[x_1] = CurrDom[x_2] = CurrDom[x_3] = CurrDom[x_4] = \{1, 2, 3\}$

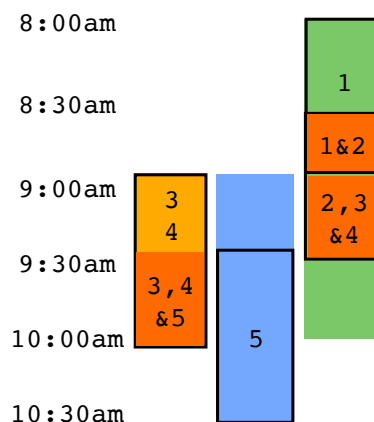
3. Explain why it might be a good heuristic to choose the variable that is the *most constrained* or the value that is the *least constraining* in a CSP search.
4. You are in charge of scheduling for computer science classes that take place on Fridays. There are 5 classes on that day, and 3 professors who will be teaching these classes. You are constrained by the fact that each professor can only teach one class at a time.

The classes are:

- C_1 - Programming Methodology: 8.00am to 9.00am
- C_2 - Discrete Structures: 8.30am to 9.30am
- C_3 - Data Structures and Algorithms: 9.00am to 10.00am
- C_4 - Introduction to Artificial Intelligence: 9.00am to 10.00am
- C_5 - Machine Learning: 9.30am to 10.30am

The professors are:

- Professor **Anna**, who is available to teach classes C_3 and C_4 .
- Professor **Jerry**, who is available to teach classes C_2 , C_3 , C_4 , and C_5 .
- Professor **Bob**, who is available to teach classes C_1 , C_2 , C_3 , C_4 , and C_5 .



- (a) Formulate this as a CSP with **each class being a variable**, stating the effective (current) domains and constraints. (For example, since C_1 and C_2 cannot be taught by the same professor, you may denote this constraint as $C_1 \neq C_2$)
- (b) What will be the domains of each variable if we run GAC-enforce on the CSP as a pre-processing step, prior to initiating backtracking search? Show your work by providing a table similar to the table in Question 2.
- (c) Give one solution to this CSP.