Artificial Intelligence Assignment 2 Report

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Given : i) **n=8** professors have been allotted to take the Engineering Visualization course, which has **n slots per week**.

ii) The professors **P1 to Pn have to be allotted to the slots S1 to Sn.**

iii) Adjacent slots are slots that **differ by 1 position**, e.g., S1 and S2, S7 and S8, etc.

iv) S8 and S1 are adjacent since this course repeats every week.

v) 1 slot can be allotted to a single professor, and **1 professor can only be allotted a single slot.**

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x								
S3	x								
S4	x								
S5	x								
S6	x								
S7	x								
S8	x								

This is the given table which we have to fill with the help of different methods.

Problem with the following **constraints:**

C1: The following pairs of professors cannot have adjacent slots: **(P1,P2), (P1,P3), (P3,Pn), (P3,P5)**
C2: P3 cannot take slots less than 5
C3: Slot of P6 < Slot of Pn-1 e.g., if n=8 then Slot of P6 < Slot of P7
C4: Pn cannot take slot n, i.e. if n=8, then **P8 cannot take S8**, but this constraint is not there for P1 to P7

Way to fill the table : i) In simple forward checking, assign professors to **slots in increasing order of the slot number (1,2,..).**

ii) In the table, add **X to denote that the current slot (row) cannot be allotted to this professor (column).**

iii) If multiple professors are available to be allotted to a slot, then try to allot that room in the **order P1>P2>P3>P4>P4>P5>P6>P7>P8**.

iv) If more than one slot is equally eligible to be allotted next, follow the increasing order of the slot to allot first.

v) Stop at the first Failure and mention why the failure occurred. **Failure can be caused by not having any slots for a specific professor or having a slot that cannot be allotted to anyone.**

vi) Slot S1 is allotted to P1 by default. The order column should mention the order in which you tried to allot the room, even if you were not able to assign any professor to that room.

i) Solve using CSP with backtracking i) with only forward checking

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x								
S3	x								
S4	x								
S5	x								
S6	x								
S7	x								
S8	x								

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x						
S3	x								
S4	x								
S5	x								
S6	x								
S7	x								
S8	x	x	x						

Step 1 : Since we are given the default table and we have to fill this table with the above given instructions ,it will be the first table.

Step 2 : Since the constraint C1 is applicable on the slot S2 and S8 for the professors P2 and P3 and P4 will be placed here in the S2 because this is the only option left.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x			x					
S4	x			x					
S5	x			x					

S6	x			x					
S7	x			x					
S8	x	x	x	x					

Step 3 : We have to fill in the S3 slot , due to maintaining the order we have an option of filling the P2 in this slot.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	3
S4	x	x		x					
S5	x	x		x					
S6	x	x		x					
S7	x	x		x					
S8	x	x	x	x					

Step 4 : We have to fill in the S4 slot , due to maintaining the order we have an option of filling the P3 in this slot but due to constraint C2 we are not able to fill P3 here so we have to go for the option P5 while maintaining the order.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	3
S4	x	x	x	x	P5	x	x	x	4
S5	x	x		x	x				
S6	x	x		x	x				
S7	x	x		x	x				
S8	x	x	x	x	x				

Step 5 : We have to fill in the S5 slot , due to maintaining the order we have an option of filling the P3 in this slot but due to constraint C2 we are not able to fill P3 here so we have to go for the option P6 while maintaining the order.

	P1	P2	P3	P4	P5	P6	P7	P8	Order

S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	3
S4	x	x	x	x	P5	x	x	x	4
S5	x	x	x	x	x	P6	x	x	5
S6	x	x		x	x	x			
S7	x	x		x	x	x			
S8	x	x	x	x	x	x			

Step 6 : We have to fill in the S6 slot , due to maintaining the order we have an option of filling the P3 in this.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	3
S4	x	x	x	x	P5	x	x	x	4
S5	x	x	x	x	x	P6	x	x	5
S6	x	x	P3	x	x	x	x	x	6
S7	x	x	x	x	x	x			
S8	x	x	x	x	x	x			

Step 7 : We have to fill in the S7 slot , due to maintaining the order we have an option of filling the P7 in this cell . and when we move forward for the slot S8 ,there is only option available i.e. P8 and because of the constraint C4 this will be the failure eventually.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	3
S4	x	x	x	x	P5	x	x	x	4
S5	x	x	x	x	x	P6	x	x	5
S6	x	x	P3	x	x	x	x	x	6
S7	x	x	x	x	x	x	P7	x	7
S8	x	x	x	x	x	x	x		

ii) Solve using CSP with backtracking i) with only forward checking

Step 1 : Since we are given the default table and we have to fill this table with the above given instructions ,it will be the first table.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x								
S3	x								
S4	x								
S5	x								
S6	x								
S7	x								
S8	x								

Step 2 : Since the constraint C1 is applicable on the slot S2 and S8 for the professors P2 and P3.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x						
S3	x								
S4	x								
S5	x								
S6	x								
S7	x								
S8	x	x	x						

Step 3 : Because of the MRV we have to fill in the S2 slot , due to the constraint C1 , P2 and P3 will not be going to fill here and we have an option to fill P4 here.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x			x					
S4	x			x					
S5	x			x					
S6	x			x					
S7	x			x					
S8	x	x	x	x					

Step 4 : Because of the MRV we have to fill in the S8 slot , so here we have an option to fill here with the professor P5 , here we are maintaining the order also.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x			x	x				
S4	x			x	x				
S5	x			x	x				
S6	x			x	x				
S7	x			x	x				
S8	x	x	x	x	P5	x	x	x	3

Step 5 : Because of the MRV we have to fill in the S3 and S4 slot ,because of maintaining the order we will choose S3 to fill first, so here we have an option to fill here with professor P2 , here we are maintaining the order also.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	4
S4	x	x		x	x				
S5	x	x		x	x				

S6	x	x		x	x				
S7	x	x		x	x				
S8	x	x	x	x	P5	x	x	x	3

Step 6 : Because of the MRV we have to fill in the S4 slot ,so here we have an option to fill here with professor P6 , here we are maintaining the order also. P5 can't be filled here because of the constraint C2

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	4
S4	x	x	x	x	x	P6	x	x	5
S5	x	x		x	x	x			
S6	x	x		x	x	x			
S7	x	x		x	x	x			
S8	x	x	x	x	P5	x	x	x	3

Step 7 : Because of the MRV we have to fill in the S5 slot ,so here we have an option to fill here with professor P3 , here we are maintaining the order also.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	4
S4	x	x	x	x	x	P6	x	x	5
S5	x	x	P3	x	x	x	x	x	6
S6	x	x	x	x	x	x			
S7	x	x	x	x	x	x			
S8	x	x	x	x	P5	x	x	x	3

Step 8 : Because of the MRV we have to fill in the S6 slot ,so here we have an option to fill here with professor P7 , here we are maintaining the order also.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2

S3	x	P2	x	x	x	x	x	x	4
S4	x	x	x	x	x	P6	x	x	5
S5	x	x	P3	x	x	x	x	x	6
S6	x	x	x	x	x	x	P7	x	7
S7	x	x	x	x	x	x	x		
S8	x	x	x	x	P5	x	x	x	3

Step 9 : Because of the MRV we have to fill in the S7 slot ,so here we have an option to fill here with professor P8 , here we are maintaining the order also.

	P1	P2	P3	P4	P5	P6	P7	P8	Order
S1	P1	x	x	x	x	x	x	x	1
S2	x	x	x	P4	x	x	x	x	2
S3	x	P2	x	x	x	x	x	x	4
S4	x	x	x	x	x	P6	x	x	5
S5	x	x	P3	x	x	x	x	x	6
S6	x	x	x	x	x	x	P7	x	7
S7	x	x	x	x	x	x	x	P8	8
S8	x	x	x	x	P5	x	x	x	3

B) Programming Part and Their Respective Results :

Professor A is allotted by default and including Professor A , there are a total 9 Professor as asked in the Assignment.

Note : Here Professors are denoted by [C1,C2,C3,C4,C5,C6,C7,C8,C9]

i) Problem using CSP with backtracking with only forward checking

The following image is showing the results obtain with the Program

```
Trying to allot Slot 1 to professor C1...

Trying to allot Slot 2 to professor C4...

Trying to allot Slot 3 to professor C2...

Trying to allot Slot 4 to professor C5...

Trying to allot Slot 5 to professor C6...

Trying to allot Slot 6 to professor C3...

Trying to allot Slot 7 to professor C7...

Trying to allot Slot 8 to professor C8...
Success upto Slot S8 then failure due to the constraint C1, we are not able to allot C9
Final Recipes:
Slot S1: Chef C1
Slot 1: Chef C1
Slot 2: Chef C4
Slot 3: Chef C2
Slot 4: Chef C5
Slot 5: Chef C6
Slot 6: Chef C3
Slot 7: Chef C7
Slot 8: Chef C8
Failure due to the constraint C1, we are not able to allot C9
```

i) Problem using CSP with backtracking with forward checking, arc consistency, and MRV.

The following is showing the results of the Program

Note : Here Professors are denoted by [M1,M2,M3,M4,M5,M6,M7,M8,M9]

```
Using Forward checking, Arc Consistency, and MRV:
Slot S1 is Assigned to  M1
Slot S1 is Assigned to  M4
Slot S1 is Assigned to  M2
Slot S1 is Assigned to  M6
Slot S1 is Assigned to  M3
Slot S1 is Assigned to  M7
Slot S1 is Assigned to  M8
Slot S1 is Assigned to  M9
Slot S1 is Assigned to  M5
```