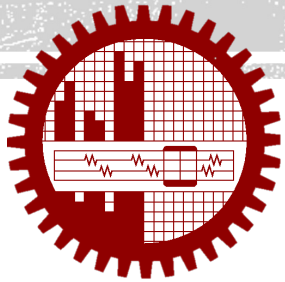
CSE-318
OFFLINE-2 ON CSP

Dr. M A Nayeem

Assistant Professor

CSE, BUET



OUTLINE

- Tasks
- Recap
- Tips

LATIN SQUARE

0	4	8	2	3	9	6	7	1	5
3	6	2	8	7	1	9	5	0	4
8	9	3	1	0	6	4	2	5	7
1	7	6	5	4	8	0	3	2	9
2	1	9	0	6	7	5	8	4	3
5	2	7	4	9	3	1	0	8	6
4	3	0	6	1	5	2	9	7	8
9	8	5	7	2	0	3	4	6	1
7	0	1	9	5	4	8	6	3	2
6	5	4	3	8	2	7	1	9	0

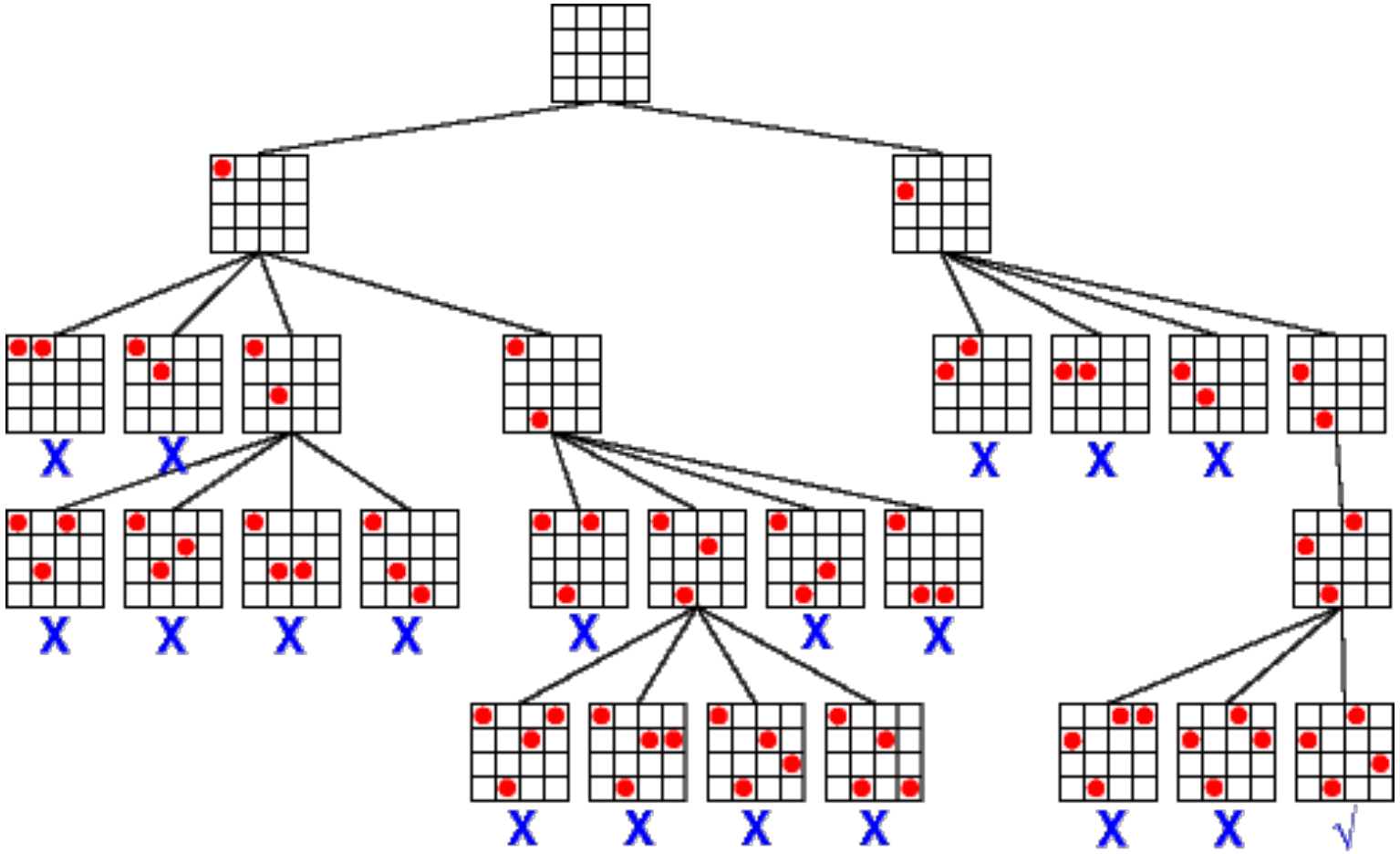
LATIN SQUARE COMPLETION PROBLEM

```
N=10;
start=
[|
0, 0, 6, 0, 0, 3, 4, 0, 10, 0 |
2, 6, 4, 0, 0, 0, 0, 0, 9, 0 |
0, 2, 10, 0, 0, 0, 0, 0, 5, 9 |
10, 1, 5, 4, 2, 0, 0, 0, 0, 0 |
0, 0, 0, 0, 1, 9, 8, 4, 0, 0 |
0, 0, 3, 2, 9, 0, 0, 1, 0, 0 |
6, 0, 0, 0, 0, 7, 0, 10, 0, 5 |
0, 0, 0, 0, 0, 8, 6, 5, 0, 7 |
1, 3, 0, 6, 0, 0, 5, 0, 0, 2 |
0, 5, 0, 9, 6, 2, 0, 0, 8, 0 |];
```

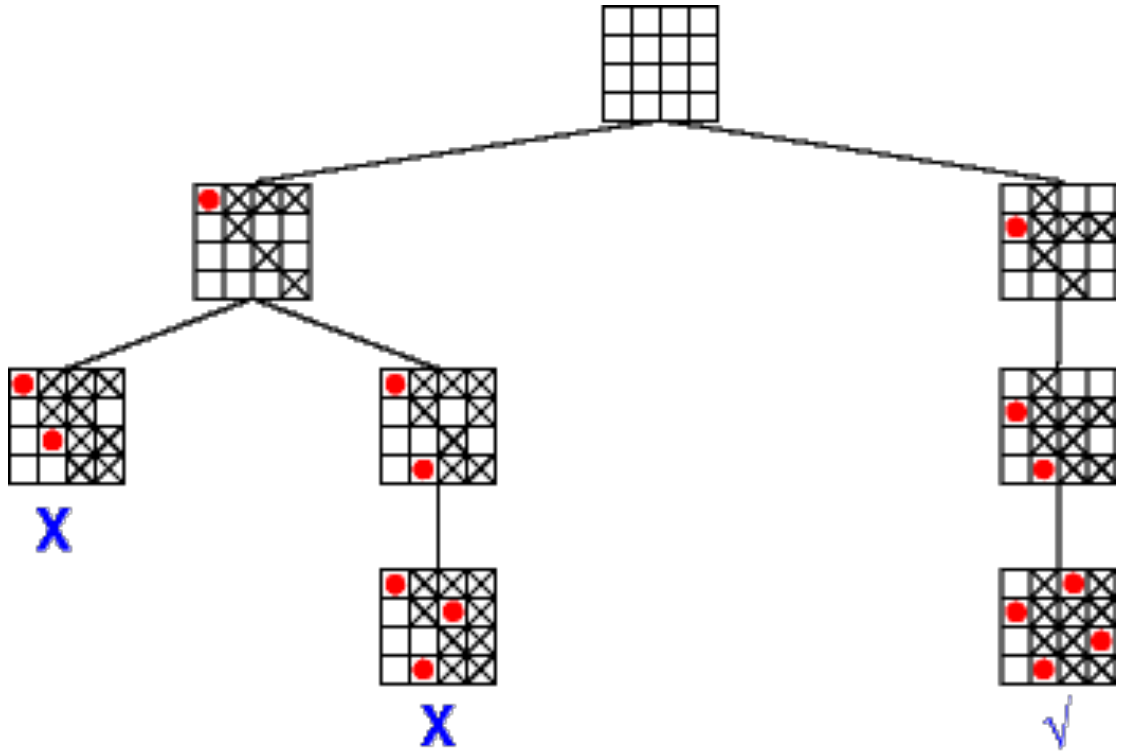
TASK: IMPLEMENT TWO SOLVERS

- Simple Backtracking (BT)
- Forward Checking (FC)

RECAP: 4-QUEENS AND BT



RECAP: 4-QUEENS AND FC



RECAP: SOLVER

```
function BACKTRACKING-SEARCH(csp) returns a solution or failure
    return BACKTRACK(csp, { })

function BACKTRACK(csp, assignment) returns a solution or failure
    if assignment is complete then return assignment
    var ← SELECT-UNASSIGNED-VARIABLE(csp, assignment)
    for each value in ORDER-DOMAIN-VALUES(csp, var, assignment) do
        if value is consistent with assignment then
            add {var = value} to assignment
            inferences ← INFERENCE(csp, var, assignment)
            if inferences ≠ failure then
                add inferences to csp
                result ← BACKTRACK(csp, assignment)
                if result ≠ failure then return result
                remove inferences from csp
            remove {var = value} from assignment
    return failure
```

TASK: 5 VARIABLE ORDERING HEURISTICS

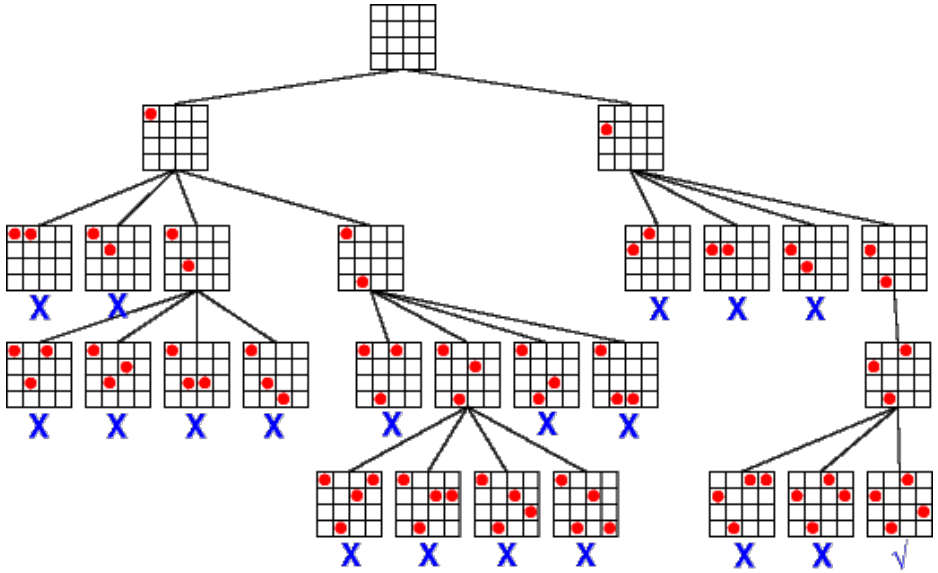
- VAH1
  - The variable chosen is the one with the smallest domain
- VAH2
  - The variable chosen is the one with the maximum degree to unassigned variables. Also, called max-forward-degree
- VAH3
  - The variable chosen by VAH1, Ties are broken by VAH2
- VAH4
  - The variable chosen is the one that minimizes the VAH1 / VAH2
- VAH5
  - A random unassigned variable is chosen

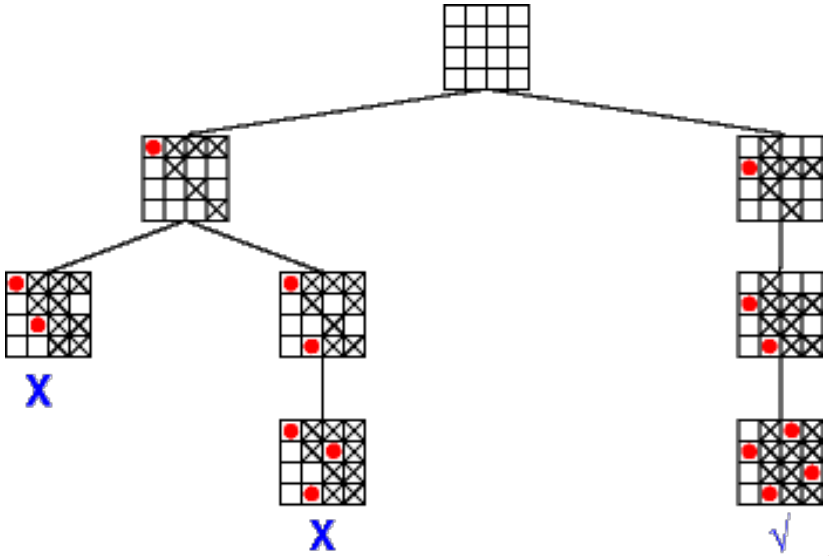
TASK: 1 VALUE ORDERING HEURISTICS

- Your choice
  - Justification -> Offline-2 Report

TASK: PERFORMANCE MEASURE

- How to compare among solutions schemes?
  - Number of total node
  - Number of backtracks
  - Runtime





TASK: REPORT (SUBMIT WITH CODE)

- Value Order Heuristic
  - Justify your choice
- Table: Summarizes all results
  - 5 problems, 2 solvers, 5 VAH
  - Mark the best (optionally 2nd best) scheme for each solver
- Conclusion
  - Which scheme seems the best according to your opinion?
  - Provide justification as much as possible

Problem	Solver	VAH	#Node	#BT	Runtime
d-10-01	BT	VAH1			
	BT	VAH2			
	BT	VAH3			
	BT	VAH4			
	BT	VAH5			
	FC	VAH1			
	FC	VAH2			
	FC	VAH3			
	FC	VAH4			
	FC	VAH5			
…	…	…	…	…	

TIPS: AN OOP DESIGN [OPTIONAL]

- *Class* Variable
  - Domain: list of values
- Assignment
  - *Hashmap*: variable -> value
- *Class* Constraint
  - Scope: a tuple of variables
  - Condition: Boolean function to be applied to scope
  - *method* holds(assignment) -> bool
- *Class* CSP
  - Variables
  - Constraints

- *Class* Variable_Order_Heuristic
  - *method* get_next_variable(csp, assignment) -> variable

- *Class* CSP_Solver
  - Variable_Order_Heuristic
  - CSP = null, assignment = null
  - *method* solve(csp, assignment) -> solution
  - *method* value_order_heuristic(variable) -> value

TIPS: AUTOMATE VIA SCRIPT [OPTIONAL]

- Command line arguments

- Your script:
  - ./yourProgram data=# solver=# vah=# …
  - …
  - …
  - …

ACKNOWLEDGEMENT

- Special thanks to
  - Abu Wasif Sir
  - Hasibul Hisham
  - Md. Ashraful Islam
  - Tanjeem Azwad Zaman

THANKS
KEEP SMILING :)