

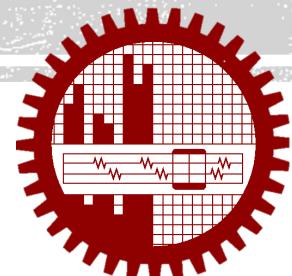
CSE-318

OFFLINE-2 ON CSP

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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

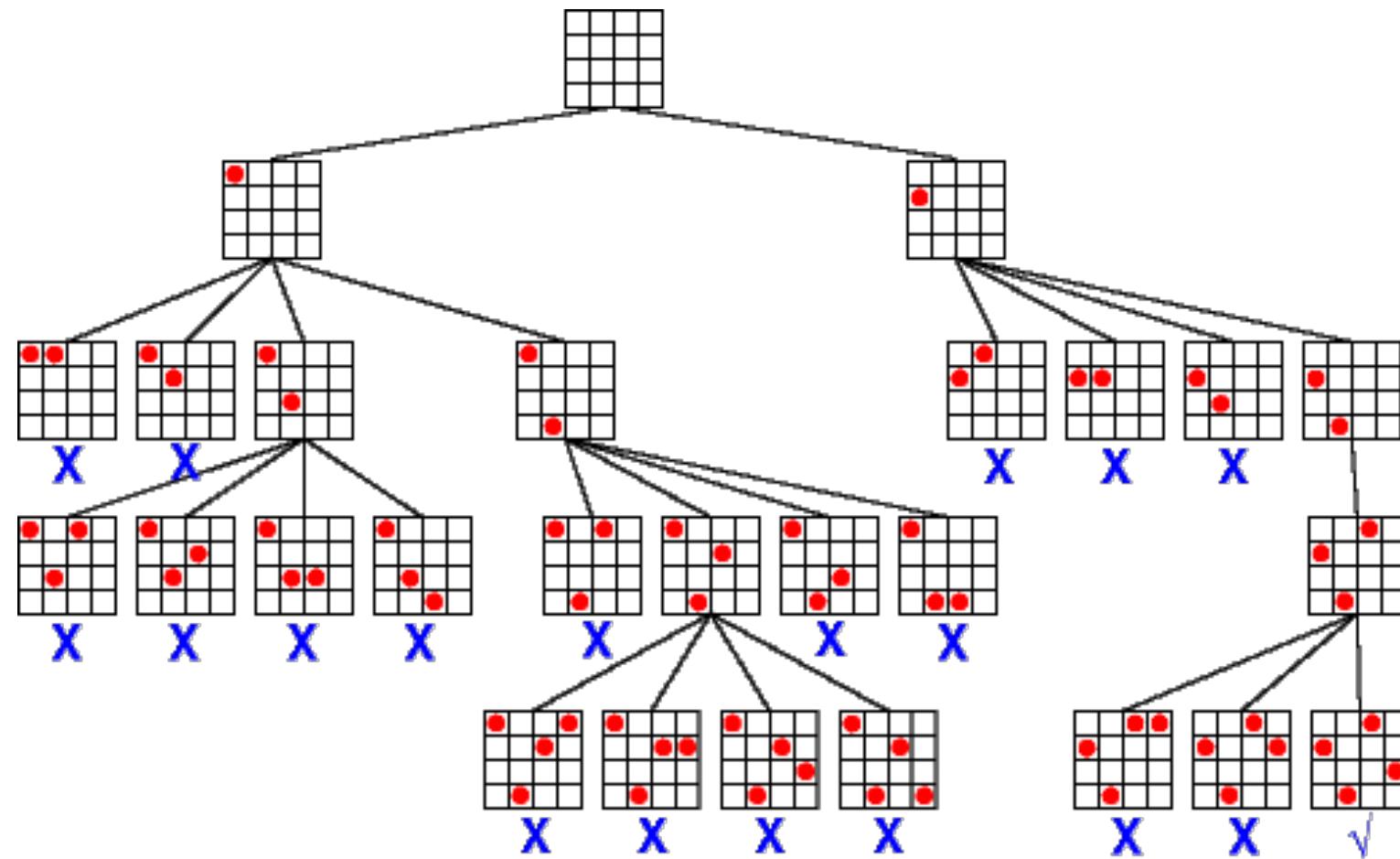
LATIN SQUARE COMPLETION PROBLEM

```
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 | ];
```

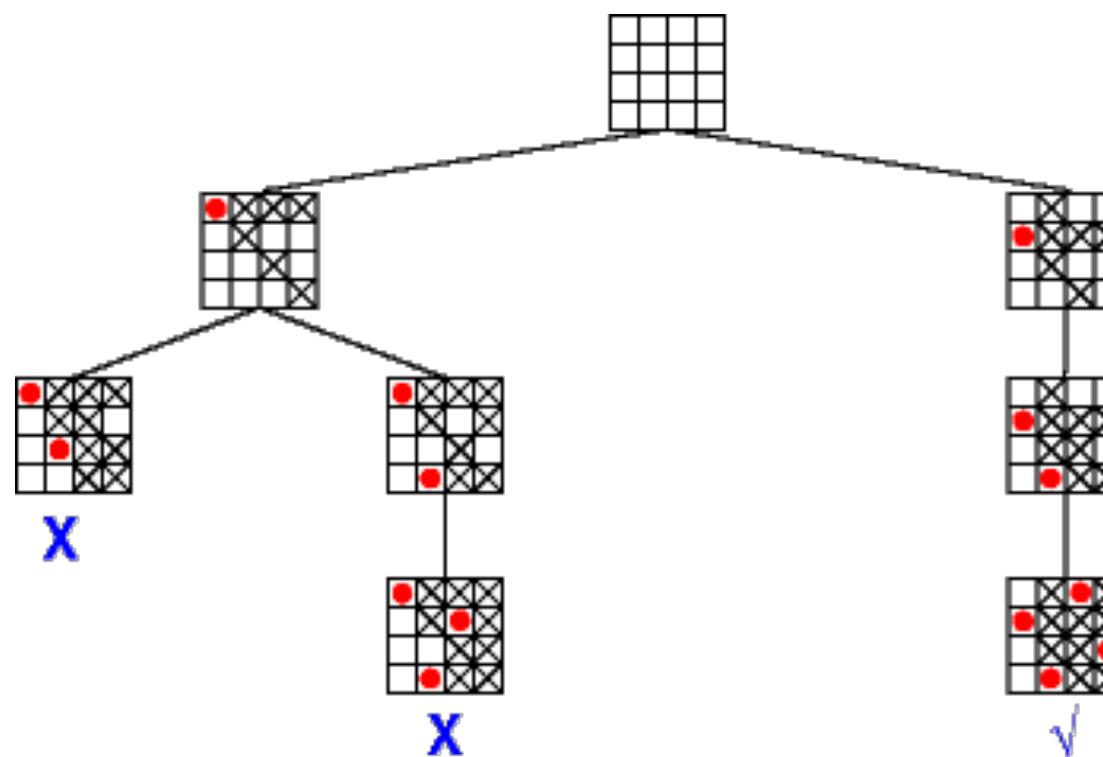
TASK: IMPLEMENT TWO SOLVERS

- 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 \leftarrow SELECT-UNASSIGNED-VARIABLE(*csp*, *assignment*)
 for each *value* **in** ORDER-DOMAIN-VALUES(*csp*, *var*, *assignment*) **do**
 if *value* is consistent with *assignment* **then**
 add $\{ \text{var} = \text{value} \}$ to *assignment*
 inferences \leftarrow INFERENCE(*csp*, *var*, *assignment*)
 if *inferences* \neq *failure* **then**
 add *inferences* to *csp*
 result \leftarrow BACKTRACK(*csp*, *assignment*)
 if *result* \neq *failure* **then return** *result*
 remove *inferences* from *csp*
 remove $\{ \text{var} = \text{value} \}$ from *assignment*
 return *failure*

TASK: 5 VARIABLE ORDERING HEURISTICS

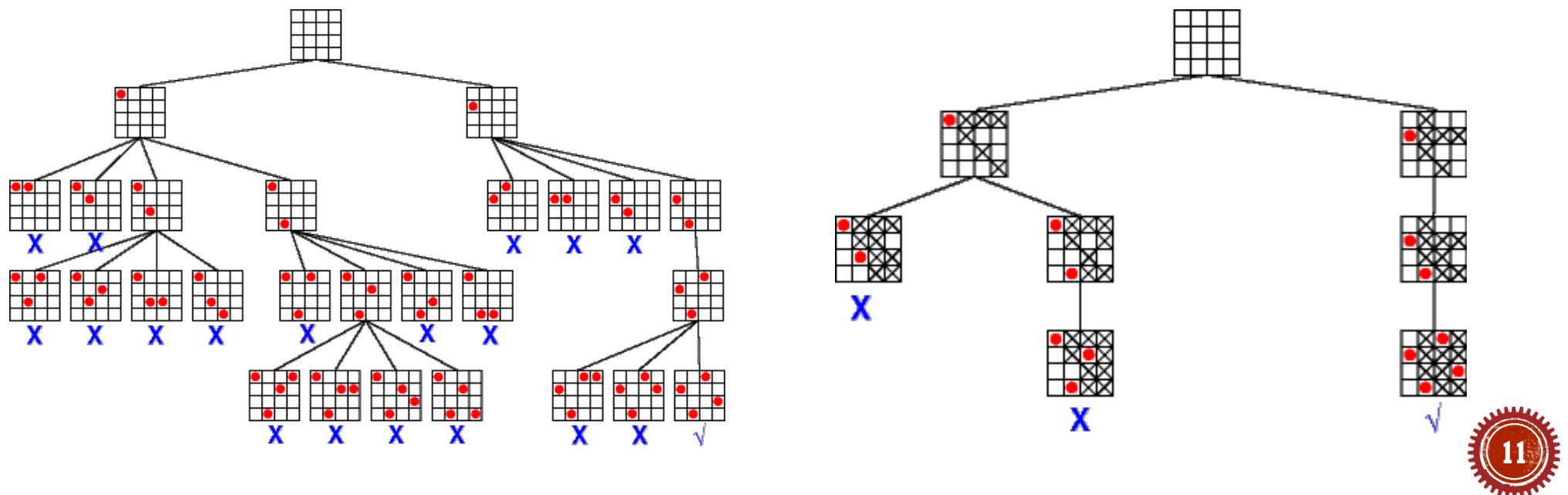
- VAH1
 - The variable chosen is the one with the smallest domain
- VAH2
 - The variable chosen is the one with the maximum degree to unassigned variables. Also, called max-forward-degree
- VAH3
 - The variable chosen by VAH1, Ties are broken by VAH2
- VAH4
 - The variable chosen is the one that minimizes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

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**THANKS
KEEP SMILING :)**