Nonograms

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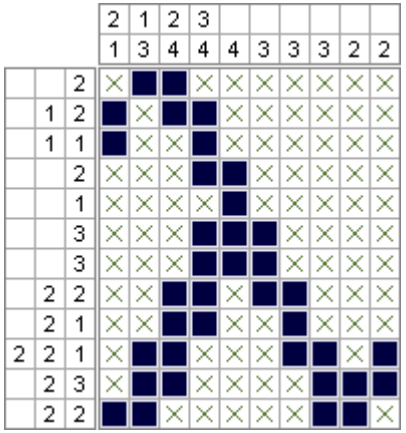
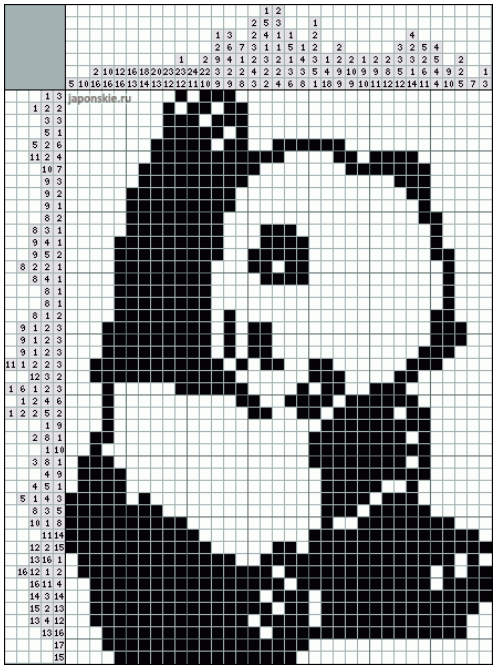
Introduction to Nonograms

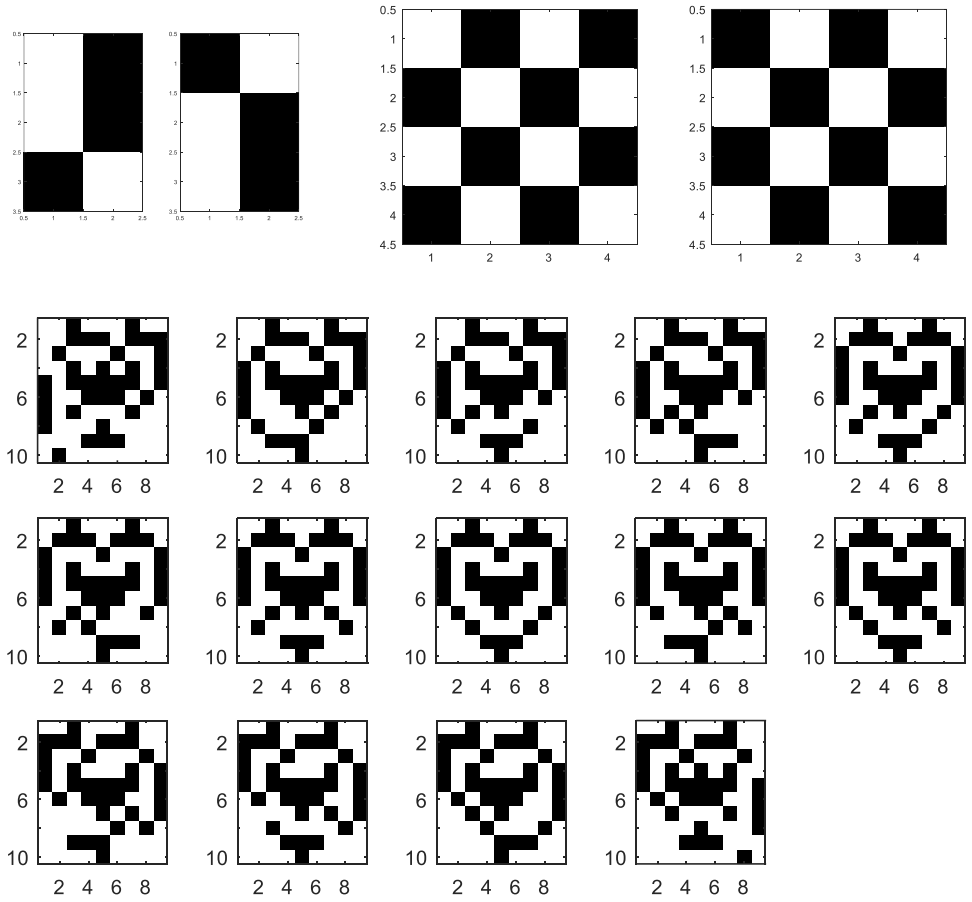
- Nonograms
  - AKA Hanjie, Picross, Griddlers, Paint by Numbers, …
  - Invented by Non Ishida in 1987
- Examples





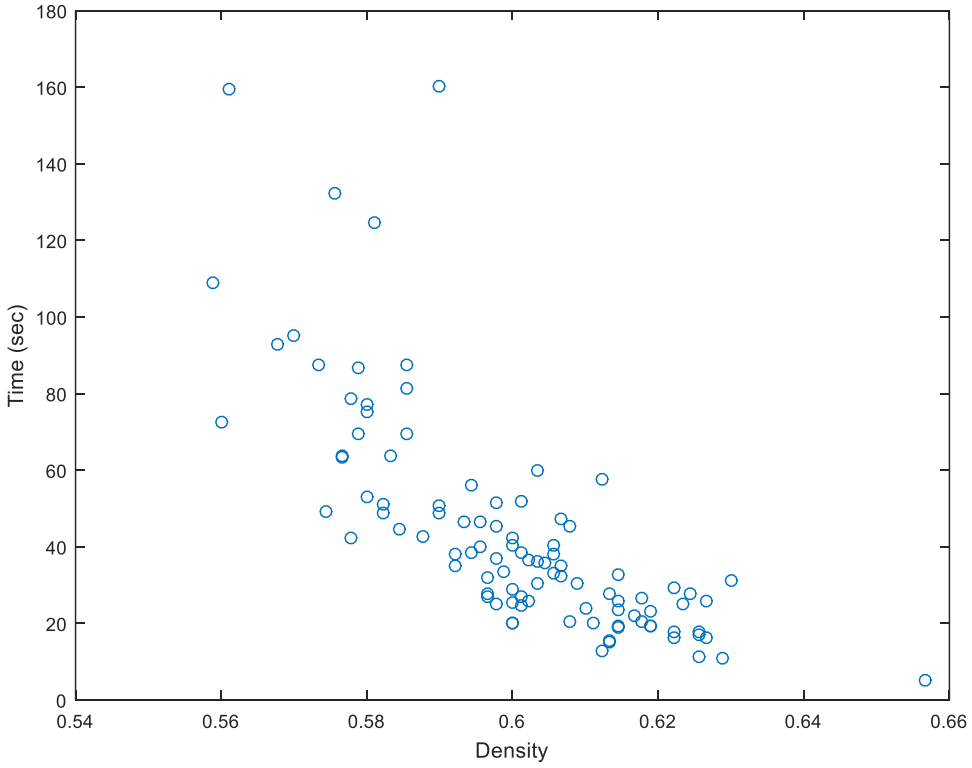
Properties of Nonograms (1/2)

- Solutions may not be unique



Properties of Nonograms (2/2)

- Higher density leads to easy solution
- Test based on 30x30 maps



Solution to Nonograms

- Exhaustive search
  - 2^{mxn} ➔ Impossible!
- Initial heuristic search
  - Reduce the search space
  - Can also lead to a solution directly
- Search based on maze traversal
  - DFS (depth-first search) ➔ Preferred
  - BFS (breadth-first search) ➔ Need much more memory

Initial Heuristic Search: Examples

- Examples

	2	3	3	3	1 1
1 1					
4					
3					
1 1 1					
1					

	2	4	2	3	2
3					
4					
1 1					
2					
2					

Quiz!

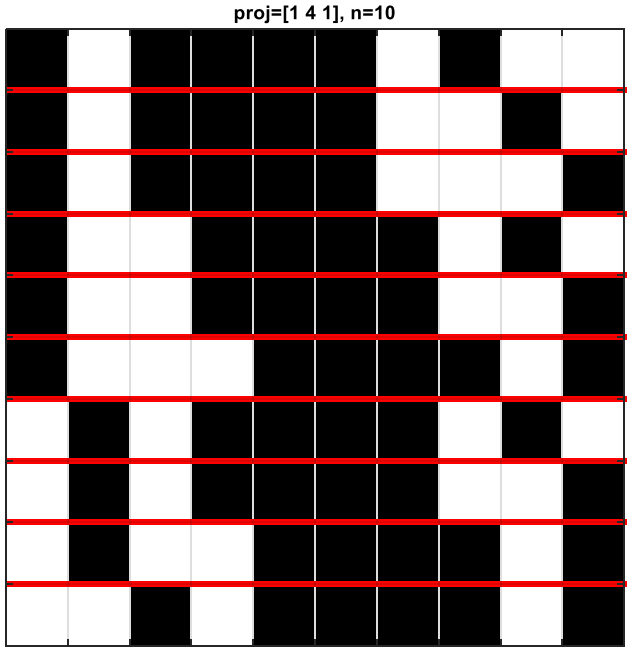
	4	2	2 2	1 1	1
3					
1 1					
1					
3					
4					

	6	1 2 1	1	6 2	5 2	5 1	3	3	5 1	6
2 4										
1 4 1										
1 5 2										
1 3 2										
2 3 2										
2 1 2										
2 3										
2 1										
1 2										
1										

Initial Heuristic Search

- Generate all patterns for each row
  - Proj=[1 4 1], n=10

  ➔ xxxx11xxxx
- Generate constrained patterns
  - Constraint=[0xxxxxxxx1]
  - ➔ 0xxx111xx1
- My steps:
  1. Fill each rows
  2. Fill each columns
  3. Repeat 1 and 2 until convergence



Pseudo code for DFS Search

```
Initial stack
Push maps of one row to stack
If size of stack > 0 {
        Pop stack to have a map A
        If A fulfils all requirements, return A and break
        If A has k rows, find p candidates for row k+1
        Augment A with these p candidates
        Push these P maps to stack
}
No solution exists.
```

Some Examples