Dancing links 패키지와 그 활용

Exact cover problem

남수진

2018년 2월 3일 토요일

2018 한국텍학회 학술대회 및 정기총회
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목차

Dancing links

Dancing links

- Exact cover 문제를 해결하는 알고리즘에 사용되는 기법
- 백트래킹을 효율적으로 구현하는 방법 (*do*, *undo* 연산)

Exact cover problem

Exact cover problem

0과 1로만 구성된 행렬에서 각 열이 정확히 하나의 1만 갖도록 하는 행들의 집합을 구하라.

$$\begin{pmatrix} 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 0 & 1 \end{pmatrix}$$

Exact cover problem

$$\begin{pmatrix} 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 0 & 1 \end{pmatrix}$$

Exact cover problem

$$\begin{pmatrix} 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 0 & 1 \end{pmatrix}$$

A	B	C	D	E	F	G
C	E					
A	D	G				
B	C	F				
A	D	F				
B	G					
D	E	G				

Exact cover problem

A	B	C	D	E	F	G
C	E					
A	D	G				
B	C	F				
A	D	F				
B	G					
D	E	G				

Exact cover problem

A	B	C	D	E	F	G
C	E					
A	D	G				
B	C	F				
A	D	F				
B	G					
D	E	G				

Exact cover problem

A	B	C	D	E	F	G
C	E					
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Exact cover problem

A	B	C	D	E	F	G
C	E					
A	D	G				
B	C	F				

Exact cover problem

A	B	C	D	E	F	G
C	E					
A	D	G				

Exact cover problem

A	B	C	D	E	F	G
C	E					
A	D	G				
B	C	F				
A	D	F				
B	G					
D	E	G				

Exact cover problem

A	*B*	*C*	*D*	*E*	*F*	*G*
C	*E*					

A	*D*	*F*
B	*G*	

Exact cover problem

A	B	C	D	E	F	G
C	E					
A			D		F	
	B					G

Exact cover problem

A	B	C	D	E	F	G
C	E					

A	D	F
B	G	

lua-dancing-links

github.com/sjnam/lua-dancing-links

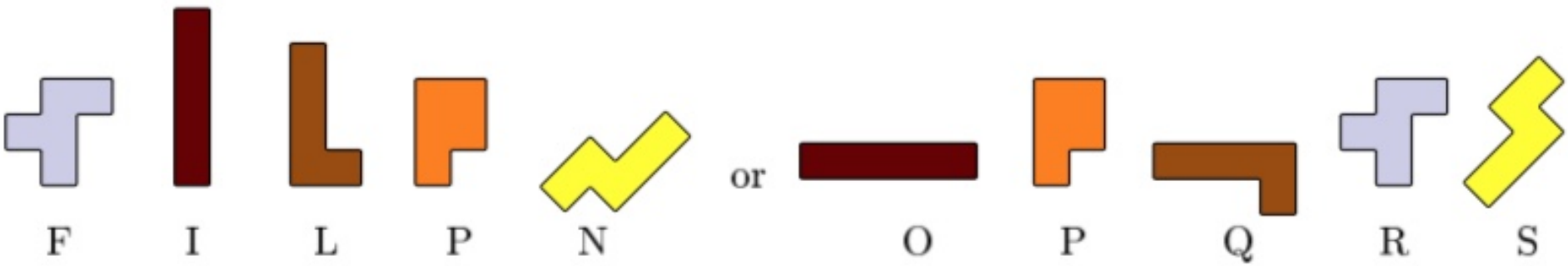
Exact cover problem

Polyominoes

Pentominoes

T U V W X Y Z

But two different systems of nomenclature have been proposed for the other five:



F I L P N O P Q R S

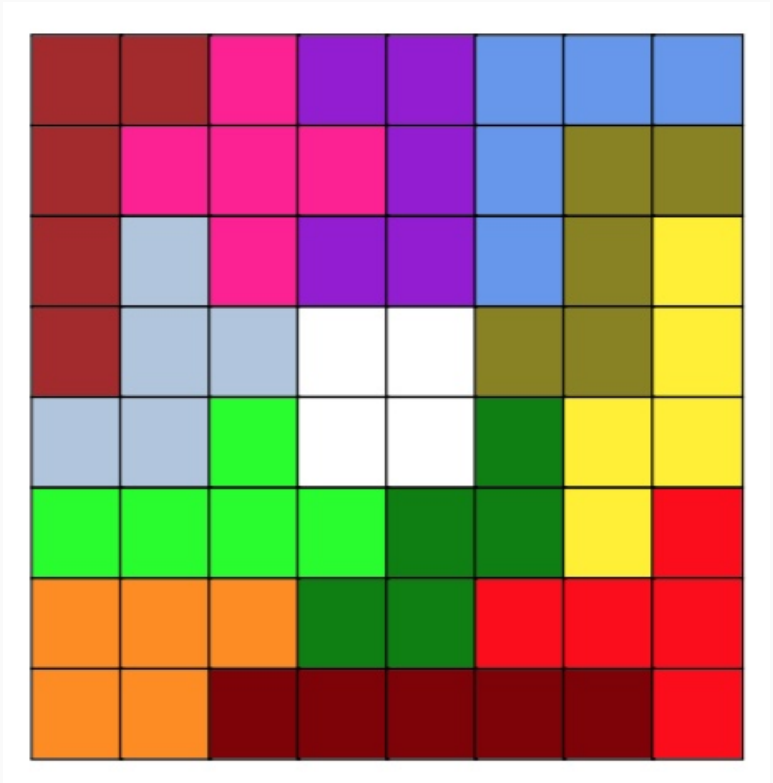
(S. W. Golomb) (J. H. Conway)

Pentominoes 3×20

```
\usepackage{pentominoes}

\pentominoes{3x20.dlx}{3}{20}.
```

Pentominoes 8×8 with center hole



```
\pentominoes{8x8_center_hole.dlx}{8}{8}.
```

Exact cover problem

Sudoku

Sudoku

```
\usepackage{sudoku-dlx}
\Sudoku{9.......6.3.4....9...915.8..8.5..7..%
..3.9.4....2..1.9.32176....6..1.2.3.8...5...1}
```

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

Sudoku

```
\Sudoku*{9.......6.3.4....9...915.8..8.5..7..%
..3.9.4....2..1.9.32176....6..1.2.3.8...5...1}
```

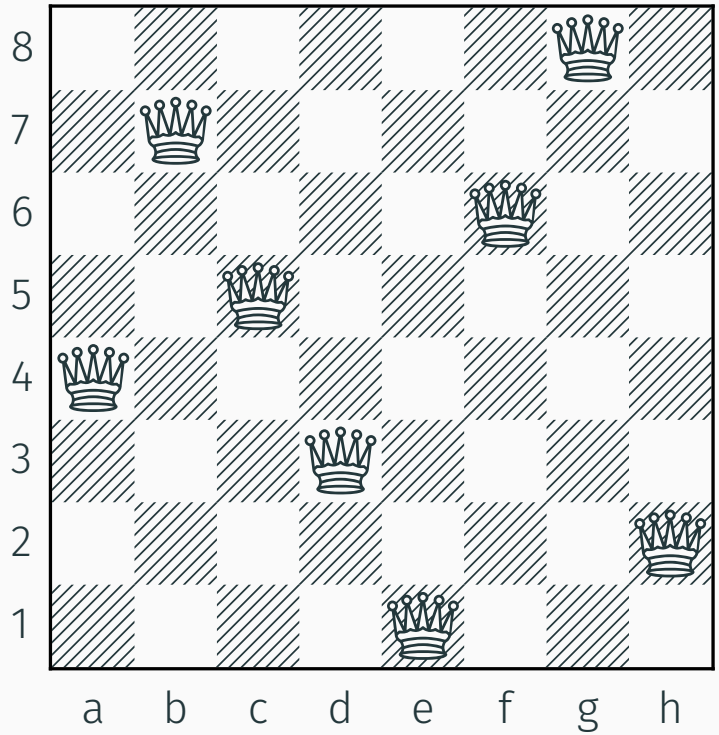
9	1	4	8	3	7	2	5	6
5	3	8	4	2	6	1	7	9
2	7	6	9	1	5	3	8	4
1	8	9	5	4	3	7	6	2
7	6	3	2	9	8	4	1	5
4	5	2	6	7	1	8	9	3
3	2	1	7	6	9	5	4	8
6	4	5	1	8	2	9	3	7
8	9	7	3	5	4	6	2	1

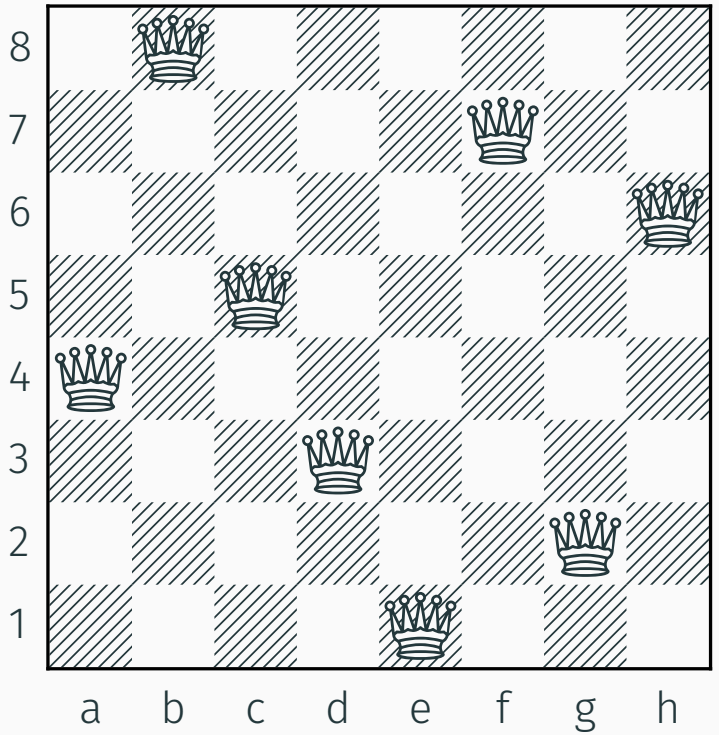
Exact cover problem

N-Queens puzzle

N-QUEENS

```
\usepackage{queens}
\queens{8}{2}.
```





참고

- The Art of Computer Programming Pre-Fascicle 5c
- github.com/sjnam/lua-dancing-links

감사합니다